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A NEW BREED: WIRED FOR SUCCESS

Redefining the possibilities of solar powered electric fence energizers

Nicholas. R. Marks

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Abstract

Gallagher, world renowned for their electric fencing innovations, requested ways to develop their solar powered energizer range. The intent of this project was to work with Gallagher product specialists to identify key market gaps and use them to develop a conceptual design proposal for a new solar charged, battery powered electric fence energizer.

Industrial design literature investigations provided a foundation for this project and specific methods were used to identify and utilize key information from the Gallagher product and energizer range and Gallagher's competition. Other strategic research areas included; context of energizer use, common energizer issues, market gaps/opportunities, ergonomic principles, safety aspects, manufacturing guidelines and relevant state of the art technologies. The core research methods used to support the investigation and consider industrial design and business requirements were; market analysis, ethnography, surveys, informal expert interviews and focus group meetings with Gallagher departmental managers. Structured concept generation, test rigs, mock-ups, models, iterated design development and CAD renderings ensued.

A potential market gap was discovered through these explorations where isolated farm blocks needed electric fencing, but had no mains power. The unit needed to be semi-portable, yet had to have the potential power to supply the equivalent of mains powered energizer capabilities. Solar powered technology has widened the scope for design to solve this scenario, which provided the starting point for initial design concepts.

The product was required to solve issues and objectives (functionality), be intuitive, easy to use and practical (usability), and appeal to the target market (desirability). The final design proposal is a modular energizer unit which allows the end user to customize the system to suit their individual needs. This investigation aimed to fulfil Gallagher's brief to expand their solar powered energizer range, and uncover any other potential product opportunities in the market.

Keywords: Animal management, Electric fence, Modular, Energizer, Solar, Desirability, Functionality, Form, Aesthetics, Usability, User experience, Branding, Ergonomics, Industrial design

Acknowledgements

Throughout this journey, I have found that it's not about how much you know or how well you can design. It is about listening to people, especially the ones who know more than you do. In this case, the feedback, comments and support from others around me are what defined the project and end result.

This exegesis is the result of many conversations with key people associated with this industrial design project along with friends and family. Without these influences, the result would have been extremely different. I would like to extend my gratitude to these people, and emphasize how valuable their input was throughout this year long Masters Degree.

First and foremost, I would like to thank Callaghan Innovation; for funding not only my own, but many projects across New Zealand. Without the generous financial assistance, it could not have been achieved.

I have been blessed to have been given the opportunity to accomplish my Masters Degree within a New Zealand company; Gallagher Group. I wish to

identify how extensively Gallagher has helped this project, in an effort to express my appreciation. They have provided a significant brief to work on, an environment to work in, personnel time, resources and shared sensitive knowledge. The effect of these factors has been extremely beneficial to the final outcome and I thoroughly appreciate the positive attitude and friendly atmosphere I encountered when on site.

I wish to thank my mentor, Byron Arnold (Business Manager of Energizers) and Mark Harris (Marketing Manager of Animal Management Systems), who have had executive oversight throughout the project. As well as taking me under his wing and showing me the ropes, Byron has guided me through the project from start to finish, becoming a role model I looked up to when I was uncertain, confused or lost in the process. Thank you for putting up with my lack of knowledge while learning about the industry; I'm sure it was frustrating at times.

I now offer my sincerest gratitude to both my supervisors, Oliver Neuland and Professor Tony Parker, who have supported me throughout the project, offering dependable guidance and teaching me

in many cases, beyond the curriculum. Your consistent teamwork, encouraging feedback and belief in me helped provide a stable foundation while completing this project. I am pleased we climbed this mountain together.

Glossary of terms

Energizer: An energizer is a component required for an electric fence setup. It is an intelligent control system which converts power from the battery into a high voltage pulse or shock.

Solar Energizer: An energizer which uses a solar panel to help maintain full battery charge.

Modular system: A system which can accommodate many different types, sizes and powers of components, providing variability.

Grounding: Electrical energy always tries to return to its source. Grounding may be used as part of that return path. An animal becomes part of the circuit as it touches the fence whilst also standing on the ground.

Joule (J): The work required to produce one watt of power for one second ie 1 Joule. This derived unit is used to rate an energizers' power output.

Output (J): The output, measured in joules, of the energizer is the power rated for each product.

Amp Hours (Ah): A unit of charge measured in amps (current flow) per hour and used to describe the output of batteries.

Watts (w): A unit of power defined as one joule per second, measures the rate of energy conversion or transfer eg A solar panels output to a rechargeable battery.

Territory Manager: A Gallagher Territory Manager is an experienced sales professional, who knows and understands the Gallagher product range. Using this knowledge, the TM assists the customer to choose the most suitable product for his/her needs, offers solutions to specific problems, and promotes Gallagher products with the aim of increasing Gallagher sales in a specific region or area by building trustworthy relationships with the customer.



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1. Project Background

This Masters of Design project was funded by the Ministry of Science and Innovation through their Callaghan Innovation Research and Development (R&D) student fellowships, which are intended to encourage R&D intensive businesses to involve Masters and PhD students in their programmes. The 12 month project was undertaken with Gallagher Animal Management, part of the Gallagher Group, and focussed on industrial design research for a new solar powered electric fence energizer.

1.1. Student fellowship benefits

- Work on a significant problem faced by the company
- Gain and develop technical skills in a commercial R&D environment while completing their Masters or PhD degree.
- Gain commercial experience through a professional development plan.

1.2. Firms' Benefits

- The fellowship will contribute to the development and commercialisation of a new product, process or service.
- New capability generated in the students' R&D project will be transferred to the company.
- Builds a close link with the University resulting in the transfer of knowledge.



Figure 1. Callaghan Innovation Logo



Figure 2. Gallagher Hamilton Headquarters

1.3. Company Involvement

Callaghan Innovation

Callaghan Innovation was founded 2013, in the name of Sir Paul Callaghan. Working to accelerate commercialisation of innovation by firms in New Zealand, Callaghan Innovation helps fund R&D projects, which leads to helping New Zealand businesses grow. Their financial assistance has enabled me to engage and pursue this collaboration with Gallagher.

Gallagher

Early in the 1930's Bill Gallagher Senior, founder of Gallagher Group, invented the world's first electric shock system, in an effort to keep his horse off his car. This idea led to the invention of the electric fence which was further developed to control livestock on farms worldwide (Gallagher, n.d.).

Gallagher Group is based in Hamilton, New Zealand and has been developing, manufacturing and marketing world leading farming products since the 1930's. Bill Gallagher Senior, the founder of the company, led Gallagher to become a world-leading corporation in all areas of Animal Management, with current representation in over 130 countries (7 Markets). Within these markets, Gallagher are competing against dozens of rivals, all vying for the same market sector; predominantly farmers.



Figure 3. Gallagher Values

The primary Gallagher contacts have been mentor, Byron Arnold (Business Manager of Energizers) and Mark Harris (Marketing Manager of Animal Management Systems), who have had executive supervision throughout the project.

The initial brief described the overall topic and scope for design research, and outlined company business objectives.



Figure 4. Gallagher Timeline

2. Project Aims

Due to project requirements that looked for different outcomes, the business research aim was separated from the design aim. The aims have been explained below.

2.1. Business Research Aim

Initially, Gallagher business managers required a better understanding of the international electric fence energizer market, with a specific focus on solar powered units. The aim was to develop a thorough understanding and map of the current product market offering, identifying market competitors, gaps in the market and ultimately see how Gallagher were rating relative to their competitors. Refer "Market Research" section later in this document.

2.2. Design Research Aim

This new market research identified a specific gap in the market which became the focus of detailed product design research. The intention was to use this market understanding to direct the development of a new and innovative product in Gallagher's solar powered electric fence energizer range.

2.3. Research Objectives

- Develop a comprehensive understanding of existing Gallagher products, problems and opportunities to enable preparation of a requirement specification document of design issues, customer interests, market segmentation and product requirements.
- Develop a thorough appreciation of the existing Gallagher brand identity, user product interaction and environment, and consider how form languages communicate with potential users.
- Produce material which comprehensively describes the final design proposal and reflects the research findings.
- Develop a comprehensive understanding of state of the art, solar powered electric fence energizer products (usability, ergonomics, experience, desirability, aesthetics, technology and performance) and the likely developments anticipated within the design life of the new product family.
- Analysis of data which communicates findings to establish a foundation for a change in the design. Design Criteria to be formed as a reflection of the research conclusion.
- Generate, develop and prototype an innovative, industrial design proposal, for an integrated solar electric fence energizer for Gallagher Animal Management Systems, based on established design criteria.

2.4. Research Questions

- What company values are important to Gallagher?
- What aesthetic, usability and technical characteristics are found in the Gallagher product range?
- How does Gallagher compare against its competitors in each major market?
- What do customers think of the existing Gallagher product range?
- What are the differences between types of solar powered energizer?
- How are solar energizers used, and in what context are they used in?
- What issues are evident in the existing solar powered energizers?

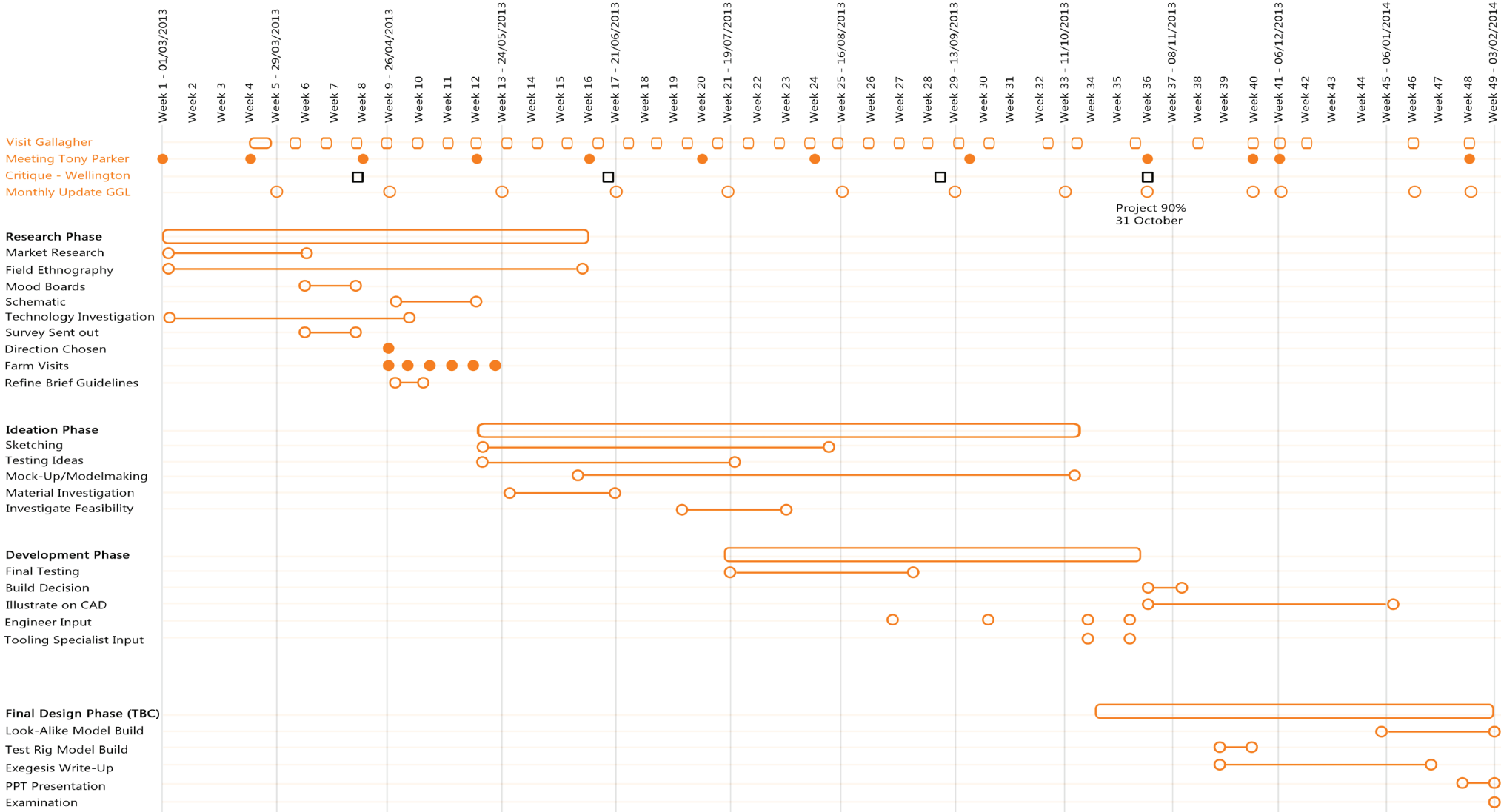
- How can solar powered energizers be improved to achieve a more desirable product experience for the user?
- What design principles should be considered when designing a solar powered electric fence energizer so that the end user finds it intuitive to install, assemble and operate?
- What design principles are best used to improve the overall design?

- How does an Industrial Designer fit in with other team members from other professions?

2.5. Project Timeline

This timeline outlines the main procedures and deadlines for the project.

(Opposite page: **Figure 5.** Project Timeline)



3. Background Information

3.1. Farming in New Zealand

Farming and agriculture are an integral part of New Zealand's historical way of life. Currently two of our most important primary industries, farming and agriculture make up roughly two thirds of our export trade. The agribusiness has made a rising contribution to New Zealand's economy and over the last 15 years, its productivity doubled the rate of the rest of the economy, (Anderton, 2006).



Figure 6. Farming in New Zealand

3.2. Gallagher Product Range

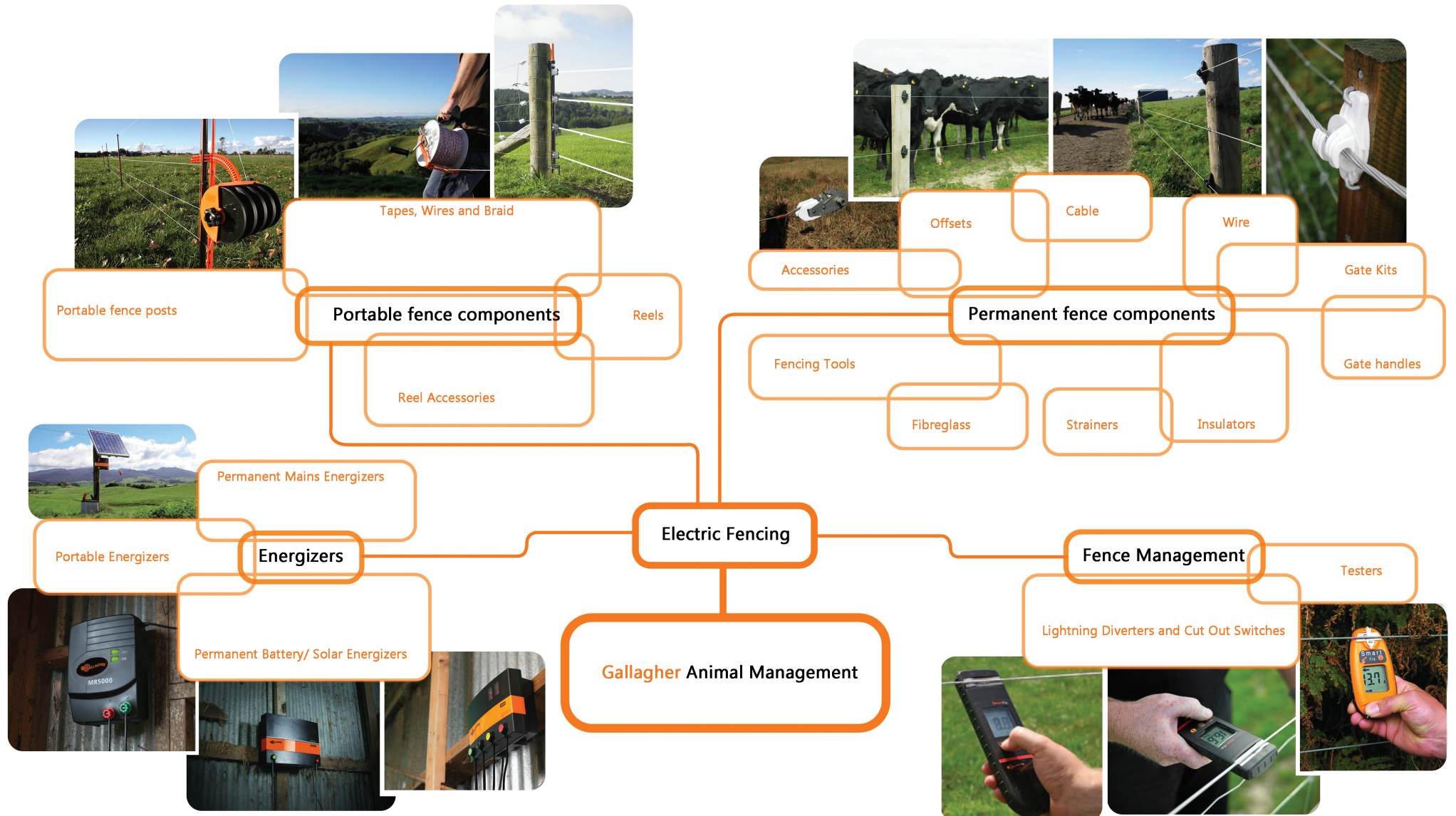
The overall Gallagher Animal Management product range is outlined briefly below with some examples of products in use. All products here are to be use on/with electric fences.

(Opposite page: **Figure 8.** Gallagher range of animal management products)



Figure 7. History of Farming in New Zealand

Gallagher Electric Fencing Product Scope



3.3. Basic Layout of a Solar Electric Fence Setup

The diagram below shows the 6 key components needed for a solar powered electric fence to work, followed by a description outlining the basic function or purpose of each component.

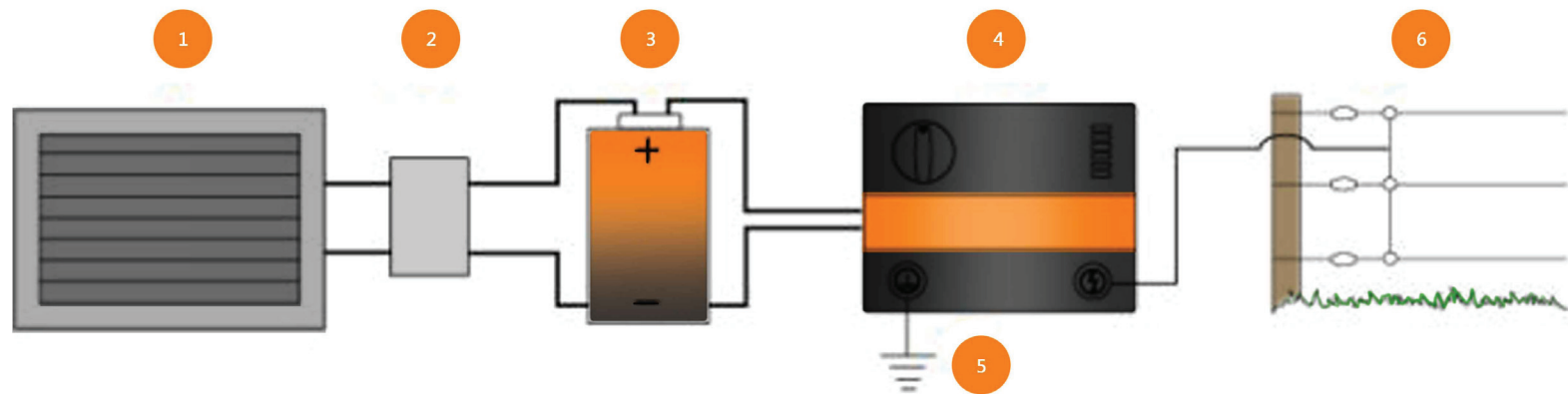


Figure 9. Components needed for an electric fence setup

1 Solar Panel

Solar panels generate power by processing the UV light in the atmosphere and send it through the regulator to be stored in the battery

2 Regulator

The regulator is effectively a surge protector, ensuring that the battery is not damaged by excessive amounts of power sent from the solar panel.

3 Battery

The battery stores electrical charge and is the source of power required to run the energizer. The solar panel can charge the battery, extending the life.

4 Energizer

The energizer draws power from the battery and sends electric pulses along the fence every few seconds. The pulse is always trying to find its way back to its point of origin; the energizer

5 Grounding system

The grounding system requires a way for the electricity to reach the ground, often using a grounding rod. The grounding rod is part of the circuit that is completed when the animal touches the wire. The completion of the circuit is what allows the animal to get a shock.

6 Fence

The fence is the containment which provides a physical boundary for stock control. To work, the fence must allow electricity to flow through it, but prevent the electricity from reaching the ground unless it comes in contact with an animal; only then should it complete the circuit by flowing through the animal, the ground, back to the grounding rod and energizer.

3.4. Energizers

As previously mentioned, the project area of interest is energizers; specifically solar powered. The following chapters provide background knowledge on solar powered energizers

In **Figure 10**, the solar energizers have been divided into basic categories which define them in terms of size, power, use, form and layout. Refer to Gallagher Product Range Analysis for more information.

Solar Powered Energizer Categories



Semi-Permanent Energizer

Semi permanent solar energizers can be used with either a battery or a solar panel. The battery, solar panel and energizer are separate units. The solar panel must be mounted separately to the energizer. These energizers are typically more powerful than portable solar energizers.



Portable Box Energizer

These units contain a battery which sits inside the box. The battery is connected to the electric energizer components but is easy to get to. A solar panel can be mounted to the portable box energizer, making it an "all in one" unit. In addition, it has a carry handle to promote its portability.



Integrated Solar Energizer

Integrated solar energizers are a single unit containing built in electric components, battery and solar panel. A handle is built in to promote its portability. They are the least powerful of the three types, but the easiest to move as they are smaller, lighter, and all-in-one.

Figure 10. Gallagher energizer range

4. Literature Review

An outline of literature has been assembled to highlight some of the key theoretical reasons for design decisions and outcomes. The following human factors discussed have provided solid foundation for product design and are reflected in the final outcome.

- Functionality/Practical Functions
- Usability
- User Experience
- Desirability
- Experience
- Branding

4.1. Functionality/ Practical Functions

Functionality forms the foundation of this project. It is only after reliable functionality has been achieved that usability, user experience and desirability can provide benefits to the end product. P. Jordan, 2000, states in his book, *Designing Pleasurable Products*; "A product will be useless if it does not contain appropriate functionality: a product cannot be usable if it does not contain the functions necessary to perform the tasks for which it is intended." Therefore, the product is directly affected by the designers understanding of what the function, user and context of use is, because it will ultimately define the shape or form. It could be claimed that the form of a product follows both function and emotion. In **Figure 11**, it is evident that function is one of three components which dictate the form of a product.

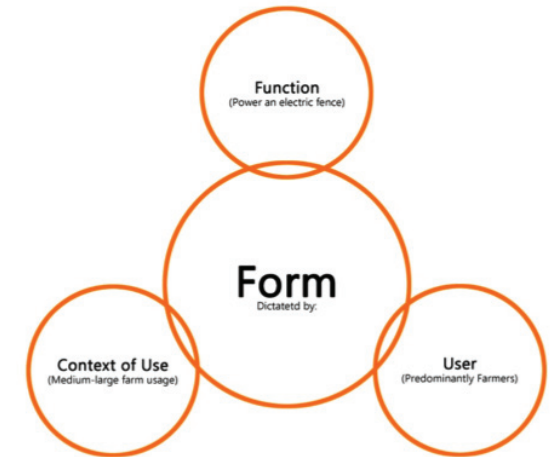


Figure 11. Connection between form, function, context of use and the user

Functions

Product functions will define the layout, size, proportion, shape, materials and construction. Functionality is also driven by visual technical issues such as draft angles, part lines, wall thicknesses, curvatures and component sizes which add to the overall appearance of the product.

Context of use

The context of use will influence the way the product functions. It will also help guide material selection, component configuration and affect the method of transportation.

User

Colour, texture and graphics are user driven form factors, which contribute to the aesthetic qualities of the end product. Ergonomic factors are influenced by the user and create visual form through user interactive features such as handles, handle grips, clips, tightening mechanisms, etc.

Function could be further divided into “two major components: (1) performance specification demands, including all-

user friendly aspects, and (2) cost and manufacturability.”(Lesko, 2008).

Performance specification demands

Performance specifications refer to the abilities and limitations of the products user. It may also reflect how the product must perform in context, what it must contain, what it must work with and how the user interacts with it. (For performance specification demands, see Functionality Criteria in Gallagher Performance Specifications in 7.2, **Table 1.**)

Cost and Manufacturability

Cost and manufacturing factors are physical aspects of the product, including the number of parts, relative size of product, and complexity of manufacture, assembly time and material selection. (For Cost and Manufacturability, refer to Manufacturability/ Tooling/Assembly Criteria in Gallagher Performance Specifications in 7.2, **Table 4.**)

Gallagher products are a good example of these factors, whereby the two components of function, structure the foundation upon which the design will develop. Furthermore,

the shape of a product is not only a reflection of its function; it is an expression of the intended use, helping to communicate to the user how to interact with it. Steve Jobs clearly articulates “It’s not just what it looks like and feels like. Design is how it works.” In conclusion, form reflects how good a product is and good design expresses and supports functionality (Cornett, 2010) (Gassmann, 2010).



4.2. *Usability*

Usability, as described by UsabilityNet, means “making products and systems easier to use, and matching them more closely to user needs and requirements.” Usability is about the effectiveness, efficiency and satisfaction of a product’s function and is affected by the user, the user’s expectations and its context of use (Usability Net, n.d.).

Burris’s view on usability in Product Design – Importance of Usability and User Experience (2008), underlines the basic principles of how important usability is for a company and their product line. He recognises that along with functionality, usability has become a factor which is no longer a luxury due to a shift in customer desires. Customers are no longer satisfied with just a functional product; they now expect an intuitive, easy to use product, regardless of what it is. It is evident that although usability adds huge value to the product, it is perceived to be a standard value to the customer.

It is evident that usability is a very standard process within product design today; however without the implementation of usability factors, the final product will lack

important consumer centred design input. Usability requires a deep understanding of the user, with an emphasis on how easy it is for the user to engage with the product and how simple the task is to achieve.

In this project, the product functions must be easy to understand, intuitive to use and user friendly, providing the expected usability aspects which will help consumers with 1) limited knowledge on electric fencing setups; as well as 2) offering a platform for experienced users to generate their own collection of components.

4.3. User Experience

Again in Burriss's Product Design – Importance of Usability and User Experience (2008), he explains that “while user experience might sound related to usability, there are very distinct differences between usability and user experience. User experience is not about the capabilities and ease of use, but rather about the feeling about the interaction a user has with a product. User experience is entirely emotional. It is how satisfied, content, happy, disillusioned, frustrated, or angry the user is with their experience with the product.” The importance of enjoying a task or experience while using a product adds value to a completely functional and usable product.

During the design process, the following key issues aim to demonstrate user experience properties:

Value will be expressed through ergonomic interactions that may protect, enable, facilitate or fit/suit the consumer, instilling a sense of usefulness.

Usability will be transformed through simple, understandable and familiar elements which describe their intended use.

Adoptability may use semantic communication to describe, express and identify the product features, encouraging the user.

Desirability will be integrated into the product by creating symbolic, aesthetic and identification factors associated with farming, agricultural tools and Gallagher.

The end product aims to demonstrate intuitive usability while connecting with the user, providing them enjoyable, simple and safe experiences through interactions with features and functional components. By infusing a useful, enjoyable user experience, the consumer is likely to feel positive, adding key desirability traits to the end product.



Figure 12. User Experience connections

4.4. *Desirability*

In Design Crux, (2006), John Soellner writes, “Desirability is claimed to create symbolic, aesthetic and identification factors people associate with products, services and software. Rather than brand after construction is finished, desirability is branding through design.”

In, Pleasure with Products: Human Factors for Body, Mind and Soul, P. Jordan (1999) states, “Humans always have and always will seek pleasure. The artefacts and products with which we surround ourselves are potential sources of pleasure.” People are buying to fuel desires, express personal values, aspirations and emotions. In a similar book, Designing Pleasurable Products (2000), Jordan suggests that since products have almost reached a level of maturity on the functionality, usability and user experience in terms of consumer needs, it is inevitable that customers will start wanting more. Desirability is emerging as a consumer need, driving the market in new directions. **Figure 13** shows how basic human needs and wants are also evident in what consumers want from products.

Desirability can add cost to the end product. For farmers, the biggest end user, cost is a dominant buying factor. However, desirability traits are manifested in existing Gallagher products and due to the success of these; it is evident that desirability is bringing added value. In the creation of a more desirable product, the intention is to develop a connection with the user through desired characteristics, by making the product easy and simple to understand while being enjoyable to operate.

In Designing Pleasurable Products (2000), Jordan also describes methods for creating pleasurable/desirable products such as focus groups, think aloud protocols and field observations, which can be used through the design process to collect information about what farmers consider desirable.



Figure 13. Hierarchy of product requirements

Anders Warell (2008) has developed Perceptual Product Experience (PPE) framework for analysing how consumers perceive products in order to capture the desires of users, create meaningful experiences for people and support the design for its intended market. "The PPE framework is designed to allow users to focus on perceived, non-instrumental aspects of product interaction in order to understand, map, organise and analyse possible user experiences." (Goellner, Warell, Adank, Garret and Parker, 2011)

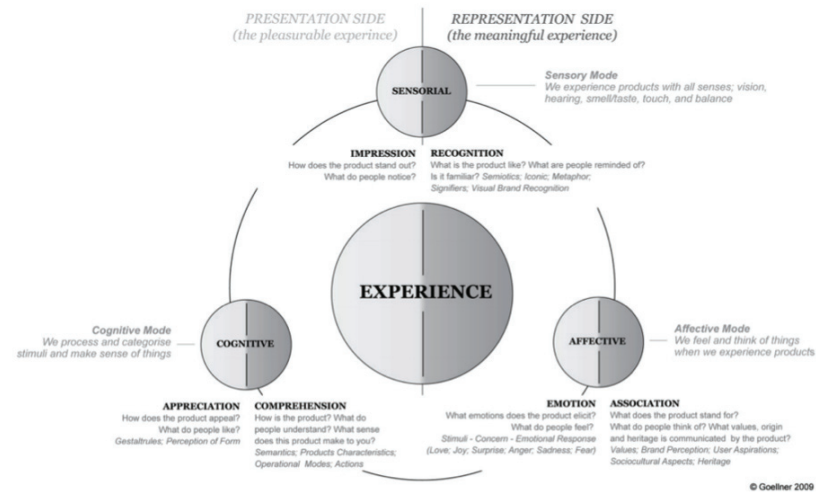


Figure 14. The Perceptual Product Experience (PPE) framework (based on Warell, 2008)

There are two models used for describing the affective qualities of products: Representation and Presentation. Both models can be broken up into three modes.

Presentation

Impression communicates the unique characteristics noticeable to the user. The impression tool can be used to establish what makes a product, family or brand different from other products in the market, highlighting the strongest impression.

The attractive, striking or captivating traits are often what users like about the product. The **Appreciation** mode is used to identify these traits and investigate how it is accomplished

Emotion mode corresponds to the emotion or feelings a product 'elicits' when visualised or interacted with. The connection between user and product is important to create a desirable product feel.

Representation

When interacting with a product, **Recognition** is 'what people are reminded of'. A reminiscent memory or experience can evoke a specific connection with the product, whether it is positive or negative.

'What people understand' about the function, form and features are an indication of how well the user comprehends the product.

Comprehension is often able to be integrated into the product through semantic functions and carefully designed form language.

Association recognizes what users think of; often another product, and what the product stands for. The mode questions what values, origin and heritage are communicated by the product.

4.5. Experience

Experience has close associations to form, function, user experience and desirability aspects described earlier in this literature review. Chitturi, Raghunathan and Mahajan, (2007) examine how the 'Hedonic' and 'Utilitarian' values can influence the experience for a customer when interacting with a product and how these factors can benefit the product design process.

Hedonic: Aesthetics and experiential product properties
 Utilitarian: Functional and practical product properties

Chitturi et al (2007), believe that “after a necessary level of functionality is met”; the hedonic properties become not only important, but more desirable due to the fact that they are an added bonus to the basic function of a product. This adds greater value to a product, as the user is often not expecting these benefits, resulting in satisfaction among other positive emotions. When the hedonic value is absent, the user may feel dissatisfied. However, if the utilitarian or functional property is not up to standard above all else, the user will likely be extremely disillusioned by the product, as it

no longer meets the basic users' needs.

Hedonic and Utilitarian properties bring emotions to users. **Figure 15** illustrates different emotions consumers get from hedonic and utilitarian product attributes, which will be used to help guide the final outcome of this project.

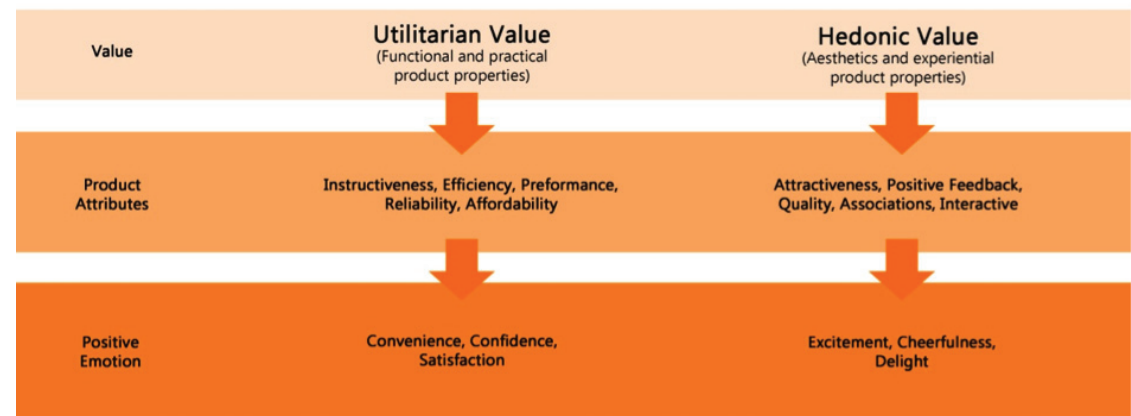


Figure 15. Properties and response to utilitarian and hedonic values

4.6. Branding in Product Design

Monika Hestad (2013) clearly describes in *Branding and Product Design*, the link between product and brand association. She describes branding and product design presently as two separate professional disciplines; however the product is an important touch point which carries real brand experiences which have a powerful influence on how brands are perceived and valued. Hestad states that “the product is important in telling the story about the brand by delivering brand promise.”

Branding is an important factor in this project, because the proposed product will need to fit within an existing product brand family. The product must therefore reflect Gallagher values, approaches and establish brand design colours, graphics and other formal elements. For more than 10 years, Professor Tony Parker, Chief Designer at Gallagher, has been creating a visual representation of the Gallagher brand through product aesthetics. His approach to design has facilitated the emergence of a family of products, which now stand as one of the main touch points of the Gallagher brand.

Gallagher products will later be analysed in order to identify the key visual characteristics of the product family and show what differentiates them from other brands in the market.

4.7. Design for Manufacture

Understanding materials and manufacturing is a substantial part of designing a product. Jim Lesko (2008) states in *Industrial Design; materials and manufacturing guide*, that “The designer, whether on a design team or acting alone, is responsible for the appearance and form of a product.” It is important to visualise and develop forms which can be manufactured, and if there is a lack of knowledge on these aspects, creative potential is limited. Lesko adds “It would be like a composer writing a symphony totally unaware of the colour and full range of some instruments”.

4.8. Manufacturing Technology Investigation

Plastic Injection moulding is the preferred method of manufacture because it allows almost complete freedom for designing products with a high level of detail. Additionally, injection moulding has low operation, maintenance and running costs in comparison to other methods when parts are mass produced. With the estimated volume of production around 3000 units/year, there are sufficient numbers to warrant plastic injection moulding.

This project is heavily influenced by manufacturability, tooling and assembly constraints; therefore it must comply with the following design specifications:

- Practical to tool for manufacture by injection moulding of main plastic enclosure components
- Can be realistically manufactured at a reasonable price, with minimal complexity involved

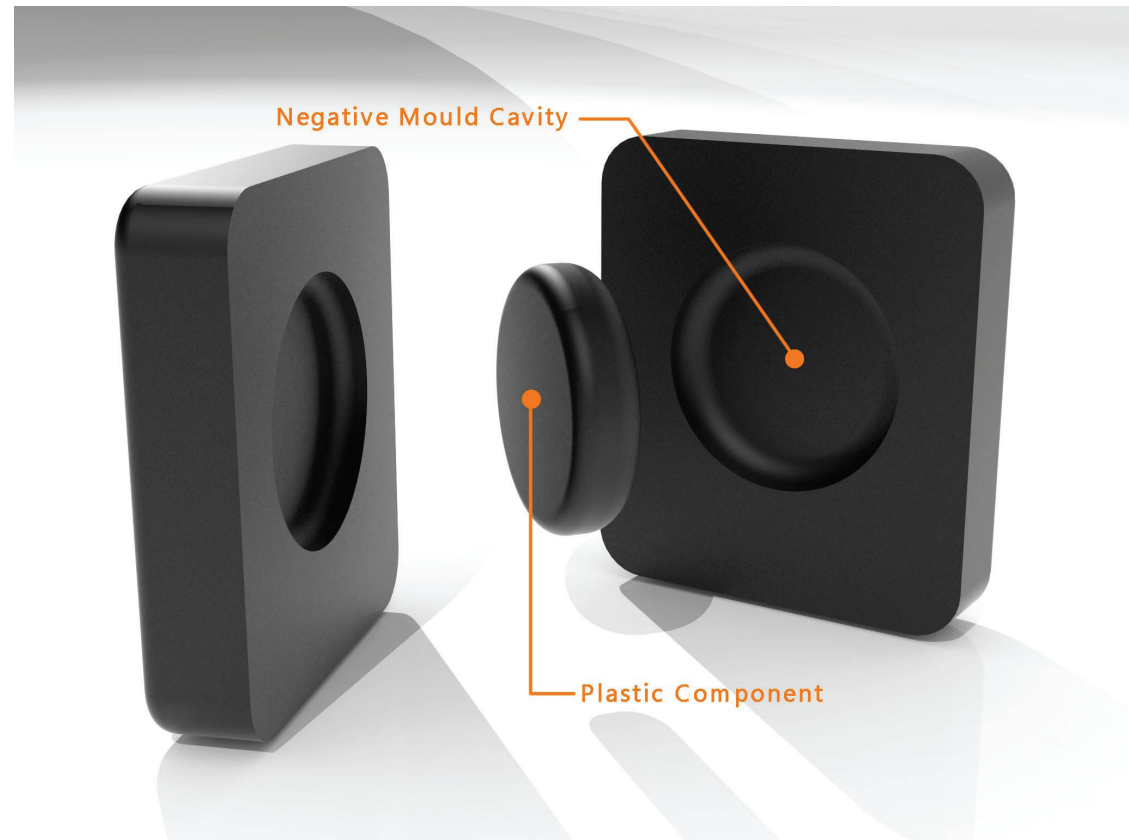


Figure 16. Injection Moulding (Basic Principle)

4.9. Tooling for Injection Moulding

Informal meetings with Gallagher tooling expert Matthew Bell provided insight into the expectations placed upon a product for manufacturing.



Figure 17. Machining an injection moulding tool

4.10. Ergonomics

As a result of the health and safety concerns, investigation into real life case studies has been used to identify realistic benchmarks. Fitting the Human: Introduction to ergonomics by Karl H.E. Kroemer (2009) and The measure of Man and Woman: Human factors in design by Alvin R. Tilley (2002) were used as guides to making informed design decisions. Hand ergonomics, shoulder widths and human related measurements were investigated along with lifting techniques, max lifting weights and benefits associated with each. For this data, see **Appendix 3** (Karwowski, Soares, and Stanton, 2011)

Recommended limits in the UK are as follows:

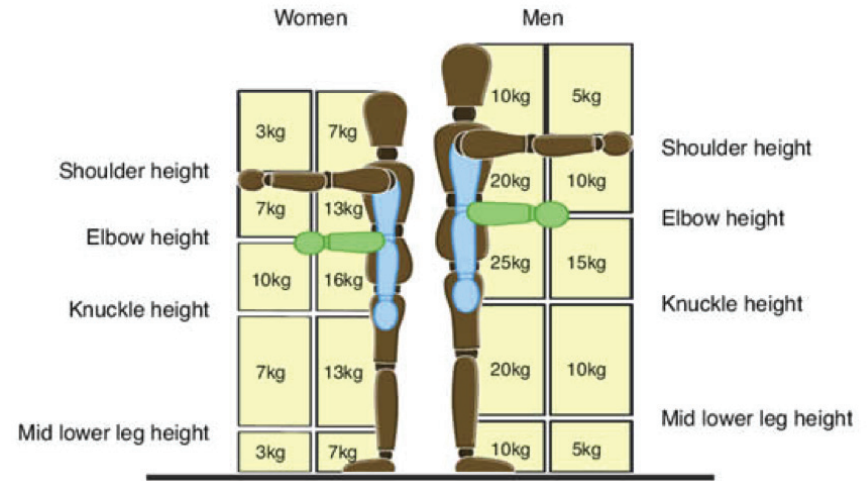


Figure 23. Ergonomic lifting principles

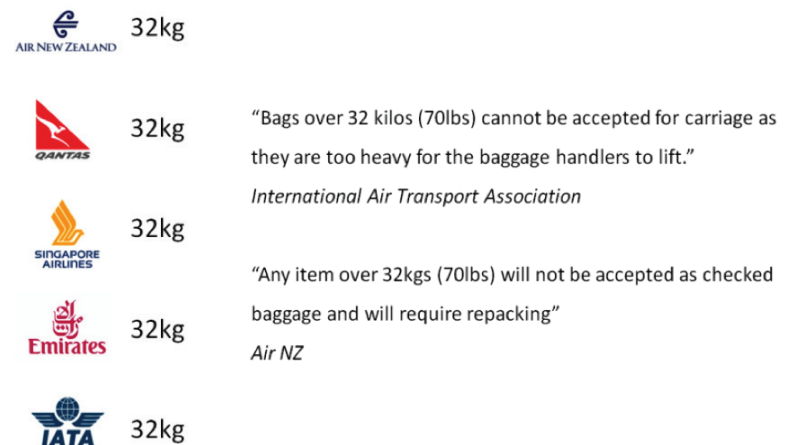


Figure 24. Airline companies investigated

International Carry Weight Standards
and related Regulations

In New Zealand, it is claimed that “There is no maximum safe level for lifting specified in employment law.” <http://www.dol.govt.nz/workplace/knowledgebase/item/1354>

However, this product would be sold worldwide, and must be accepted in all markets as safe enough to use. Based on ergonomic data from the International Air Transport Association (IATA), Air New Zealand, Qantas and other internationally recognised flight businesses, a maximum weight of 32kg has been established. IATA (n.d.) exclaims that “bags over 32 kilos (70lbs) cannot be accepted for carriage as they are too heavy for the baggage handlers to lift.” (IATA, n.d.). This ergonomic health and safety decision reflects a safe weight for an individual to carry, therefore, a weight reduction must be incorporated into the design criteria.

4.11. Industrial Design as part of a team

In order to make informed decisions when designing the product, it is beneficial for the designer to have a solid appreciation of the principle aspects in other fields of expertise. The following points explain the role which industrial design played and its relationship to other project team members in this project. (Cuffaro, 2006)

Marketing

Industrial designers need to understand the brief, which is primarily orchestrated by the marketing team, in regards to a gap or opportunity in the market. Industrial designers need to work closely with marketing experts to get a solid understanding of the client needs, financial limits and other essential guidelines of the brief.

Engineering

Engineers and designers typically work side by side during the development stages of the design to work out realistic and innovative technical and manufacturing solutions. Engineers provide their expertise in the mechanical, electrical and electronic aspects of the product such as strength, performance, materials and can forecast possible issues such as water ingress, weak areas in the product and electric failure which can avoid unnecessary expenditure. Industrial Designers must understand the above physical limitations which directly influence their final outcome.

Manufacturing

Tooling and manufacturing play a big part in the product design and development process and must be considered extensively before going into production. Industrial Designers require tooling advice throughout the development process to confirm that the design can be manufactured with the chosen manufacturing method and early discussions can prevent unnecessary mistakes.

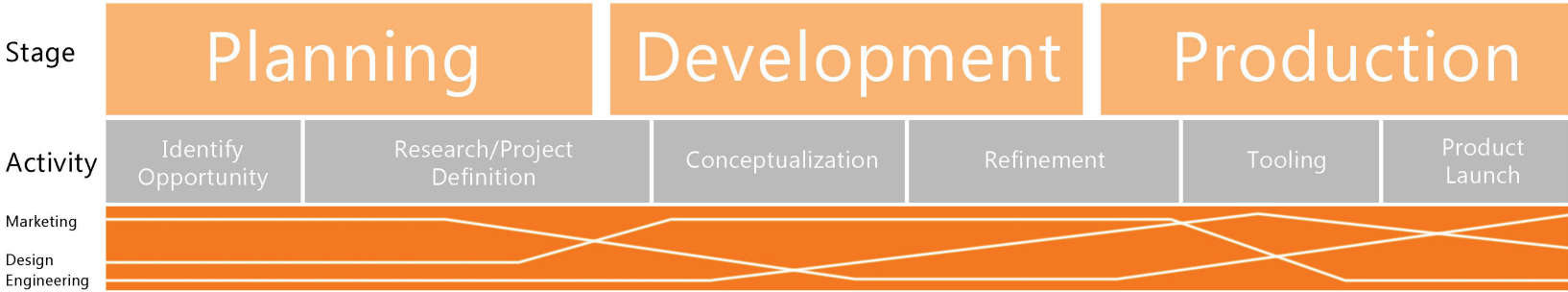


Figure 25. Design process and involvement

5. Industrial Design Research Investigation – Defining a Market Gap

Due to dissimilar project requirements, the business research brief was separated from the design brief. The methods used to address the business research brief helped define the design brief for the project.

5.1. Research Methods used

In this section, unexplored market opportunities were sought where innovative solutions could satisfy unmet user needs. In order to do this, a comprehensive understanding of the animal management industry was required. The following processes were used to aid in identifying crucial practical information.

Online Literature Review

Online literature provided an overview of the current situation in the farming industry. As shown above in the background research, it also enabled a sound understanding of the electric fence industry.

Brain Dump

The brain dump technique was used for idea generation, aimed at releasing initial spontaneous ideas which were a result of early investigative findings. These very early explorations of design concepts helped to better understand issues and possibilities and identified knowledge gaps for further investigation (Van Wulfen, n.d.).

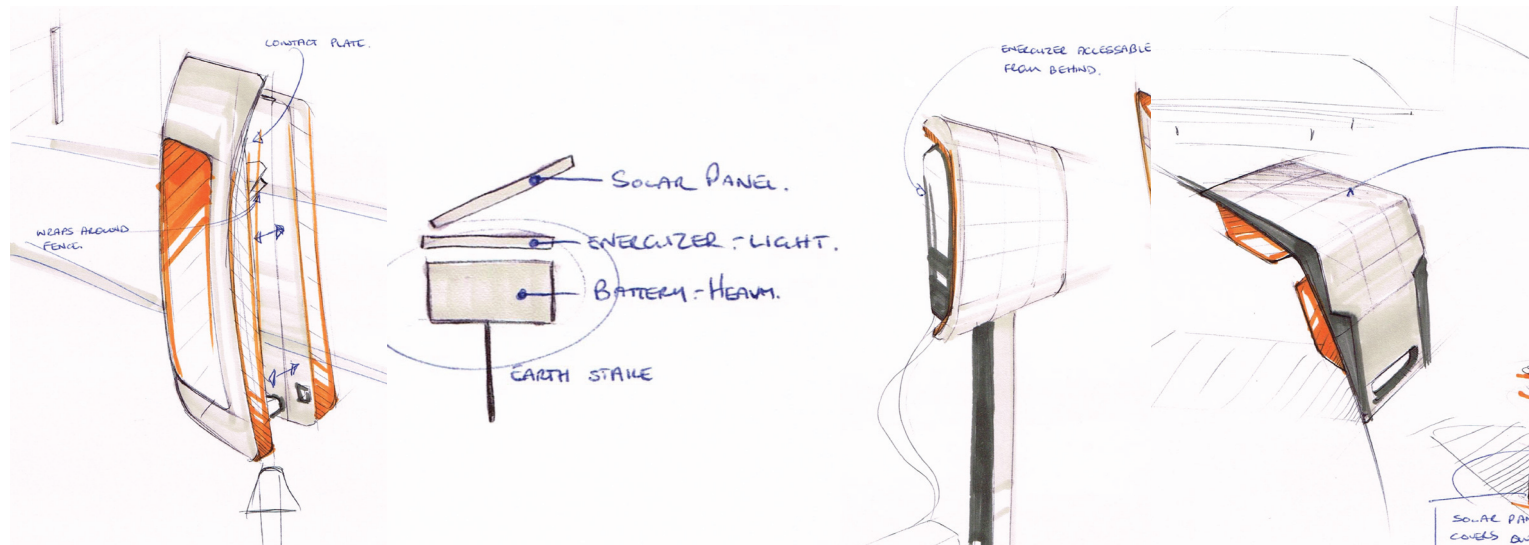


Figure 26. Sketches from brain dump

Informal Individual Expert Interviews (Byron Arnold)

While spending days at a time with mentor Byron Arnold, many in-depth considerations were discussed around the current situation of energizers. This researcher, having limited knowledge initially, helped him to empathise with new users and understand how they could feel. While these conversations were not digitally recorded, key notes were written, often focussing on the answers of the questions asked. These interviews are mentioned after key stages in the design process throughout this exegesis document and helped inform new directions, questions and possibilities.

Amateurism (User Testing)

A small electric fence was established for the purposes of user testing. Participants with little or no knowledge were asked to set up different types of energizer to energize the fence. Participants of this skill level were chosen because they provided a fresh unbiased view on the energizer and electric fence system. They were observed and recorded in order to evaluate how user friendly these existing products were and figure out what common problems emerged.

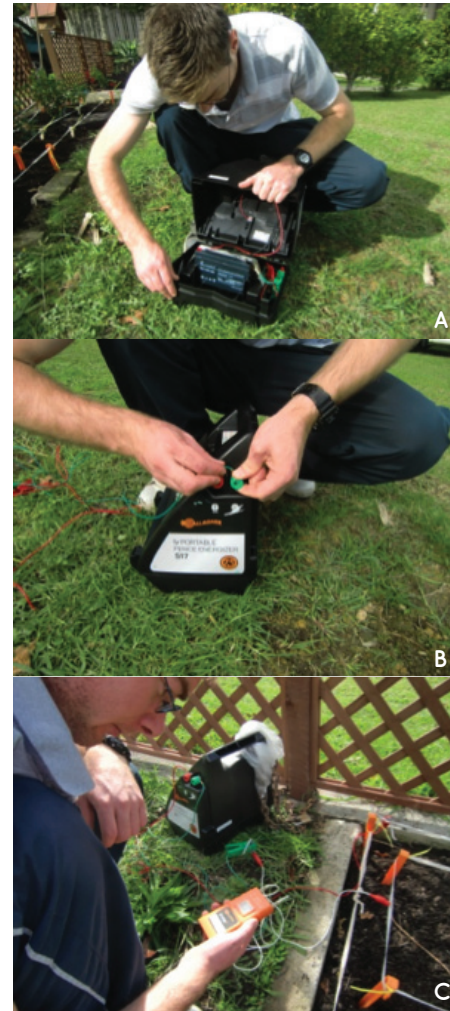


Figure 27. A) Opening Gallagher S17 to investigate the inside components. B) Negative and positive cables hooked to terminals. Trouble with available space. C) Making sure the fence works



Figure 28. A) Opening Gallagher B100 to investigate the inside components. B) Placing lid back after hooking crocodile clips from energizer to battery terminals. C) Checking connections to identify where the problem lies



Figure 29. A) Opening Gallagher B40 to investigate the inside components. B) The participant has attached the grounding cable to the fence (common misunderstanding). C) Lid has been put on incorrectly. The reverse clip prevents extraction of the lid in this position



Figure 30. A) Attaching wire into crocodile clip. B) Connecting energizer grounding cable to the grounding rod. C) Participant is unsure what to do with grounding rod

Findings

Users with little or no knowledge of the technology struggled with the following:

- Grounding – Users did not understand how to complete the circuit
- Connectivity between battery, energizer and fence – Users with no knowledge could not work out which cable attached to each component. The more complex the product, the more confused they became.
- Knowing they had done it right – Once the energizer was setup, there was little visual feedback to confirm it was working
- It is common for users to clip the lid on incorrectly as shown in **Figure 29C**, resulting in the lid being locked in the improper position. From this point, it becomes almost impossible to remove without excessive leverage using tools.
- Portable energizers were the easiest for a new user to set up
- Semi-portable energizers were possible to set up with minimal knowledge
- Permanent energizers were not understood by users with a low level of understanding and could not be set up.

Farm Visits (Field Ethnography)

A number of farms with electric fences were visited by me and my mentor, Byron Arnold (Business Manager of Energizers). The farms visited helped comprehend the context in which energizers were used. Gallagher experience and farm visits provided additional relevant documented information, images and knowledge insight which had been collected over the years.

Huntley - 26 March 2013

Farm Overview:

A Huntley farm was chosen by Daniel Loughnane, Business Manager of Gallagher Weighing and EID systems, to give a general understanding of a typical farming environment. A Gallagher staff member's father allows Gallagher personnel to test Gallagher products on the property which is used predominantly as a small dairy farm.

Observations:

- Energizers are often installed or mounted, left for very long times and endure hot, cold, wet, dry, dusty or conditions.
- Farmers want to know their fence is secure and will visit the energizer regularly to ensure it is working well, implying there is a certain psychological need to check fence condition.
- Paddocks can be many kilometres apart, suggesting that long distances must often be travelled to get around on farms.



Figure 31. A) Typical NZ farming environment. B) Energizer installed in a barn on wall. Note the environment conditions. C) S17 hooked up to the fence to power a small fence.

Warkworth - 9 April 2013

Farm Overview:

The lifestyle block belonged to a lifestyle/hobby farmer with number of Gallagher S50 energizers installed. The land was mostly flat, but many other properties in the area had much steeper terrain. Fences were set up to hold roughly 15 sheep, a good representation of many hobby farms here in New Zealand. S50 portable solar energizers were set up along the fence lines and were easy to relocate if needed.



Figure 32. A) Farm environment. B) Gallagher S50 installed on a warratah. C) Gallagher S50 front.

Byron Arnold Various Farm Visits (2011-2013)

The following images are from various farms across New Zealand and other countries. Information on these farms was given verbally and was used to visualise the context of use.



Figure 33. A) Gallagher B40 working amongst long grass. B) Permanent energizer setup installed in a small shelter to protect from the elements (Japan)



Figure 34. A) Large solar setup in Australia. B) Typical NZ farm. C) Permanent system setup in an old fridge.

Personas

User groups were identified and analysed based on a cross section of similar groups of real people, to identify the different user needs associated with the end product. Personas helped to inspire and guide the concept design.

Professional Farmer

Steve was born and raised on farms. From an early age, he started helping his father. His involvement on and around the farm gave him an understanding of the difficulties, which he learnt to accept and would use what he had to solve these problems. His parents allowed Steve to experience life for himself and not restrict what he could and couldn't do. This foundation of learning shaped his mindset and incited his ability to use common sense. He firmly believes in thinking for oneself, and learning from experiences. For this very reason, he believes that people are too safety conscious and that common sense is being bred out of people.

He kept farming throughout his life with other odd jobs on the side to make ends meet. Most of his land and stock was inherited from his parents and he continues to maintain it. His wealth increases because he is good at his job, makes use of what he has and keeps expanding. His children have grown up and helped on the farm but sometimes decide to go down the path of education instead of farming.

Professional Farmer (Land and Stock Owner)



"Lets get it done"

"It's like to keep an eye on things"

"Use common sense"

Background

- 30-70 Years Old
- Minimal education
- Full time farmer
- Manages his farm
- Financially comfortable
- Large family
- Responsible for land, stock and workers

Attributes

- Innovative
- Takes no "crap" from anybody
- Runs his own life
- Staunch
- Says what he thinks
- Experienced in hands-on farming
- Firm believer in common sense
- Can solve anything

Customer Needs

- Easy
- All about functionality
- No time wasting
- Best quality
- Best tool for the job
- Tough and hardwearing equipment

Figure 35. Professional Farmer

Farm Worker

Farm workers generally grow up working on a farm from a young age. They often enjoy the tasks and learn while they are working under parents, siblings and other teachers.

In many cases farm workers have not ventured out of their country or even town. They stay working all their lives and the farming environment is their home. This can lead to them owning the farm later in life and passing on their experience to others as they climb the ladder.

Young farm workers are now engaging with a lot of the social media and products, and have a natural ability to use technology. Their interest in these devices is now playing a major role in the shift between doing everything by hand to using technology to assist them in the tasks at hand.

Farm Worker



"I just get told what to do and I do it"

"Sometimes I can't be bothered"

"Maybe one day I'll own my own farm"

Background

- 16-30 Years Old
- Minimal education
- Full time farm worker
- Lives on farm
- Earns good wages
- Often starting a family
- Brought up farming/on a farm

Attributes

- Physically active
- Understands technological devices
- Aware of farming responsibilities
- Not always careful when using equipment
- Experienced in hands-on farming
- Enjoys farming as a job

Customer Needs

- Simple/easy to understand products
- All about functionality
- Tough and hardwearing equipment
- Enjoyment
- Safe equipment

Figure 36. Farm Worker

Hobby Farmer

Hobby farmers are predominantly city people who have dedicated a large portion of their lives to their full-time city job or business. It is common for them to have become very wealthy and upon raising a family, have opted for a lifestyle change away from the city.

Hobby farmers usually focus on low scale farming and raise uncommon animals such as alpaca. They often live off the animals they raise such as chickens, sheep or pigs and also agriculture farming. They care for their animals and commonly create an emotional attachment.

With a low level of farming knowledge and expertise, they rely on products which are easy to use, paying high prices for the best equipment designed with simplicity in mind.

Hobby Farmer



"I love animals"

"The lifestyle is important"

"I don't know that much about farming"

Background

- 30-60 Year old male/female
- High level of education
- Has a full-time job
- Farming is a hobby
- Lives on lifestyle block
- Earns good money
- Often has a young family
- Brought up in city life

Attributes

- Minimal farming knowledge
- High level of business knowledge
- Farming for a lifestyle change
- Doesn't like getting hands dirty
- Often wealthy
- Enjoys farming and animals
- Has high morals for animals

Customer Needs

- Simple/easy to understand products
- All about ease of use
- Enjoyment of product use
- Latest technology, best products

Figure 37. Hobby Farmer

Territory Manager

Territory Manager (Profession)



"I enjoy talking to people"

"I care about the customer"

Background

- 20-65 Years Old
- Varied Educations
- Full time Gallagher Employee
- Connection between Gallagher company and the customer
- Has good farming experience
- Primary installer of Gallagher systems
- One TM/Region

Attributes

- Innovative
- Good people skills
- Wide farming knowledge base
- Technical
- Experienced in farm related issues
- Can solve anything

Customer Needs

- Tools
- Quick installation solutions
- Reliable product
- Good Communication skills

Figure 38. Territory Manager

Market Overview Board

The market overview board is a collage technique used to explore relevant environment, activities and product examples which reflect or encapsulate appropriate feelings and associations with the farming and agriculture industry. These images offer valuable insight into the feelings, expressions, colours and emotions related with farming, providing inspiration for further thoughts throughout the project.

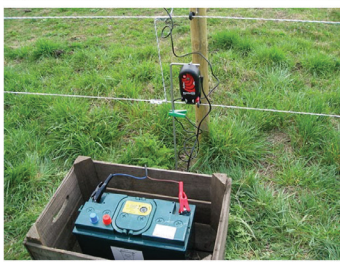
(Opposite page : **Figure 39.** Market Overview Board)



Robust



Modern

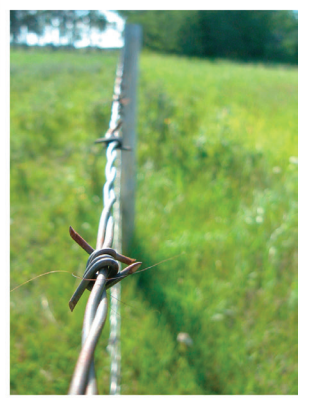


Contrast

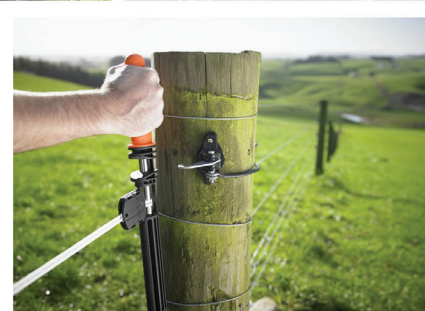


Striking

Utilitarian



Natural



Online Survey

In order to reach customers worldwide, survey questions were prepared and a survey was conducted through FreeOnlineSurveys, an online survey engine. It enabled the author to make contact with Gallagher Territory Managers in all the major overseas markets. TM's were targeted because they deal with customers and end users every day in their jobs, gathering important information from the target farming market.

The voice of many farmers could be heard through each TM, who would relay their concerns, doubts and objections as well as their advice, opinions and general comments. This was the most useful method used to gather new unknown research from the target end user group. For information on TM's, see Glossary of Terms.

The refined survey results can be found in **Appendix 2: Survey** where they have been placed in tables and graphs to condense the information

6. Research Data/ Findings

These pages document information about the following key topics:

- Gallagher aesthetic/family/brand/identity analysis
- Gallagher product analysis
- Gallagher energizer differentiation
- Gallagher position in each major market
- Technology and materials forecasting
- How each type of energizer is used
- Context of use
- Market gaps/opportunities

The following methods were used to gather the most relevant research information and applied in the following documents:

- PPE Analysis
- Future Forecasting
- Expert Interviews
- Market Segmentation
- Market Figures and Graphs
- Competitor Reviews
- Advantage/Disadvantage Evaluation
- Discrimination/Market Maps
- Technography

6.1. Gallagher aesthetic/family/brand/identity analysis

The PPE Analysis aimed to establish a thorough understanding on the aesthetic qualities of various relevant Gallagher products. The documents provide information which will help connect the new product to the existing Gallagher family, brand and identity.

Gallagher Portable Solar Range S17



Presentation

Impression

Robust solid form appears reliable and fit for purpose

Appreciation

Clear utilitarian feel with simple product semantics

Emotion

Strong, robust, simple, affordable, and expresses very basic functionality. No frills.

Representation

Recognition

Very boxy product. Despite Gallagher logo, there is no clear association with Gallagher product brand identity.

Comprehension

Solar panel clearly explains it is a solar unit. No other visual cues help the user to comprehend its use.

Association

The S17 has no clear indication of its intended use. Its unclear form could be mistaken for a floodlight.

Figure 40. PPE Analysis Gallagher S17

Gallagher Portable Solar Range S20-S50



Impression

Clear glossy shield, corrugated texture, minor detailing

Appreciation

Smooth lines, subtle form curvatures, material and texture contrast.

Emotion

High tech and high performance appearance. Pride instilled in the product

Recognition

Black band and orange print are synonymous with Gallagher. Corrugated texture reminds people of tough "corrugated iron"

Comprehension

Large clear surface dominates the face of the product as the most important feature. Intent is obvious. Single control (dial) is easy to understand.

Association

State of the art, using new distinctive materials to show new innovative ideas and ways of doing things.

Figure 41. PPE Analysis Gallagher S50

**Gallagher Permanent Solar Range
B80, B180, B280**



Presentation

Impression

Colour contrast, bright, large terminals, clear dials

Appreciation

Simple lines and subtle surface tension on curvature. Surface texture changes and clear product semantics provide hierarchy.

Emotion

Precise uncomplicated functionality: Pleasure
Professional Appearance: Pride
LED Lights: Surprise

Representation

Recognition

Banding, colour application and form are strong Gallagher identities

Comprehension

Obvious feature hierarchy and relation to function. Features are easy to understand and switch has natural affordance.

Association

Professional well engineered product. Balanced symmetrical proportions and layout help distinguish the association with Gallagher.

Figure 42. PPE Analysis Gallagher B80,180,280

**Gallagher Tag Reader
HR3 Smart-Reader**



Impression

Interesting organic form. The careful use of curves has been used, but in harmony with the flowing form.

Appreciation

Comfort and user interaction were well considered to making this product stand out as an ergonomic product.

Emotion

Organic flowing form bestows a humanistic feel: Comfort
Smooth surfaces and ergonomic handle: Desirable

Recognition

New revised product form which pushes the Gallagher aesthetic boundaries, yet retains its colour and banding identity.

Comprehension

Coherent form applied to the handle and trigger demonstrate how the scanner is used. Black communicates function. Hold like a gun

Association

An innovative and technologically advanced product which looks like it could be used as a weapon.

Figure 43. PPE Analysis Gallagher HR3

**Gallagher Semi-Portable
Solar Range
B40**



Presentation

Impression

The contrast between the orange and black, in addition with the smooth surfaces create a very intense bright impression.

Appreciation

Simple lines, elegant curves and obvious forms communicate ease of use.

Emotion

Solid, elegant form provides a sense of assurance and subtle complexity.

Representation

Recognition

Essentially a glamorised box. The housing has identifiable Gallagher curved form, banding and colours.

Comprehension

Carry handle is easily recognized. Colour helps identify visual hierarchy and dial switch is easy to understand.

Association

The B40 has a robust, heavy feeling of a product which is protecting the interior, similar to a safe box.

Figure 44. PPE Analysis Gallagher B40

**Gallagher Semi-Portable
Solar Range
B100, B200, B300**



Impression

Chunky, soft forms morph together creating a curved organic amalgamation of parts.

Appreciation

No special traits stand out. The organic shape is overly detailed and the details seem to merge into one another.

Emotion

Soft bulky product and organic form bestows a humanistic feel

Recognition

Entirely organic unorthodox appearance does not fit with other Gallagher products. The colours and banding are evident.

Comprehension

The design has too many stickers, details and features which conflict with one another, making it more difficult to navigate than other Gallagher products

Association

Organic shape has similar aesthetic traits to a wheely bin.

Figure 45. PPE Analysis Gallagher B100,200,300

Gallagher Live Fence Indicator



Presentation

Impression

The contrast between the orange and black, in addition with the smooth surfaces create a very intense bright impression.

Appreciation

Cylindrical/spherical form is clean, crisp and visually appealing. Soft curavtures are elegant and pronounced.

Emotion

Precise uncomplicated functionality:
Confidence
Clean, crisp appearance: Delight
LED Lights: Suprise/
Excitement

Representation

Recognition

Corrugate texture reminds users of corrugated iron, a common roofing material. It communicates affordability, reliability, strength, durability.

Comprehension

Basic one function unit. LED's are the only indicator, making it easy to understand. Clip on rear side explains its function; Attach to fence

Association

The product appears to look and work like a clothes peg, making it intuitive to use. It stands for simplicity, reliability and affordability.

Figure 46. PPE Analysis Gallagher Live Fence Indicator

Geared Reel



Impression

Large reel product which must be wound up

Appreciation

Rubber over-moulded handle grip make the handle desirable to crank

Emotion

Simplicity and Ease of Use: Convenience
Pure performance product: Confidence and Satisfaction

Recognition

Resembles fishing equipment. The plastic handle is the only feature which can be recognized as a Gallagher branding.

Comprehension

Handle communicates how to hold the product and crank arm encourages winding of the reel. Easy to understand

Association

Simple and reliable to operate. Fishing reel association.

Figure 47. PPE Analysis Gallagher Geared Reel

6.2. Format Analysis Matrix

Warell, Fjellner and Stridsman-Dahlstrom (2006) format analysis matrix is a methodological tool used to determine visual cues from a family of products. Form, material, colour, style and detailing will be looked at to identify key Gallagher brand language.

Figure 48 recognizes important traits apparent in Gallagher products and identifies which of them are most prominent.

Comments

- Expensive, newer and higher quality products generally possess the most visual Gallagher cues
- Curved forms were most prominent in the family of products, followed by orange detailing, black surfaces and the banding detail.

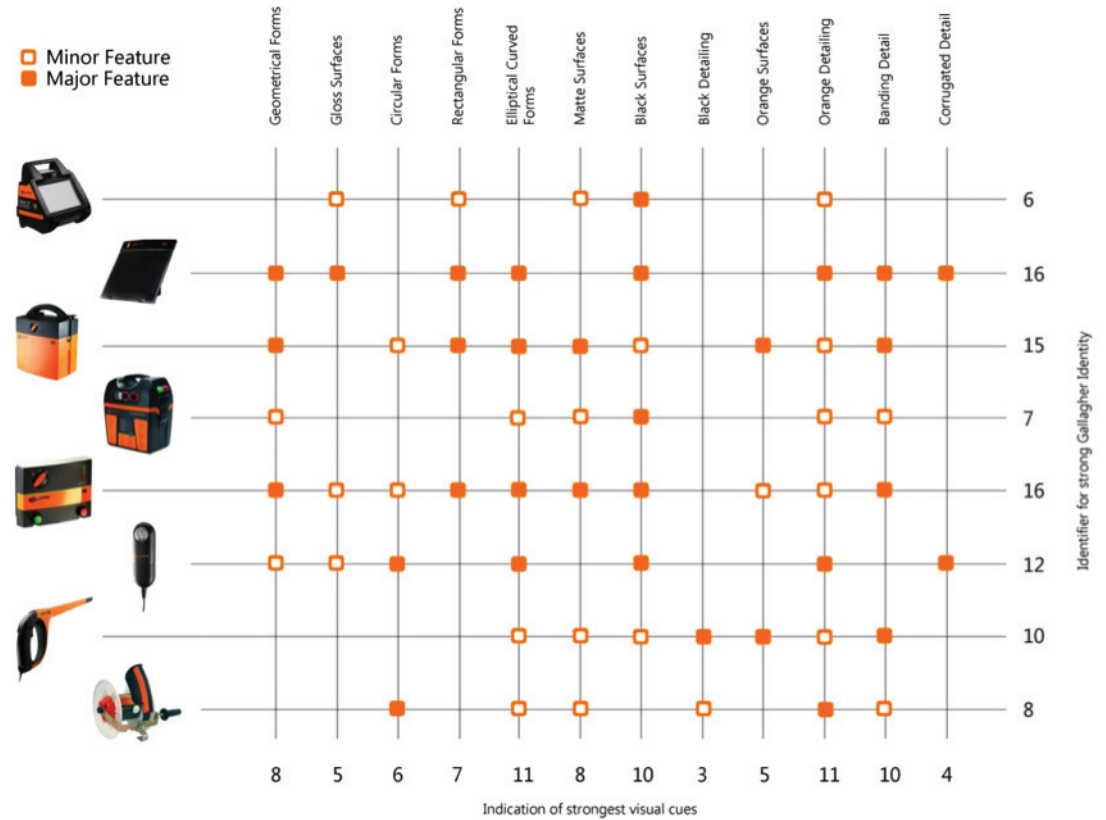


Figure 48. Gallagher Products: Format Analysis Matrix

Corrugated Texture

The corrugated texture is a multipurpose feature. It is used to hide surface moulding defects and associates itself as having the same qualities of corrugated roofing iron (strong, durable, tough, affordable). The texture also adds visual interest and a certain amount of ergonomic handling grip to an otherwise very smooth plain surface.

The corrugated texture is evident in many of the newer Gallagher products and has now become a key signifier of the Gallagher brand.



Figure 49. Corrugated Texture Identity

Circular Attribute

The timeless circular form is one of Gallagher's most appealing product features. When used as a detail in combination with carefully contrasting shapes and colours, the circular attribute becomes a focal point and cognitively indicates the purpose. Similar to how a car's wheel arch is shaped around the wheel, the circular attribute is seen on Gallagher products as one which communicates intent.

For example, radial switch, a pivot point or a joint which rotates.

The incorporation of classic geometrical forms will ensure Gallagher's brand maintains a certain level of product longevity as the standard circle form will remain classic indefinitely.



Figure 50. Circular Attribute Identity

Colour Distribution

Orange and black form the basic Gallagher symbol which is used as a brand signature and a stamp of quality. These colours are almost like a blank canvas for all products to follow. The orange colour is generally applied to the parts where the user interacts with the product and creates crisp contrast against the black surfaces. Orange has been predominantly used to highlight main focal features which

help guide the user when viewing the product. Orange is also a playful colour and brings a bright cheerful feeling to the product. Black has primarily been used to cover large surfaces. It is interesting to note that the more coverage of black the product has; the more expensive, advanced and up to date it is.



Figure 51. Colour Distribution Identity

Elliptical Curved forms

Many Gallagher products have elliptical curved forms as an integral part of the product shape. The gentle curve which can be seen on the front surface of the Gallagher B40, B180 and new i-series energizers is a distinctive quality of the product range which differentiates itself from other competitor product. The structure communicates faultless functionality, robustness and effortless professionalism.

Product unity is established through building similar product architecture, which is largely due to the relationship between smooth curves and sharp defined edges.



Figure 52. Elliptical Curved Forms Identity creates

Banding

Along with the colour use of black and orange, banding is the most obvious form related feature. The banding represents a stamp, brand or flag and focuses on focussing attention on the product. The flag-like banding creates differentiation between itself and other products on the market without even requiring the Gallagher logo. Banding does many things, including isolate parts and brings focus to them or helps group certain features. Symmetry is often involved, creating repetition, rhythm, balance and orderliness to maintain a clean, clear and professional brand identity

The banding has been integrated into the surface finish in various ways depending on the proportions, size, surface contours and materials. In many cases, the material used creates the subtle change in colour, creating the banding effect. This can be seen in the Gallagher S50 solar energizer. The use of subtle material differences can effectively describe the product, create visual hierarchy and balance among features whilst instilling a

professional undertone to the product.

The banding is an exceptional example of how a product can be branded without any logo, similar to a countries flag. It has now become an insignia of the Gallagher brand.



Figure 53. Banding Identity

PPE Discussion (Gallagher Brand Identity)

The Gallagher energizer selection has been updated over the past 10 years to develop a united family. The energizers which have been upgraded to encompass the new Gallagher styling provide a professional appearance which is unique and easy to recognise as a Gallagher product. This cohesive visual identity must be continued with this project's final design proposal.

The five key features mentioned above will act as guidelines to help design the product aesthetic and will ensure that the final outcome fits in with the Gallagher energizer family and is recognised as a Gallagher product.

The use of black promotes the message of professionalism in the Gallagher range (i.e. Smartpower MX7500, Powerplus S50, Live Fence Indicator), whilst product with more coverage of orange pronounce a message of playfulness (Powerplus B40) and feature more commonly in units with lower power output. The use of black and orange will be tested during the development phase to establish the appropriateness according to the final size, proportion and form. The

outcome should aim to look professional and use orange only to highlight sections of importance.



6.4. Gallagher Product Range Analysis

Project specific product information has been collated in **Figure 54** next page.

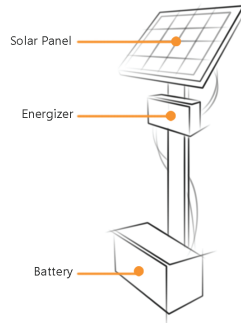
The three types of energizers have been explained and differences highlighted. Within the Gallagher range, they have 13 battery/solar energizers on the market.

Current Products

Permanent Solar Energizer

Description

- Battery or solar powered. (Some can be mains powered)
- Compatible with a solar panel
- More powerful than other solar setups



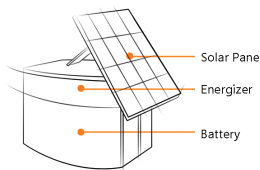
- + Powerful
- + Mountable to a solid structure
- + Versatile. Can separately choose the solar panel, battery, energizer.

- Installation costs
- Encumbersome (many components)
- Must buy parts individually
- Installation complications

Semi-Portable Box Energizer

Description

- Battery or solar powered
- Box can contain battery
- Compatible with a solar panel



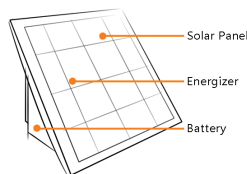
- + Battery easily accessible (generally)
- + Can provide own choice of battery
- + Solar panel is optional to mount
- + Can be relocated relatively easily

- Bulky and heavy
- Solar panel mount obstructs handle
- Unstable in windy conditions
- Designed to be placed on ground

Integrated Portable Solar Energizer

Description

- Built in components
- Solar + Battery powered
- Portable design

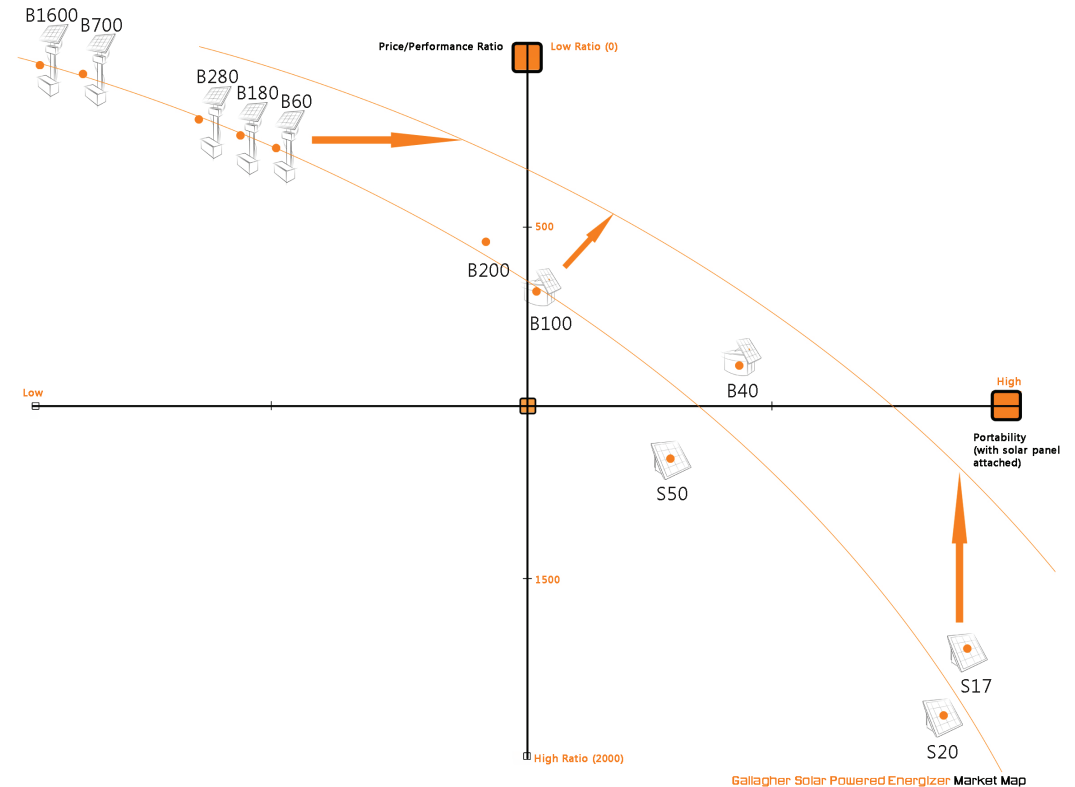


- + Convenient. No extra components required + already assembled
- + Requires the least knowledge
- + Easy to relocate, setup and mount

- Least powerful
- Expensive (overall cost)
- No flexibility for modification
- Of interest: Night Save

Market Map

The below graph shows where each of the energizers sits in relation to:
 1) The ratio (price(\$)/performance(J))
 2) The *portability of each product
 *Portability is measured by how easy it is to set up and move,



Gallagher Solar Powered Energizer Market Map

Conclusion

- Clear differences between the 3 groups
- The smooth curve highlights the relationship between each category.
- These products appear to cover the market adequately
- Price has a lot to do with portability (convenience, ease of use, setup, etc)

*The purpose of this graph is to show the relationship between the different products
 *The North American Market was used to gather these scores (Other markets will differ slightly due to price)
 *Outliers have been ignored

Figure 54. Gallagher energizer range analysis

Figure 55 and Figure 56 illustrate how the three types of energizer have been categorised, regarding their power, portability and ease of use.

Note: Later, In "Additional Research Findings", a new understanding of portability will be explained as it influences the design criteria significantly.

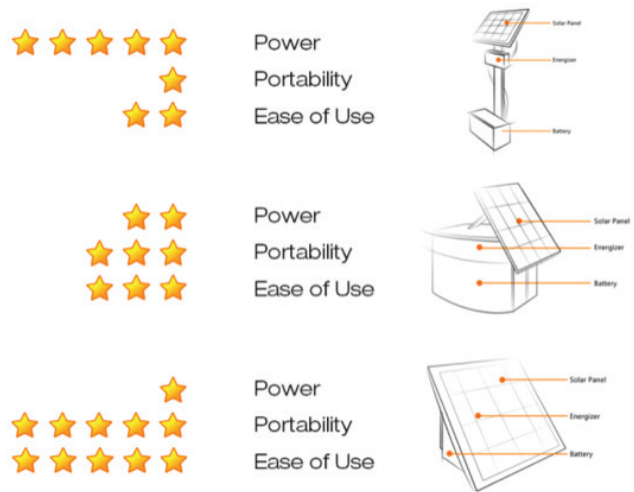


Figure 55. Energizer Categorization

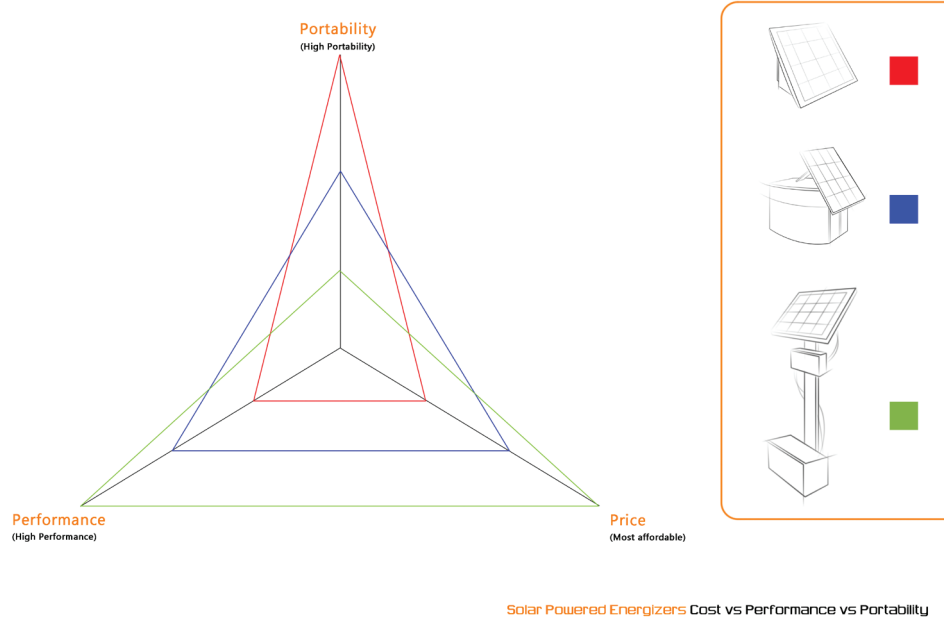


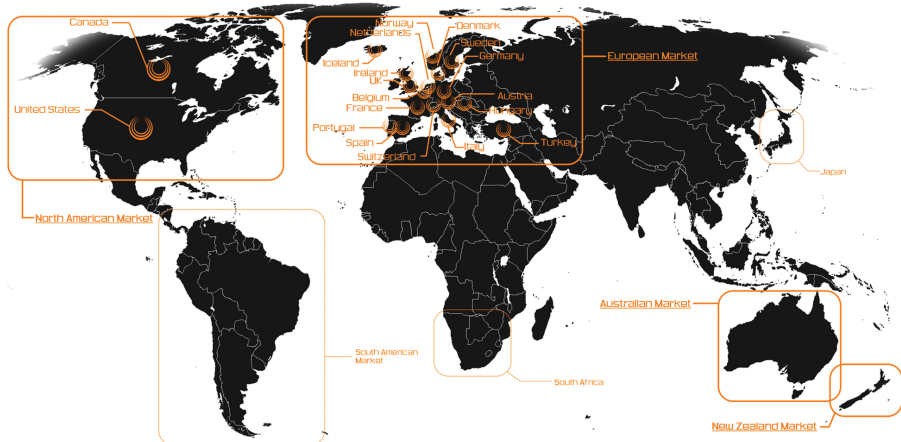
Figure 56. Energizer Differentiation

6.5. Gallagher in the great scheme of things

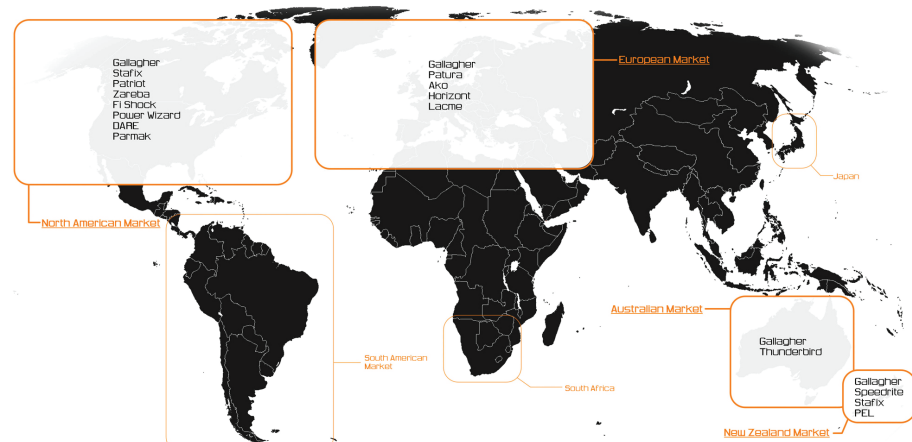
The following material provides an overview of the major international regional markets and how Gallagher products compare with competitor offerings. The main goal was to establish which energizer was perceived to be the best in each category and market.

(Opposite page: **Figure 57.** Gallagher competition overview)

Major Markets



Market Competition

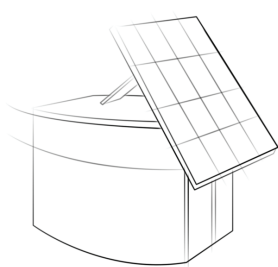


Competition (Brand+Model)



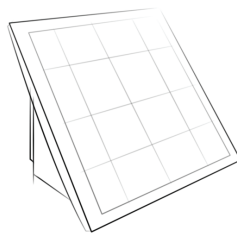
Permanent

- Gallagher**
 - B60, B80, B180, B280, B700, B1600
- Staffix**
 - X12i, X6i, X3, X2, X1 (Unigizers)
- Patura**
 - P1, P2, P3, P4, P5, P1500, P2500, P3500, P3800, P 4500 MaxiPuls, P 4600 MaxiPuls, P 6000 MaxiPuls
- Zareba**
 - EDC25M-Z, EDC15M-Z, EDC5M-Z, B15L1, B10L1, B5
- Fi-Shock**
 - EDC25M-FS, EDC15M-FS
- Power Wizard**
 - PW2000B, PW1000B, PW500B, PW250B
- DARE**
 - DE 6400, DE 4000, DE 2400, DE 1200, DE 600, DE 400, DE 300
- Ako**
 - Duo Power X 4000, 3000, 2000, 1000
 - Mobil Power ANI 5500, 3100
- Horizon**
 - horiSMART AN160, horiSMART A80
 - farmer AN25, farmer AN15,
 - Trapper AN24, AN12, AN8
 - Ranger A70, Ranger A50
 - hotSHOCK A50, A15, A8
- Lacme**
 - Dual 5000,
 - Secur 1800+, 2000+, 2500, 2600, 2700
 - Ulison 10000, 15000,
 - Clos 1800, 100
- Parmak**
 - EM 200, MAG.12 U.O.
- Thunderbird**
 - S550R, S1050R, S1750R



Semi-Portable

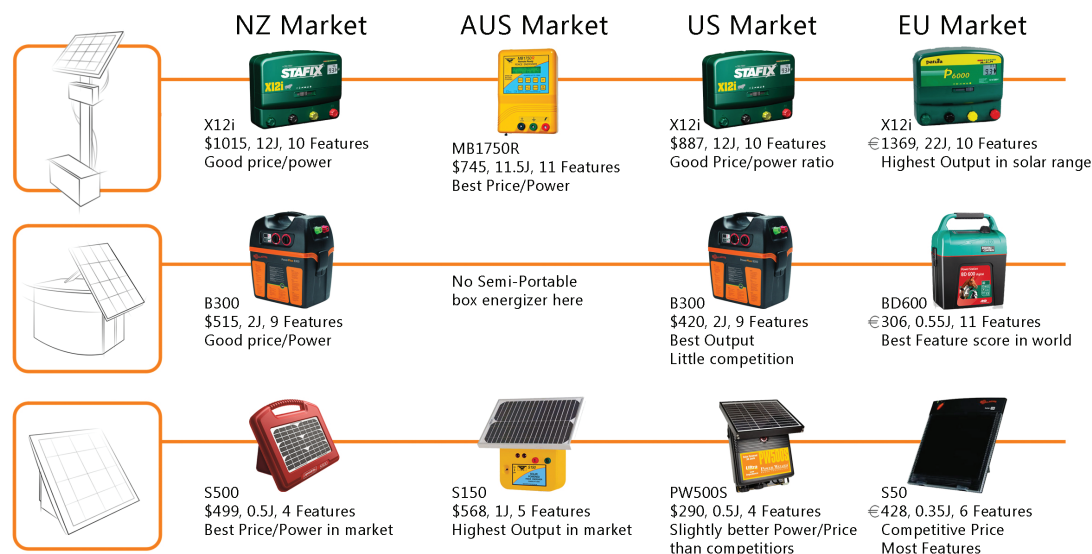
- Gallagher**
 - B40, B50, B100, B200, B300
- Staffix**
 - CB1.2 Battery Energizer, CB2.3 Battery Energizer
- Patura**
 - MaxiBox P350, MaxiBox P250
- Zareba**
 - ESP30M-RS, ESP30M-Z
- Fi-Shock**
- Power Wizard**
- DARE**
- Ako**
 - Power Station BD 300 digital, 400 digital, 600 digital
 - Mobil Power AD 3000 digital, 2000 digital, 3000, 2000
 - Mobil Power A 1200
 - Compact Power B 140, Compact Power B 240 multi
 - Eco Power B 250 plus, 500 plus
- Horizon**
 - Farmer A 1000, 1000S, Farmer B3, B2
 - Ranger A 3000, 3000S, 2000
 - Ranger B, Ranger B8, B6, B4, hotSHOCK B4
 - TurboStar AB, TurboStar B
 - Hollygard AB30
- Lacme**
 - Secur 500, 300, 200, 130, 100
 - Clos 40, 30, 20, 10
- Parmak**
 - DI-SP-11 (6V), MAG.12-SP (12V)
- Thunderbird**
 - S250, S350



Portable

- Gallagher**
 - S17, S20, S50
- Staffix**
 - SXS, SXI
- Patura**
 - P35, P70
- Zareba**
 - ESP10M-Z, ESP2M-RS, ESP10M-Z, ESP2M-RS
- Fi-Shock**
 - ESP2M-FS, S5-740, ESP10M-FS
- Power Wizard**
 - PW500s, PW200s, PW100s, PW50s
- DARE**
 - DS200, DS100, DS40, DS20
- Ako**
 - Sun Power 5200
- Horizon**
- Lacme**
- Parmak**
- Thunderbird**
 - S15B, S25B, S40B, S65B, S70, S150

Best Energizers in the Market



Conclusion (Main Findings)

- Gallagher have well placed products in the NZ, US and EU Markets
- Tru-Test dominate the permanent solar range.
- Europe is most competitive in terms of features in energizers.
- No Gallagher semi-portable solar energizers are sold in AUS.
- The US Market is saturated with low priced, low output, low feature units.
- Minimal competition in AUS, although Thunderbird has lower prices.

6.6. Technical Overview: Comparisons

These diagrams show how Gallagher compares against their competition in each market. As a fair basis for comparison, the number of features on each product and a price/performance ratio was used.

To determine the feature score of an energizer, each feature was given a number (based on survey results) which reflected how desirable and effective the feature was. The higher the number, the better it is perceived to be.

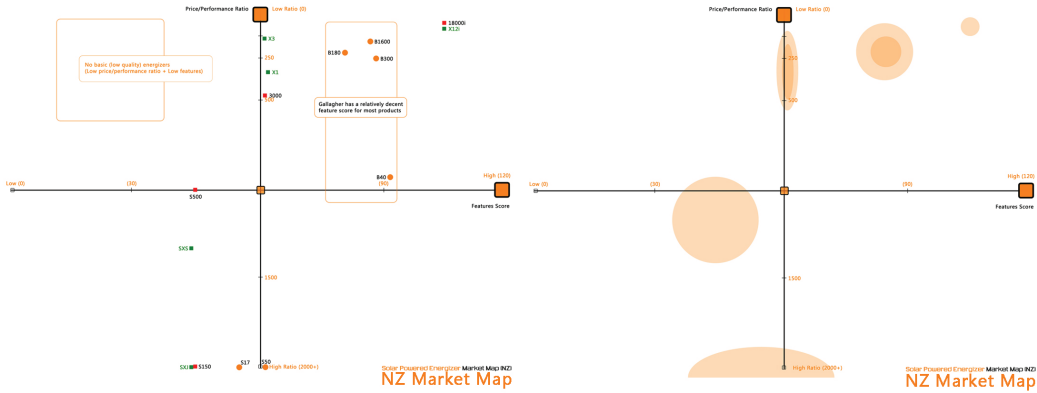
To calculate a price/performance ratio, the price of the unit was divided by its power. A lower ratio indicates a better energizer. This measure was used because Gallagher experience suggests that farmers are driven to purchase energizers based on this ratio relationship and are looking for more “bang for their buck”.

(Opposite page: **Figure 58.** Gallagher technical overview)

Market Overview

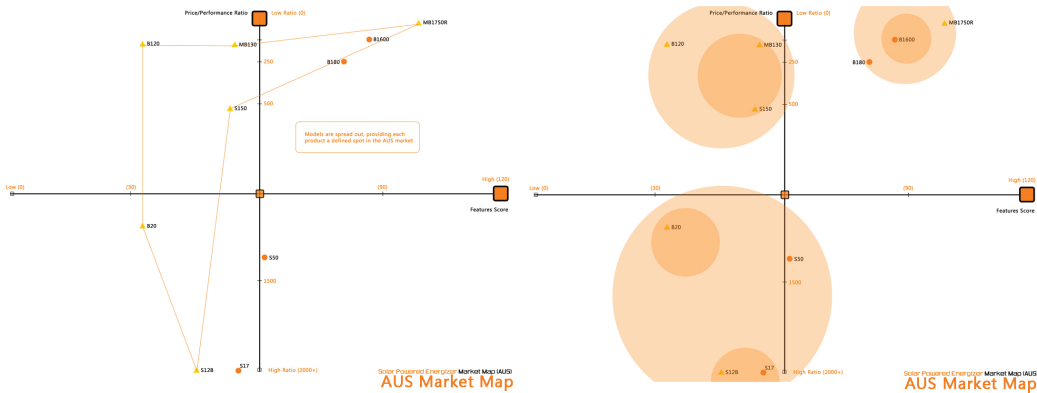
Where does Gallagher stand within each of the four markets?

NZ



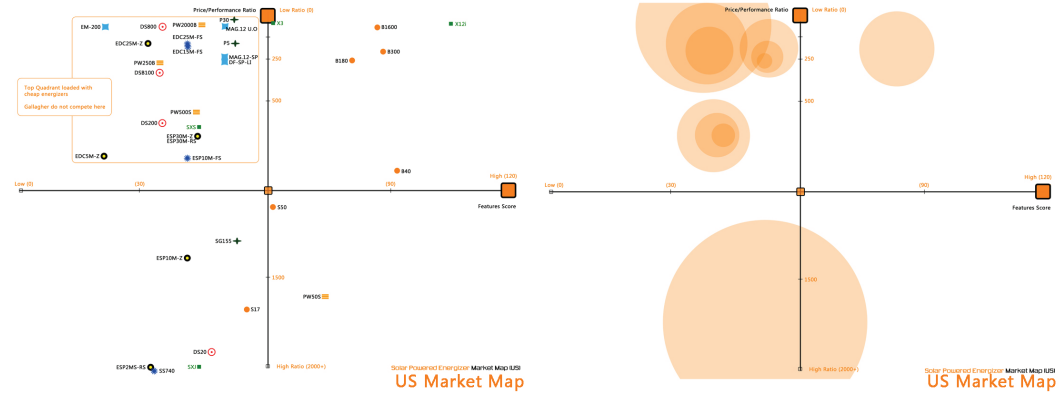
- Wide spread of models that appear to claim their own place in the market.
- Good balance, but many gaps where other models would fit.
- Permanent, semi permanent and portable models are clearly defined as different.

AUS



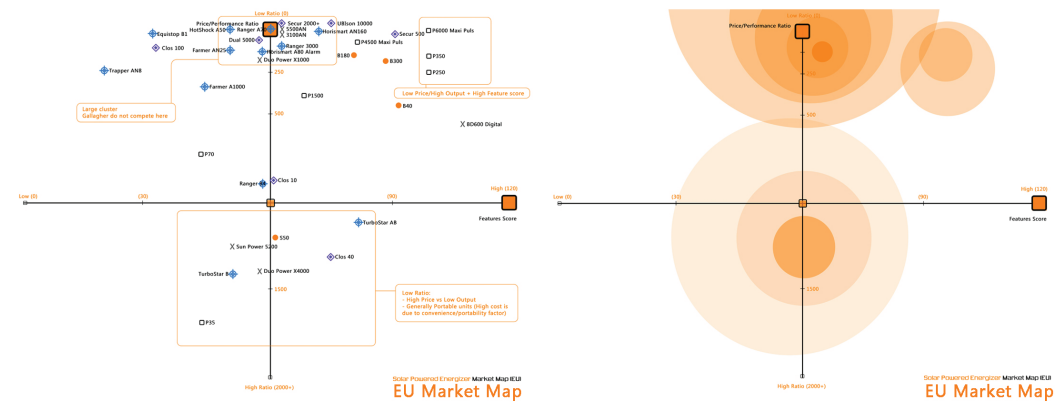
- AUS has minimal competition.
- A permanent solar energizer that had a high feature rating (90) and a mediocre rating (1000) could benefit Gallagher.
- Gallagher do not sell and semi-portable unit to AUS

US



- The U.S market is filled with low quality, low priced units.
- Gallagher do not stand out due to the sheer numbers that are in the market.
- Require more competitively priced solar energizers to compete

EU



- The European market saturated, similar to the U.S market.
- Competition have many features, and a good power/price ratio.
- Hard to compete
- Hard to say Gallagher are the premium brand

6.7. Technology/ Features Analysis

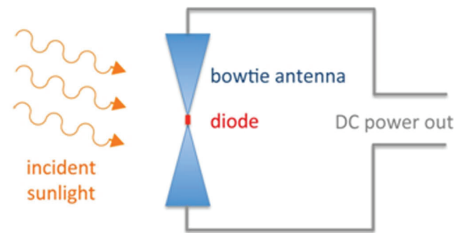
There are limitations on technological advances which can be reasonably applied to electric fence energizers or other components connected to the energizer. Although it was not a driving force for this project, the options were still explored and conclusions were made before ruling out these technologies. The design, materials and technologies used must be considered feasible and cost effective.

(Opposite page: **Figure 59.** Future technology forecasting)

Solar Technology

Nano-Scale solar rectenna

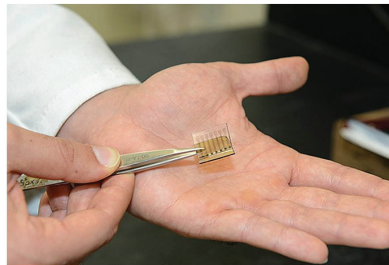
- By using nano-scaled rectenna, sunlight can be absorbed and directly turned into a DC current at an efficiency of 70%
- . In contrast to existing solar silicon solar panels which mainly work within a specified band gap, rectennas can be tuned to harvest sunlight in the whole solar spectrum which makes it very efficient.
- It's cheap, simple and scalable for mass production. (PESWiki; March 8, 2013)



Rectenna solar cell. The antenna converts incoming solar radiation to a petahertz alternating current through the diode, which rectifies it. The resulting direct-current (DC) power is available at the output leads.

All-Carbon Solar Cell

- The all-carbon solar cell consists of a photoactive layer, made of carbon nanotubes and buckyballs, sandwiched between two electrodes made of single-walled carbon nanotubes and graphene.
- These cells can be coated onto surfaces from a solution, cutting manufacturing costs and offering the potential for coating flexible solar cells onto buildings and car windows.

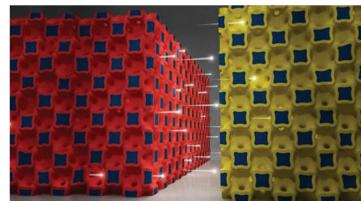


Battery Technology

New Lithium-Ion Batteries

The new battery is able to be charged 1,000 times faster than rival batteries, and it's about 2,000 times more powerful than its competitors.

- High-powered settings such as lasers and medical devices
- Other areas that normally use supercapacitors, such as Formula 1 cars and fast-recharge power tools.



Component Technology

Electric double-layer capacitor

- Super capacitors can be charged and discharged thousands of times with out any affect on the capacitor itself.

Advantages

- + High cycle life
- + Low resistance provides high load currents
- + Only draws the energy required
- Almost instant charge

Disadvantages

- Holds a fraction of energy as a battery
- Higher self discharge than most batteries
- Low cell voltage

Air Core Transformer

- Air Core Transformers could reduce cost and weight of the product, but also have high "leak" inductance.

Adaptive Energizers

Adaptive Energizers

Adaptive energizers change according to the load on the fence
Changes: 1. Pulse Interval 2. Pulse Power
This makes the running of the energizer more efficient, prolonging battery life.

Energy Recuperation

When a pulse is sent out and manages to get back to the grounding rod, that energy is then converted and put back into the battery, enabling it to last longer while keeping a normal pulse rate.

Sense Pulse

Instead of sending out an electric pulse, it sends out a "sense" pulse which returns and tells the energizer that there is a load touching the fence. Only when it identifies contact, will it use its full power.

Conclusion (Main Findings)

The improvement of batteries, solar panels and energizer components will have the most impact on the efficiency of an energizer. These improvements need to be affordable in order to apply to the next generation of energizer units.

Currently any huge advances remain to be seen commercially, as they do not make it to market.

Technology is not the main driving force behind the market at this point in time and will most likely not provide a market opportunity for this project.

6.8. Permanent Solar Unit Usage

Permanent Unit Users












Permanent solar energizers are used by a wide range of users for various reasons. The buyer, installer and user are typically different people. The buyer is often a professional farmer who owns the land and stock and may be a user. The installer is often a Gallagher Territory Manager or contract worker, and the main end user group is often farm workers although owner operations are also commonly end users. For more information, refer to “Personas”, page 38-39.

(Opposite page: **Figure 60.** Permanent solar energizer analysis)

Permanent Solar Energizer - Main Applications



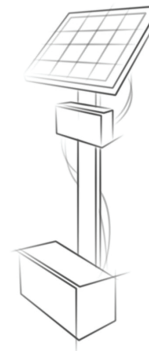
How Permanent Solar Energizers are Used

 <ul style="list-style-type: none"> - Fixed location - Long periods of time (Facing Sun) - Often used with portable fences - Often set up by TM 	<ul style="list-style-type: none"> - Set up for crop growth and harvesting period - Moved seasonally 	
 <ul style="list-style-type: none"> - Attached to a fixed point for long periods of time - Often used with portable fences - Often set up by TM 	<ul style="list-style-type: none"> - Extended periods of time with no supervision - Attached to fence or fixed point power large areas - Power multiple areas areas 	
 <ul style="list-style-type: none"> - Fixed location - Facing Sun - Keeps animals in and predators out - Set up and left for long times - Used mostly in AUS and US - Often set up by TM 	<ul style="list-style-type: none"> - Protects bee hives from bears - Set up in remote areas to surround bee hives - Set and forget - Often set up by TM 	
 <ul style="list-style-type: none"> - Solar panel maintains battery charge - Remote Locations to keep wild life out of an area - Often set up by TM 	<ul style="list-style-type: none"> - Set up for a long time - Switched on/off often - Attached to anchored object (Fence) 	
 <ul style="list-style-type: none"> - Installed and left to maintain a secure fence - Often set up by TM 	<ul style="list-style-type: none"> - Set and left for long times - Often set up by TM 	
 <ul style="list-style-type: none"> - For larger fencing needs - Not moved regularly like portable 		

Issues Identified

- 1 Location/Environment Issues**
- Energizer setup is often a long way away (Remote location)
 - Must be geographically well located (for sun)
 - Short sun period in Holland during oct/nov/dec/jan
 - Solar panel often stolen
 - Trees covering solar panel

- 2 Energizer Issues**
- Too many features confuse users
 - Too complicated to install for lifestyle farmers
 - Hard to check the battery status when the energizer does not work
 - Sometimes 2-3 Units are needed to power a large farm
 - Night Save - Energizer is unable to keep wildlife out of fenced area
 - No true mounting solution for permanent units



- 3 Solar Panel and Battery Issues**
- Clouding plastic panels after long term sun exposure
 - Often the solar panel can't keep the battery charged
 - Battery deterioration (No sun = No charge)

- 4 Animal Issues**
- Frightened horses are unpredictable
 - Horses tangle in fence if frightened
 - Possums damaging native trees/vegetation in NZ

Conclusion

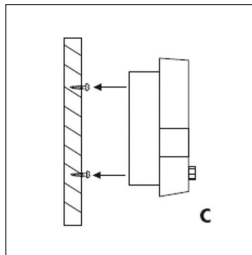
- AUS and US are in most need of solar units that can power large areas
- Permanent solar energizers are often too difficult to install for users.
- Controls the largest, most resistant animals (Bears, etc.)
- Long Lengths of time
- Set and forget
- Cover large areas
- Used when there is no mains power

Opportunities to Improve Permanent Solar Energizers

- Allow user to easily relocate
- Eliminate distance from energizer setup to user in remote location
- Simplify Setup
- Make features simple to understand and useful for specific usage
- Improve energizer affordance
- Reduce cost and increase performance of solar panels

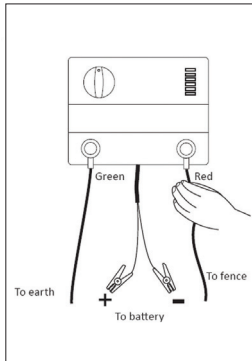
Installation and Setup

Connecting the energizer



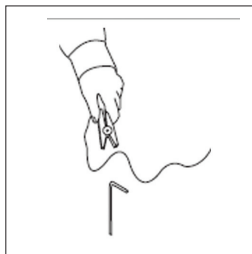
1. Mounting

Place the Energizer over and slide down on to the mounting screws



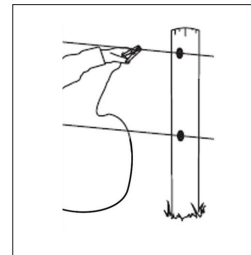
2. Connections

Attach both green and red cables to the energizer terminals



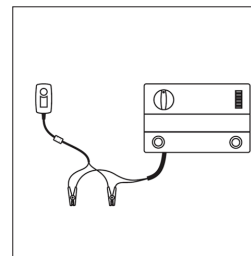
3. Connect to Earth

Take green lead and attach to grounding rod



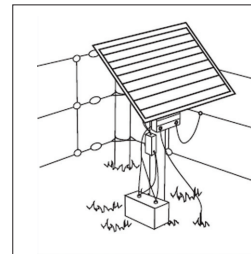
4. Connect to Fence

Take red lead and attach to the fence



5. Connect to Battery

Connect the battery leads from the Energizer to the battery; red lead to the (+) terminal of battery, black lead to the (-) terminal of battery



6. Connect to Solar Panel

Attach solar panel cable to the battery

Figure 61. Permanent unit installation and setup

6.9. Semi-Portable Solar Unit Usage

Semi-Portable unit Users

Semi-permanent solar energizers are used by a wide range of users for various reasons. The main user and buyer are different. The buyer is often a professional farmer, owner of the land and stock, but the main user group is male and female farm workers. For more information, refer to "Personas", page 38-39.

Semi-Portable Solar Energizer - Main Applications



How Semi-Portable Solar Energizers are Used



- Temporary use
- Transported in/on vehicle to site
- Sometimes used with mains
- Often moved by a farm worker



- Often used with portable fences
- Set up/left on the ground
- Carried or transported to location
- Moved occasionally (Seasonally)
- Battery replaced seasonally



- Set up and left
- Not seen for long lengths of time
- Transported in/on vehicle to site where it is set up
- Often used in rugged terrain



- Set up on full power and run for as long as possible
- Set up close to farm/ house
- Often used in rugged terrain



- Set up close to living quarters
- Easy to check up on fence status
- Generally used on portable fencing



- Set up and moved around often for horse paddocks
- Assembled and disassembled often
- Battery replaced when it dies
- Mostly powers portable fences

- Set on full power
- Set up for short amounts of time around hay bailage
- Inexperienced users
- Protects what it surrounds

- Transported in/on vehicle to site where set up
- Protects what it surrounds
- Seasonal usage (Summer)
- Often used in rugged terrain

- Often used in rugged terrain
- Can be carried to site where it will be connected
- Set up on the ground
- Set to full power

- Set up on the ground next to fence
- Battery is charged after swapped with back-up battery

- Temporary set up (weeks)
- Moved regularly



Issues Identified

1 Location/Environment Issues

- Remote Location - Solar panel often stolen
- In a remote location, If something happens to fence, user doesn't know
- Remote location with overgrown vegetation affect performance
- Sometimes 2-3 Units are needed to power a large farm
- In rugged terrain, often it can fall over in wind

2 Energizer Issues

- Heavy to carry distances over 10 steps (with solar panel)
- Solar panel sticks out over box unit (Encumbersome)
- Too many functions are too confusing for user
- Strong winds can tear the solar panel brackets
- Top heavy (Wind can pull the unit over)
- Flooding (Unit sitting on ground)
- Night Save - Energizer is unable to keep wildlife out of fenced area
- Hard to check the battery status when the energizer does not work
- Size of energizer is misleading (Does not relate to power output)

3 Solar Panel and Battery Issues

- Battery deterioration (No sun = No charge)
- Often the solar panel can't keep the battery charged
- Trees covering solar panel

4 Animal Issues

- Frightened horses are unpredictable
- Horses tangle in fence if frightened
- Possums in NZ

5 User/Human Issues

- Moved by farm worker (lack of experience)
- Often the solar panel can't keep the battery charged
- Customers try to use a smaller unit to do more than its capability
- Theft



Conclusion

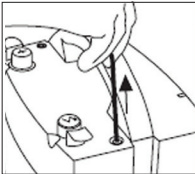
- Can be used temporarily or permanently
- Many Product Issues that affect how easy it is to use
- With solar panel attached, these energizers become almost impossible to carry long distances (over 10 steps)
- Wind + large solar panel + slight gradient = Damage to solar panel brackets and/or energizer falling over (becoming useless)

Opportunities to Improve Semi-Portable Solar Energizers

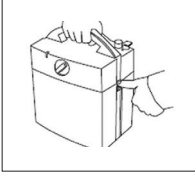
- Prevent tipping
- Strengthen the brackets on solar panel
- Change position of the solar panel
- Simplify Setup for user
- Make features simple to understand and useful for specific usage
- Improve energizer affordance
- Reduce cost and increase performance of solar panels

Installation and Setup

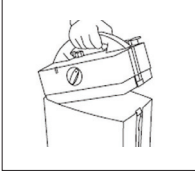
Connecting the Battery



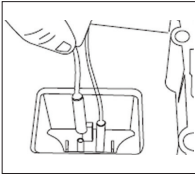
Remove the earth stake to unclip the cover



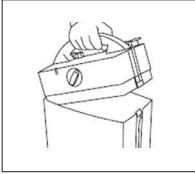
Unclip the energizer cover



Remove the energizer cover

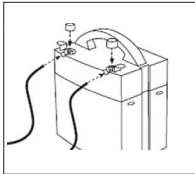


Connect the battery leads to the energizer

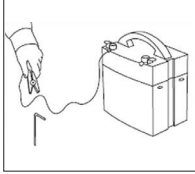


Replace the energizer cover and clip closed

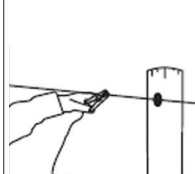
Connecting the Energizer to the fence and earth



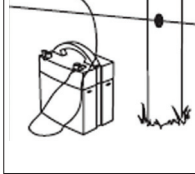
Connect the fence leads (green and red) to the energizer terminals.



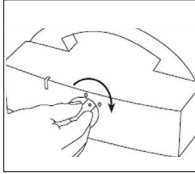
Connect the green lead to the earth stake



Connect the red lead to the fence



Switch energizer on to desired operating mode



Replace the energizer cover and clip closed

Figure 63. Semi-portable unit installation and setup

6.10. Portable Solar Unit Usage

Portable unit users

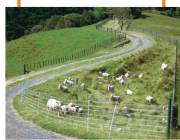
Most commonly, portable solar energizers are used for containing small areas, reflecting the type of user; a hobby farmer. For more information, refer to “Personas”, page 38-39.

(Opposite page: **Figure 64.** Portable solar energizer analysis)

Portable Solar Energizer - Main Applications



How Portable Solar Energizers are Used



- Set up with portable fencing
- Temporarily installed small fence areas
- Transported frequently
- Generally carried short distances
- Turned on to full power
- Often moved by a farm worker, not owner



- Set up to permanent or portable fence
- Power small fence areas
- Bought because it looks good (Money not an issue)
- Turned on to full power



- Installed close to fence
- Left facing the sun
- Used by inexperienced users



- Set up to power fence day and night
- Often attached to existing fence
- Powerful energizer not required
- Pets relocated regularly?



- Moved often
- Carried by user to new location
- Hooked to fence and switched on
- Often used with portable fencing
- Used for short periods of time

- User quickly connects and disconnects
- Relocated change of crops (seasonally)

- Connected to small fence
- One energizer used per fence
- Transport to remote locations
- Left for short times facing the sun

- Connected to mesh fence
- Powers small confined areas
- Checked on often (make sure fence condition is ok)

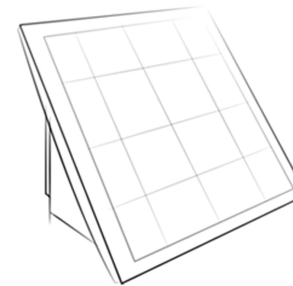


Issues Identified

- 1 Location/Environment Issues**
 - Fence type can greatly affect fence effectiveness
 - Remote Location - Unit often stolen

- 2 Energizer Issues**
 - Small solar cant power large fences
 - High cost to build an "all in one" energizer
 - Reliability of product
 - Night Save - Energizer is unable to keep wildlife out of fenced area
 - S50 Carry handle does not allow user to grip the handle firmly
 - Hard to check the battery status when the energizer does not work
 - "S20 and S50 switch is nothing but problems"

- 3 Solar Panel and Battery Issues**
 - Battery deterioration (No sun = No charge)
 - Battery not powerful enough to maintain fence when lack of sun
 - Clouding plastic panels after long term sun exposure
 - Often the solar panel can't keep the battery charged
 - Smaller battery than other energizer types



- 4 Animal Issues**
 - Animals contained require different shocking power
 - Possums in NZ

- 5 User/Human Issues**
 - Hobby Farmers don't know brands (Buy on price)
 - Some customers hesitant to buy solar

Conclusion

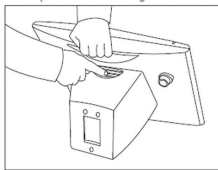
- Can be used temporarily or permanently
- Many Issues with the amount of fence it can power
- Issues with run time in winter
- Simplest and most understandable energizer
- Most commonly used solar energizer for strip grazing, pet control and portable horse control
- Expensive compared to semi portable and permanent

Opportunities to Improve Portable Solar Energizers

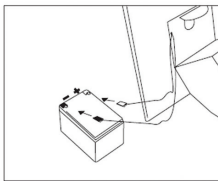
- Increase power
- Increase panel size
- Improve portability aspect
- Enable it to be mounted in multiple ways
- Redesign the features which it has to improve power saving ability
- Improve energizer affordance
- Make it easy to see energizer status, modes and functions

Installation and Setup

Connecting the Battery

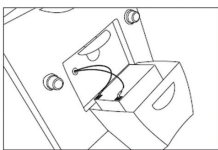


Open the energizer



Install battery

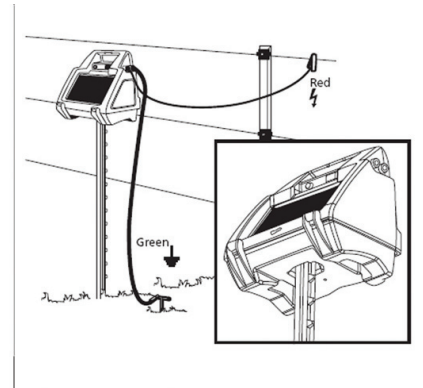
Attach battery terminals



Connect leads to energizer

On the back of the energizer, unscrew the Green terminal knob. Thread the end of Green lead through the hole in terminal and tighten the terminal knob. Repeat for the Red terminal and lead.

Connecting the energizer to the fence



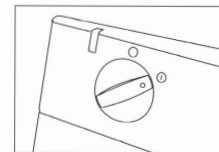
Mounting the energizer

Mount the energizer on one of the following options:

- T-post
- wooden post
- ground
- vertical surface

Connect leads to fence

Connect green ground (earth) lead to ground stake. (Install stake at least 2' (60cm) into ground. Connect red fence lead to fence wire or reel. Avoid placing in a shady area.



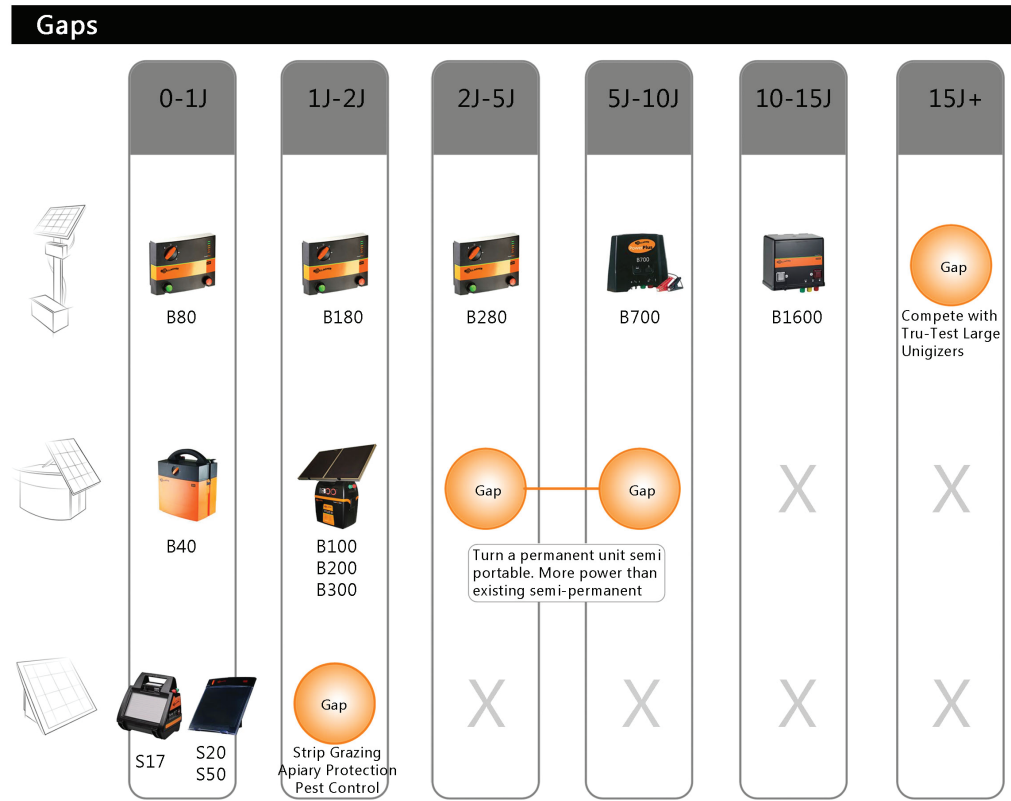
Switch ON

Figure 65. Portable unit installation and setup

6.11. Market Gaps Identified

This document analysed the market and highlighted possible gaps for new product design offerings. Many gaps in the market were found, but only few were of strategic importance to Gallagher marketing management.

Uses			
Application	How is it used?	Requirements	Most Used
 Wildlife Control	<ul style="list-style-type: none"> - Set and left for long times - Often professionally installed - Fixed location - Facing Sun - Large Panel - Big Battery 	<ul style="list-style-type: none"> - Most power possible - "Easy" Installation - Battery Care - Large Battery 	
 Isolated Farm Blocks	<ul style="list-style-type: none"> - Fixed location - Facing Sun - Large Panel - Set up and left for long times - Used mostly in AUS and US - Fixed to Infrastructure (small structure) 	<ul style="list-style-type: none"> - 15+J power - "Easy" Installation - Structure to mount on - Large Battery 	
 Large Crop Protection	<ul style="list-style-type: none"> - Moved seasonally - Set up and left for long times - Large battery and large panel - Facing Sun 	<ul style="list-style-type: none"> - 2-10J power - "Easy" Installation - Easy to configure - Large Battery 	 
 Small Farms < 100 Acres	<ul style="list-style-type: none"> - Fixed location - Long periods of time (Facing Sun) - Often used with portable fences - Often set up by TM 	<ul style="list-style-type: none"> - 2-10J power - "Easy" Installation - Easy to configure - Seasonal Battery 	 
 Horse Control (Paddocks)	<ul style="list-style-type: none"> - For larger fencing needs - Not moved regularly like portable - Permanent installation - Moved rarely (Few times/year) 	<ul style="list-style-type: none"> - 2-10J power - "Easy" Installation - Semi-Portable 	 
 Lifestyle Blocks	<ul style="list-style-type: none"> - Attached to a fixed point for random time - Often used with portable fences - Not for large paddocks - Inexperienced users 	<ul style="list-style-type: none"> - 0-5J power - No installation - Portable if needed - Not confusing 	  
 Tree/Ditch Protection	<ul style="list-style-type: none"> - Extended periods of time with no supervision - Attached to structure - Power multiple areas - Often in remote locations (eg, back of farm) 	<ul style="list-style-type: none"> - 2-5J power - Simple to install - Semi-Portable - Reliable Battery 	 
 Pest Control	<ul style="list-style-type: none"> - Medium sized solar panel - Not installed permanently (able to be moved) - Seasonal Usage (put away in winter) 	<ul style="list-style-type: none"> - 0-5J power - Semi-Portable - Easily accessible 	 
 Pet Control	<ul style="list-style-type: none"> - Set up to power fence day and night - Often attached to existing fence/structure - Powerful energizer not required - Pets can be relocated regularly 	<ul style="list-style-type: none"> - 0-1J power - Semi-Portable - Easy to understand - Small/Unobtrusive 	
 Portable horse Corral	<ul style="list-style-type: none"> - Moved often (Carried) - Used for short periods of time - Hooked to fence and switched on - Often used with portable fencing 	<ul style="list-style-type: none"> - 0-1J power - Portable/Carryable - Battery Care - Quick+Easy to set up 	
 Apiary Protection	<ul style="list-style-type: none"> - Set up in remote areas to surround bee hives - Temporary usage - Protects bee hives from bears - Carried and set up by user 	<ul style="list-style-type: none"> - Maximum Power - Reliable Battery - Battery Care - Semi-Portable 	 
 Garden Protection	<ul style="list-style-type: none"> - Set up for crop growth and harvesting period - User quickly connects and disconnects - Protect vegetation from wild animals - Moved seasonally 	<ul style="list-style-type: none"> - 0-0.5J - Simple to set up - Easy to configure 	
 Strip Grazing	<ul style="list-style-type: none"> - Temporary set up with small portable fencing - Transported short distances frequently - Turned on (Run on full power) - Often moved by a farm worker, not owner 	<ul style="list-style-type: none"> - 0.1-2J - Portable - Simple/Understandable - Easy to set up 	



Conclusion

- Large sized applications will always require the most power (large paddocks)
- Existing Gallagher products have filled the main market gaps
- B700 and B1600 are outdated. They are outclassed by Tru-Test Unigizers
- Solar panels make "semi-portable" box energizers much less portable when attached
- Portable energizers lack power and the cost price to buy makes them unattractive to customers

Opportunities

- 1 - Permanent Solar: **Make a permanent solar unit portable.** Permanent units are Powerful enough but not portable enough for medium sized applications.
- 2 - Portable Solar: **More Powerful unit for Strip Grazing (1J-2J for netting wire)**
- 3 - Permanent Solar: **Compete with Tru-Test Unigizers**
- 4 - Semi-Portable: **Unit for AUS Market (Semi-Portable not sold in AUS)**

Figure 66. Market Gaps and Opportunities

6.12. Additional Research Findings *First Major Finding*

During late May, Byron Arnold, Gallagher Business Manager of Energizers went to North America. On behalf of the author, he took photos, observed and asked farmers questions about Solar Powered Energizers. His findings were transcribed into a digital document recording his time there. His major findings were passed on to provide more depth to the research understanding. His report can be found in the appendix.

A new understanding of “Portability” was generated: It is not how far or easy it can be physically carried.

Portability refers to:

- How easy it is to set up
- How easy it is to pick up and place on a vehicle
- How quickly it can be assembled/ disassembled/picked up

While it is concerning that the battery is very large and extremely heavy, it is evident that farmers do not physically carry their existing energizers further than 50 metres.

Second Major Finding

It is recognised that many of the Gallagher retail outlets could not hold all stock. The most common example is the semi-portable B100, B200, and B300 battery boxes.

The three energizers looked the same, maintained the same dimensions, and were used in the same way but had slightly different technical specifications. Often there was not enough space on the shelf for all three to be displayed as stock and as a result, the shop would only choose to sell one. Each unit has a place in the market; therefore none could be removed from the Gallagher range. The arrangement mentioned above was expensive for both the store and Gallagher.

Gallagher realised that the number of Stock Keeping Units (SKU's) could be reduced if all three could be deleted and replaced by a single modular version.

The idea of marrying both a modular system with all types of energizers, batteries and solar panels was attractive to Gallagher, and this was immediately incorporated into the design brief.

Marketing Requirement for Design Brief:
Design a modular unit



Figure 67. Gallagher B100, B200, B300

7. Market Research Conclusion

The extensive market research and analysis developed a sound understanding of competitor product offering, customer preferences, market conditions and end user motivations. Main areas of research include:

- Gallagher brand and product aesthetics
- Gallagher's heritage, current state and future ambitions
- How an electric fence, energizer and solar energizer work
- Learning about people's perceptions of electric fences
- Industrial design contribution to customer, end user and business chain value
- An understanding of Gallagher products, competitor products and market standards
- Investigation into the competition: Comparison and analysis
- How, where, when and why energizers are used
- Issues within the current Gallagher product range
- Emerging and currently preferred technologies
-

A fairly strong understanding of the business/ marketing side was established,

which highlighted the reality of the industry and its standards. Although marketing has different priorities to design, understanding marketing processes and procedures helped to foster an empathic understanding of what they aim to achieve when a product is going to market.

Four major gaps in the market were identified through the conducted research investigations, providing choices for the design brief which were discussed with Gallagher management and supervisors. Subsequently, it was decided that a modular semi-portable solar powered electric fence energizer between 2-5J would be the best, as it provided enough scope to allow for creative solutions. The amalgamation of two ideas (2-5J semi-portable solar powered electric fence energizer and modularity) formed the design brief mentioned below.

7.1. Design Brief

Design a modular semi-portable energizer setup/system which allows for all battery, solar panel and energizer sizes to be interchanged.

7.2. Design Specifications

Both Gallagher and Industrial Design requirements have been identified and split into their respective classes. The majority of Gallagher requirements are a reflection of strategic needs in the field of animal management, while the Industrial Design requirements aim to satisfy all parties (client, target market, and other various parties) with a user centred approach to all needs. As a result of extensive research, the following specifications have emerged from 1; Gallagher and 2; industrial design perspectives.

Functionality Criteria

Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Suitable for the following uses: pest control, crop protection, horse control, orchard protection	<input type="checkbox"/>			
Work for isolated farm blocks and small farm blocks where there is no mains power supplied		<input type="checkbox"/>		
"All in one" unit			<input type="checkbox"/>	
Usable with 1-5j energizers from Gallagher range	<input type="checkbox"/>			
Must enable the user to carry the unit up to 50m				
Comfortable to lift onto a vehicle at roughly waist height		<input type="checkbox"/>		
Stable on uneven terrain				<input type="checkbox"/>
No complicated installation procedures			<input type="checkbox"/>	

Table 1. Functionality criteria

Business Criteria

Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Reduce the number of SKU numbers/products on the shelves	<input type="checkbox"/>			
Reduce the cost of manufacturing so many different solar energizers		<input type="checkbox"/>		
Provide a platform for future associated products			<input type="checkbox"/>	
Competitive Pricing		<input type="checkbox"/>		
Designed for NZ, AUS, US, EU Markets		<input type="checkbox"/>		

Table 2. Business criteria

User Criteria

Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Provide a flexible, modifiable, upgradeable semi-portable solar powered electric fence energizer		<input type="checkbox"/>		
Must be easy to set up, assemble, pack up (portability)		<input type="checkbox"/>		
Must endure hot, cold, wet, dry, dusty conditions	<input type="checkbox"/>			
Robust in construction		<input type="checkbox"/>		

Table 3. User criteria

Manufacturability/Tooling/Assembly Criteria

Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Feasible to tool for injection moulding	□			
Can be realistically manufactured at a reasonable price, with minimal complexity involved		□		

Table 4. Manufacturing criteria

Brand Identity/Aesthetic Criteria

Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Carry on with the form language strongly associated with the Gallagher range of products	□			
Must aesthetically differentiate itself from competitor products in the market		□		
Aim for timeless, long lasting aesthetic styling			□	
Look strong, durable and suitable for the job	□			
Appropriate visual aesthetic in the context of use		□		

Table 5. Aesthetic criteria

Desirability Criteria

Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Integrate desirability features within the product that will appeal to the customer, above and beyond pure utilitarian function	<input type="checkbox"/>			

Table 6. Desirability criteria

Usability Criteria

Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Must express what it is and how it is used through its form	<input type="checkbox"/>			
Be understandable to a user with limited knowledge in electric fence systems		<input type="checkbox"/>		
Ensures correct, safe assembly, installation and use		<input type="checkbox"/>		
Safe to use	<input type="checkbox"/>			

Table 7. Usability criteria

8. Industrial Design Research Investigation

Design a modular semi-portable energizer setup/system which allows for all battery, solar panel and energizer sizes to be used.

8.1. Project Ideation and Development Design Process

Figure 68 shows the key development points which have contributed towards the final outcome. This linear process clearly indicates where design decisions were made and the methods used to explore the design problems

Design Brief Established

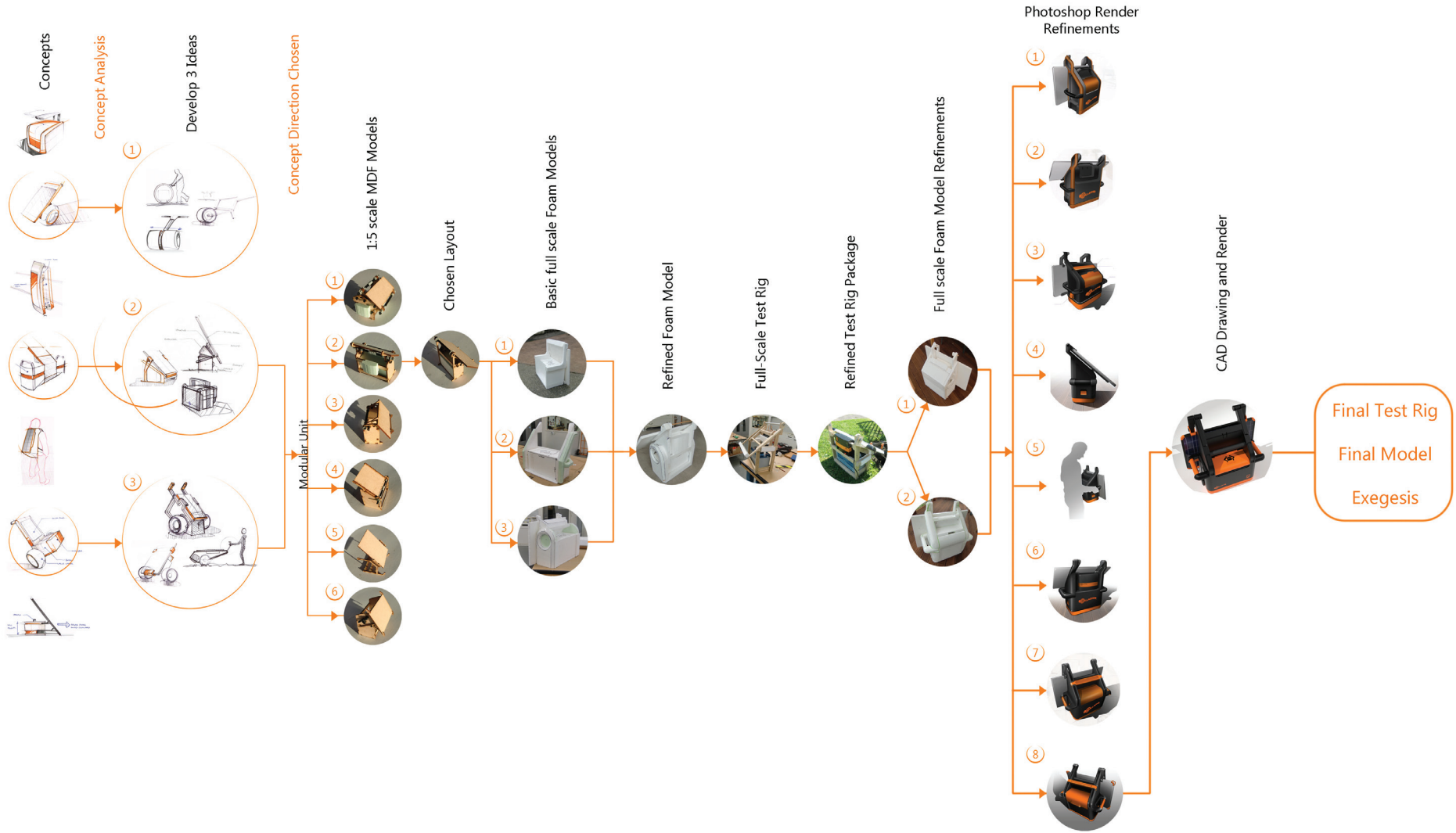


Figure 68. Project development design process

8.2. Research Methods Used

The following methods were used to take what was learnt during the research phase, then applied, evolved, enhanced and employed to deliver an insightful outcome.

Brainstorming

This individual creativity tool aimed to collate all thoughts, theories and initial understandings onto a rough A3 page. The specific goal was to draft as many ways to move a heavy unit, irrespective of how extreme the method or approach was. It provided a firm base from which to explore further into the concepts and thoughts shown below.

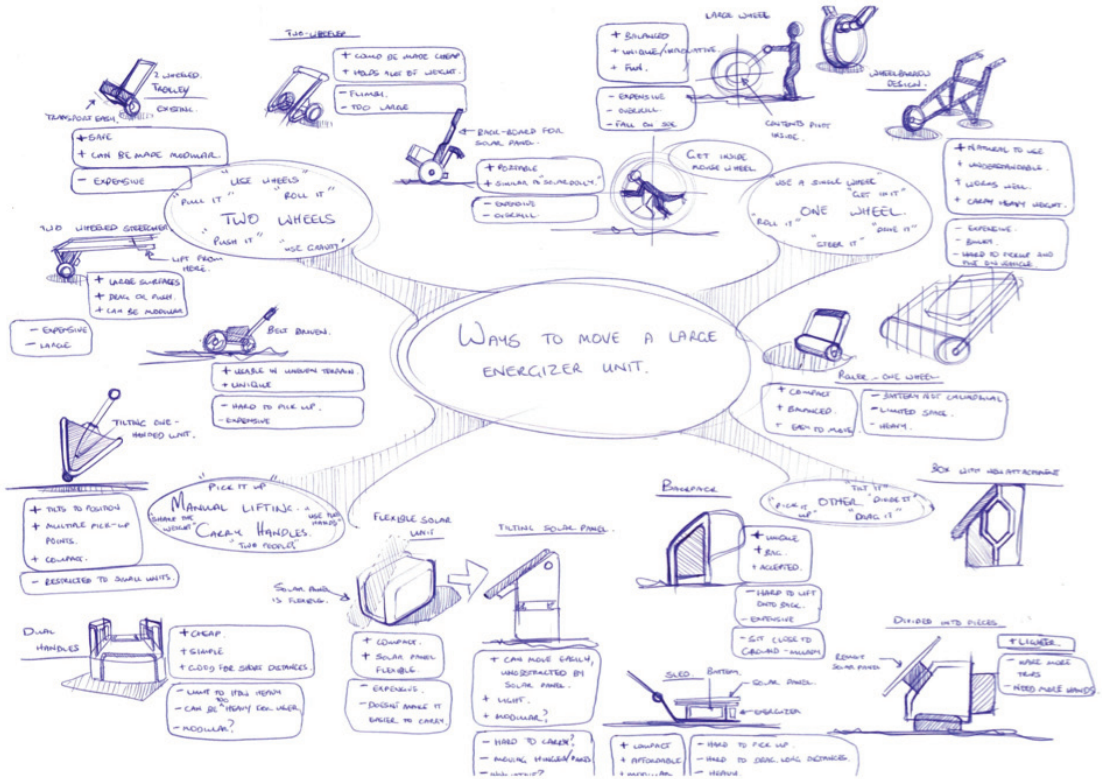


Figure 69. Concept Brainstorming

Design Schematic Board

Aim: Identify relevant state of the art product examples from similar or applicable product category sectors with appropriate features and details which express desirability factors such as: configuration, assembly, format, styling, form, colour, graphics, materials, ergonomics and usability.

Share these insights with other product development team members to ensure appropriateness of design direction and expression is on target. Use agreed examples as inspiration and reference for generative design development stages.

(Opposite page: **Figure 70.** Design schematic)



Organic



Robust



Simple



Corrugated



Masculine



Clean



Utilitarian



Dynamic



Existing Product Research

An online search of existing products that included holding/carrying/storage capability was used to identify relevant solutions and features of interest.

The search was restricted to products that expressed a robust aesthetic, appropriate for outdoor farming contexts. The parts which looked robust displayed characteristics like bold shapes, external visible structures, large radii, large part lines, material associations, joining method associations and solid colours.

Handles and clip lock mechanisms were also of particular interest because these elements were of significant design importance (for attaching the base to the body).

(Opposite page: **Figure 71.** Important product features)



Joining Method Associations

Material



Contrasting Materials

Bold Shapes

Associations



Large Radii

External Visible Structure



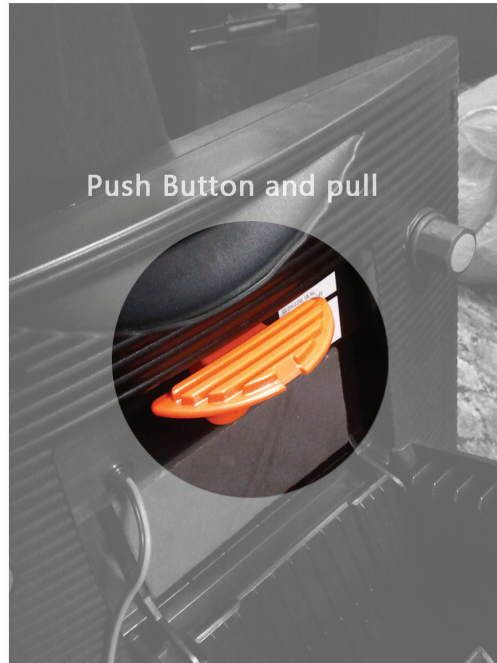
Large Partlines

Solid Colour

Gallagher Product Investigations

A review and critique of existing Gallagher energizer products, which resolved similar challenges to this project, provided insight into the how they had been designed for injection moulding manufacture. Informal interviews with Gallagher R&D and marketing staff helped to identify features and techniques that were either desirable or had been less successful in the field. Insights from this work provided benchmarks and inspiration for this design project.

(Opposite page: **Figure 72.** Gallagher product open/close mechanisms)



Product Technical Specifications

Before exploring possible product topology, investigations into physical component attributes were required. Gallagher technical advisors established the technological parameters in order for this device to function appropriately for the specifications set in the brief. The concepts were required to work with the following components:

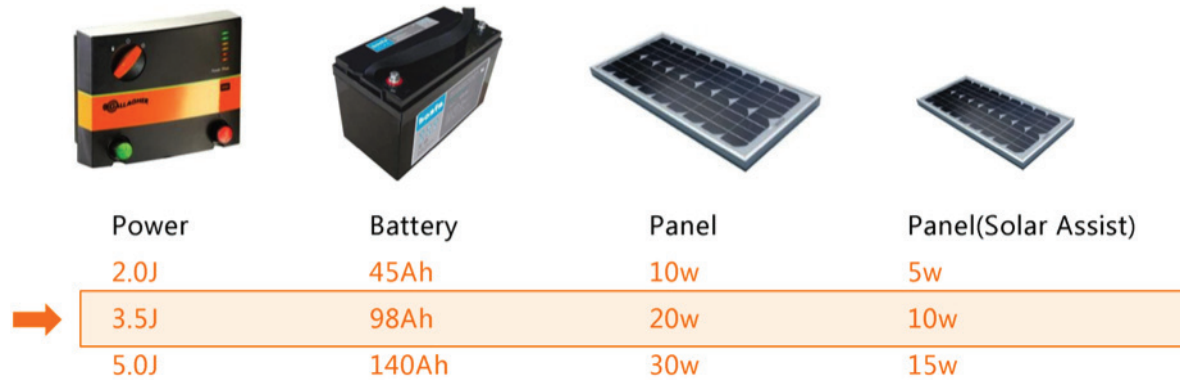


Figure 73. Most suitable components

Technical Limitations

The following limitations would be considered when moving forward with a concept. These limitations outline basic physical parameters for the product in terms of size and requirements.

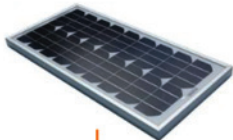
A diverse range of battery and solar panels are made available by suppliers to the end user in numerous dimensions. Therefore, the final solution must be flexible in modularity.



- Size of internal components
- Power rating
- Cost to manufacture



- Weight
- Size vs. Output
- Cost to buy



- Size of panel
- Power/Size Ratio
- Efficiency
- Cost to buy

Figure 74. Technical limitations

Ideation

This exploratory research phase, focused on generating design concepts that were relatively unconstrained. They subsequently encouraged creative speculation, to investigate whether there could be a radical design innovation that resolved the basic design challenges and could provide a new desirable product. The main goal was to find a convenient, ergonomically sound way to transport and install the large solar unit that included a heavy battery (30+kg), solar panel and energizer with limited manufacturing and cost restraints. The following concepts were generated and critiqued.

Wheels Ideation

Findings: The idea of using wheels to transport the unit opened up new potential configurations for the project. Wheels could be extremely helpful and add huge value to the product. Unfortunately the size and cost of the product would make it difficult to sell to the target market because the added value may not be advantageous to the customer.

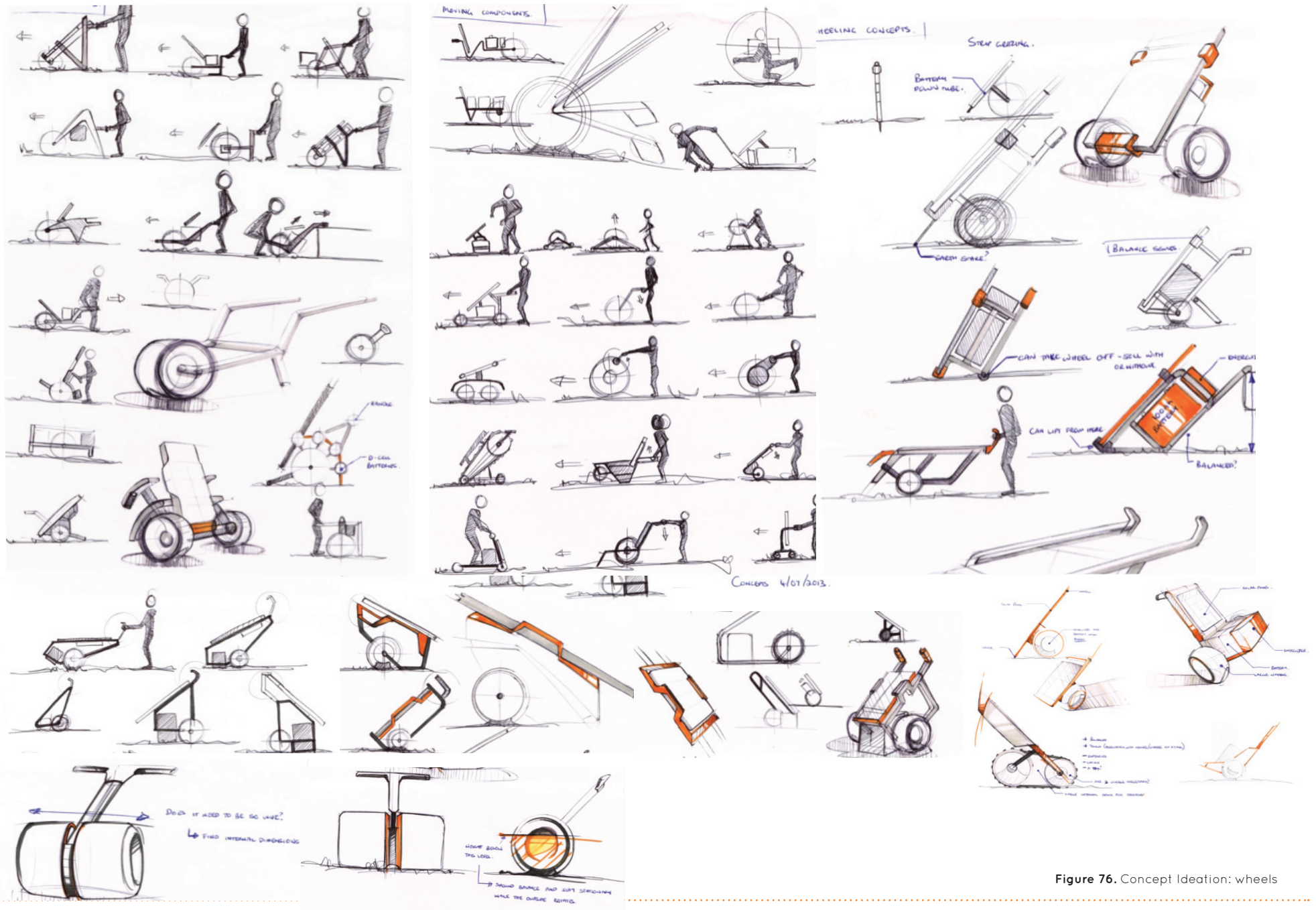


Figure 76. Concept Ideation: wheels

Backpack/ Carry on Back Ideation

Findings: Carrying an energizer unit on the back is an alternative option. Unfortunately, the weight would prevent the user from easily putting it on his back. Due to ergonomic factors, this idea was disregarded.

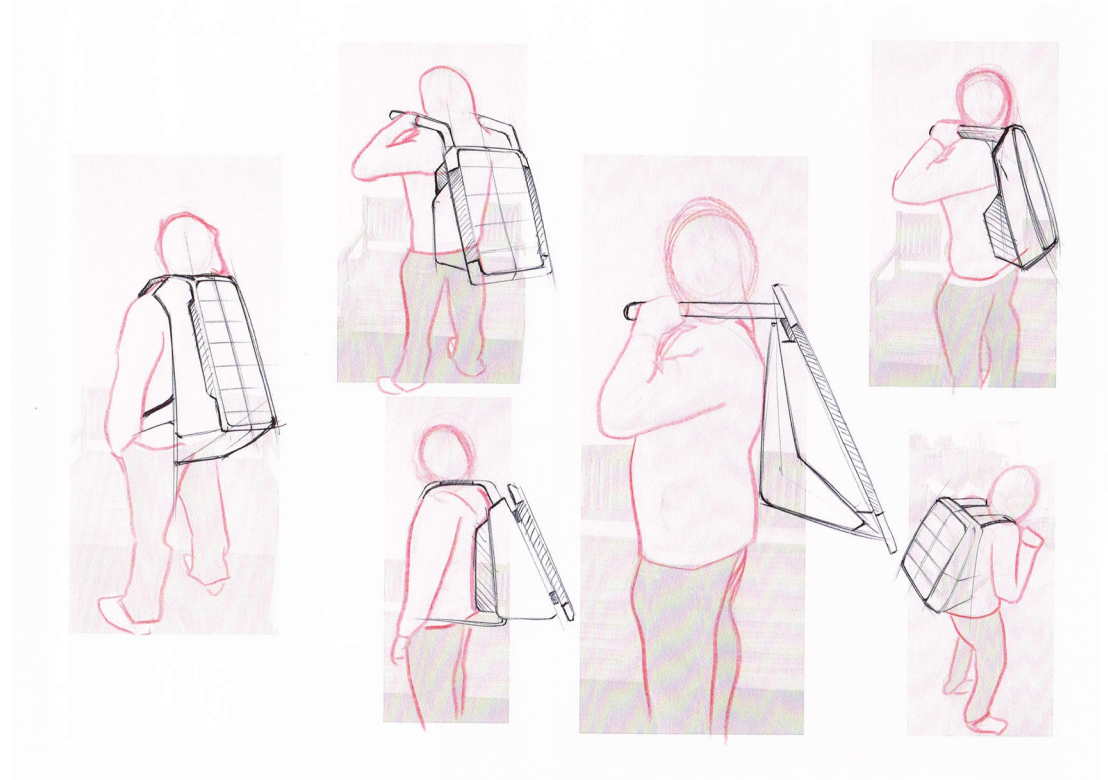


Figure 77. Concept Ideation: back carrying

Tilting Unit - Single Handle

Findings: The aim of a tilting single handle was to use the weight balance of the product to rotate the geometry, allowing the user to pick up the unit without obstruction from the solar panel. This concept was not the most appropriate, but could prove useful for application in other units.

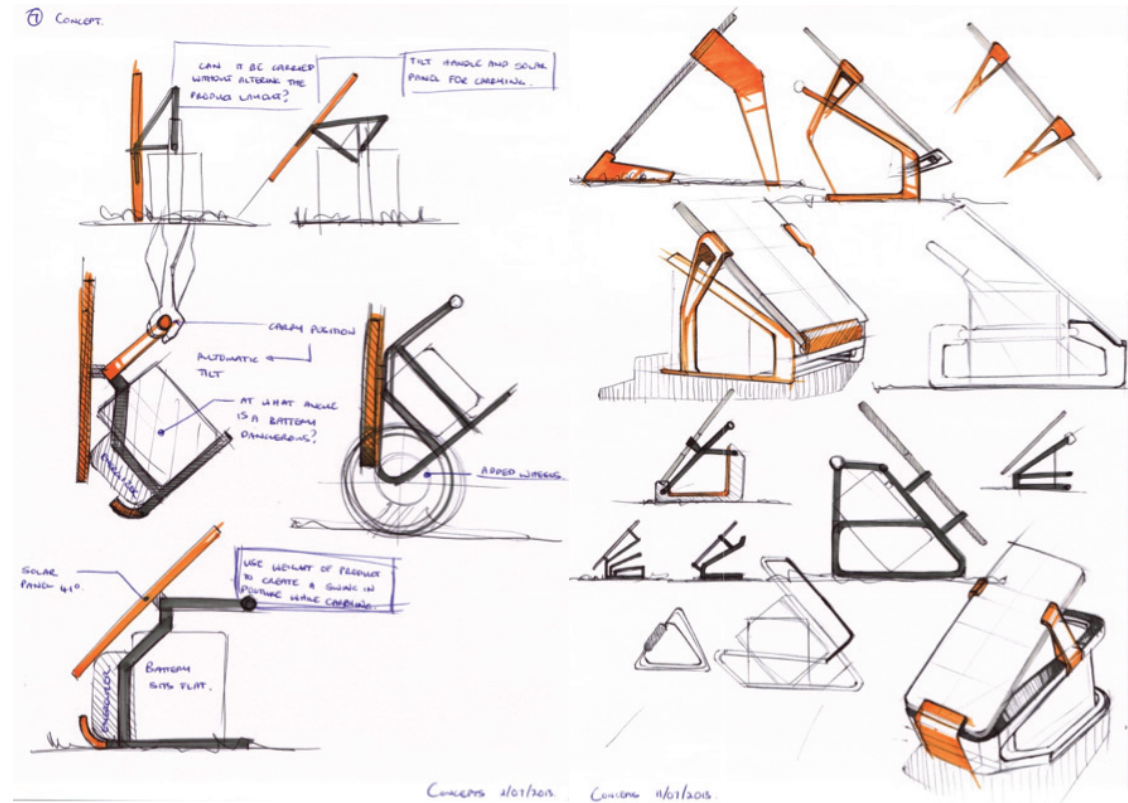


Figure 79. Concept Ideation: Single handle options

Flexing Solar Panel

Findings: The idea of using a new and emerging flexible solar panel technology opened up new potential configurations for the project. The flexible solar panel technology can be rolled up when not in use. The solar panels are many times more expensive than main solar panel types, less efficient and the benefits do not outweigh the cons. Unfortunately the unit cost of the new panel proved commercially prohibitive for use in this project.

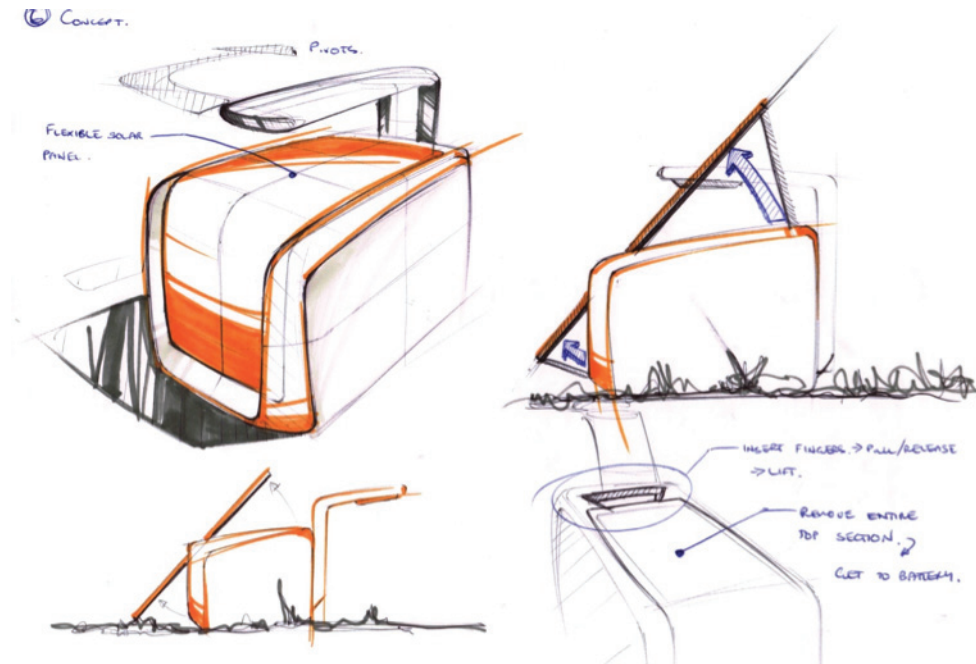


Figure 81. Flexible solar panel

Basic User Testing

Concept: Wheels

Aim of Test: The trolley concept was tested with a 33kg battery, to find out how beneficial this method of transport was and whether it was worthwhile to have wheels on the product.

Findings: While it was possible to carry the battery by hand 20m, the trolley made it much easier. However, it was tested on flat hard surfaces, and did not provide a real indication of the farming terrain that it would be used in. Despite this, the benefits of wheels were proving useful for transporting distances of over 10m with ease and so the concept of using wheels was not eliminated at this stage.



Figure 82. Wheels vs. manual carry

Concept: Backpack/carry on back

Aim of Test: In this test, an existing backpack was used and fitted with ballast to approximate size, weight and general ergonomic handling characteristics.

Findings: Carrying weight on a user's back is often the best method of carrying heavy goods because it allows for a reasonable distribution of weight into strong parts of the body in a walking posture and leaves the hands free. However, the weight of the battery immediately became a problem when getting the unit on/off. It was ergonomically challenging and was ruled out because of this.



Figure 83. Backpack unit testing

Concept: Double handle ideation

Aim of Test: To understand how, under specific postural geometry and weight load conditions, two handed lifting, carrying and manual handling performance compared with single handed lifting, carrying and manual handling.

Findings: When compared to lifting single handed, distributing the weight of the test unit between both arms helped to reduce the strain on the user by roughly half. Above 10kg, using two hands became much more suitable and sustainable for the individual.

The posture change meant that the user could stand upright comfortably with straight arms, preventing unnecessary lateral stress or bending of the spine whilst carrying single handed.

Handles on both ends of the test rig made this procedure significantly easier and ergonomically more comfortable because it provided a smooth, even surface for both hands to form contact with. It became evident that this process was not desirable if manually transporting the unit further than 50m.

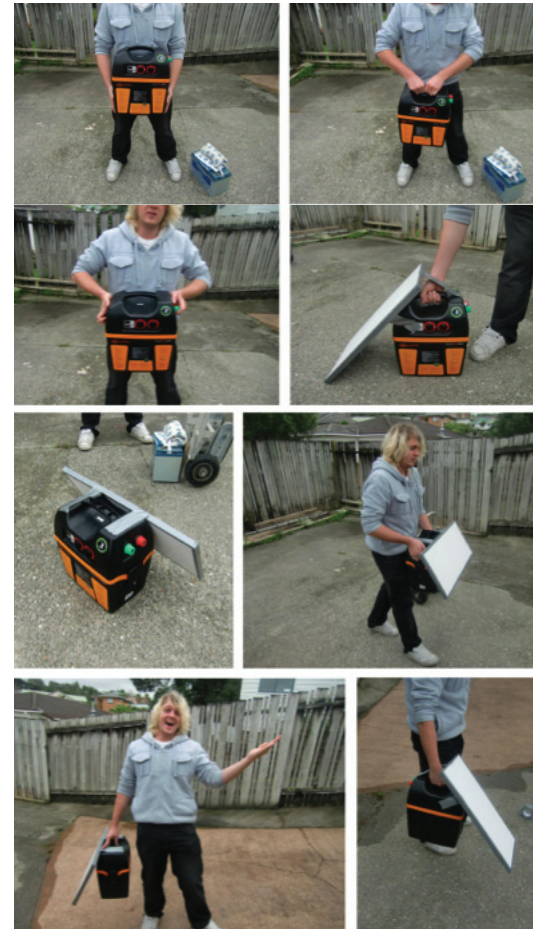


Figure 84. Two handed carry styles

Concept: Single handed lift/handle

Aim of Test: Investigate single handed lifting to identify natural lifting procedures and how feasible it was to apply them with respect to different weights.

Findings: Single handed lifting techniques often used other body parts to share the load once lifted. As previously mentioned in the findings of two handed lifting, there is a certain amount of strain placed on the user when an item is lifted on one side. When possible loads of 20+kg are to be lifted or moved short distances, based on this testing, there is reasonable doubt that using one hand or side of the body is acceptable.

A single handle has shown to be more intuitive to use when picking up a product with a low weight volume and moving longer distances (i.e 50+ steps). Due to the nature of the product, it is highly possible it will weigh above 20kg and it would not be ideal to employ a single handle as the primary handling component.



Figure 85. Single arm/side carrying options

Concept Review: Weighted Objective Method

Breakdown of Concepts

During the concept phase, ideas ranging from of blue sky to pragmatic were explored. The three main directions are illustrated below:

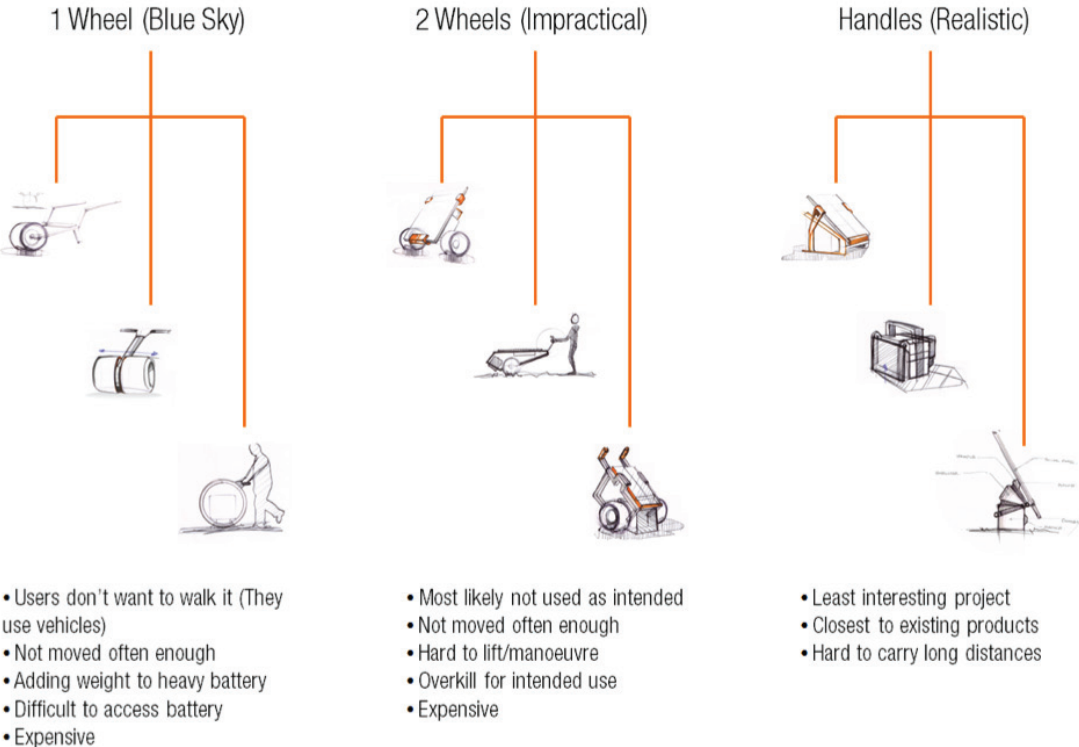


Figure 86. Likely project paths

While discussing the concepts with Gallagher, it became evident that the many constraints placed on the project would shape how novel and innovative the outcome could be. It was agreed that using a weighted objective method assessment would help critique the various conceptual proposals and determine an appropriate and realistic way forward for further design development.

When choosing from a list of possible concepts, there are many difficult design decisions to consider. This researcher has chosen the Weighted Objectives Method to validate which concepts have the most potential and identify which fulfils the design brief criteria the best (Tague, 2004).

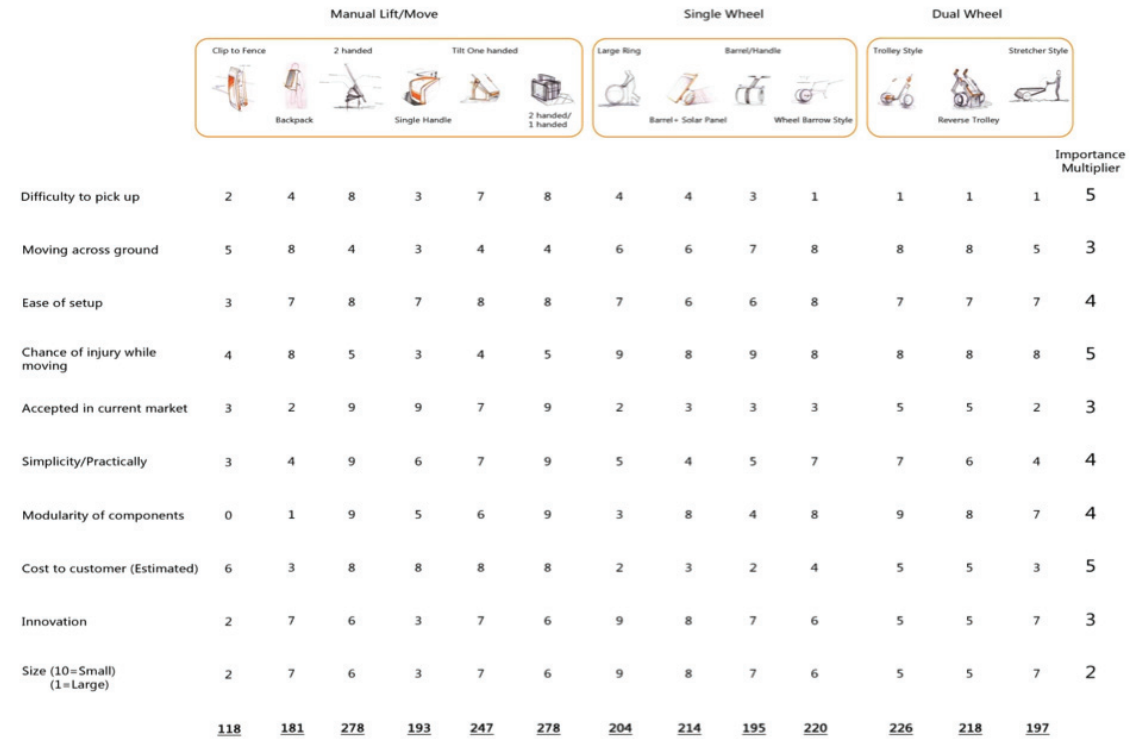


Figure 87. Choosing concept to develop

8.3. Meeting with Mark Harris (Marketing Manager – Animal Management) and Byron Arnold (Energizer Product Manager)

A meeting regarding the choice of concept took place on 11/07/2013 at Gallagher Hamilton. The following main points were recorded.

- Mark and Byron favoured the modular unit which allows for interchangeable components
- The two handed concept was received well
- It was emphasized that carry distance could not be controlled

Outcome

The results of the weighted objective method and Gallagher expert opinions coincided, making it an easy decision to move forward with the two handed lift unit. Weaknesses of this concept were addressed, with the intent on maximising ergonomic performance by:

- Providing a two-person lift solution
 - Concentrating on designing the most suitable geometry, location, shape and size of handles
-

9. Industrial Design Development Investigation

9.1. Research Methods Used

The following methods were used to take what was learnt during the concept phase, then apply, evolve, enhance and deliver an insightful outcome.

- MDF 1:5 scale test rigs
- Full scale foam model mock-ups
- Development sketches
- Full scale test rigs
- Product testing
- Informal expert interviews
- Group discussions
- Case studies

MDF 1:5 Scale Models (Investigate Product Configuration)

In the current powerbox design on right, the solar panel is mounted over the single handle, making it very awkward to carry. The concept design must be picked up easily without obstruction from a fixed solar panel covering the handle(s); therefore, 9 concepts were constructed with different mechanisms, which looked at the relationship between the handle(s) and the moving/ tilting/ adjustable solar panel



Figure 88. Gallagher Powerbox solar panel issue (handle obstruction)

Aim: Design and present test rigs which investigate product configurations, to a board of Gallagher engineers, mentors, managers and supervisors.

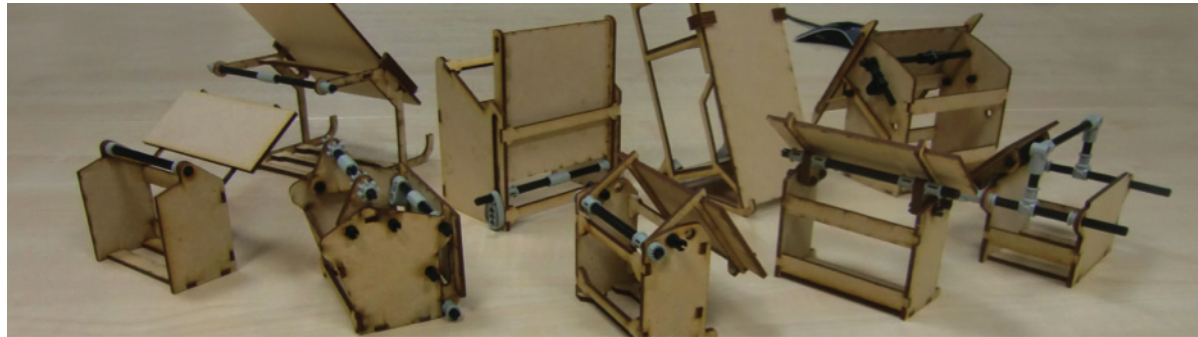


Figure 89. Scale 1:5 MDF models

Outcome: Overall, the idea of adjusting a solar panel to make it easier to pick up made sense and was well received. A pivoting hinge was chosen above all other mechanism concepts because it was simple, effective, and appeared to be an affordable solution. In addition, it offers protection for the solar panel and left the handles unobstructed when not in use. The following image shows the chosen test rig.

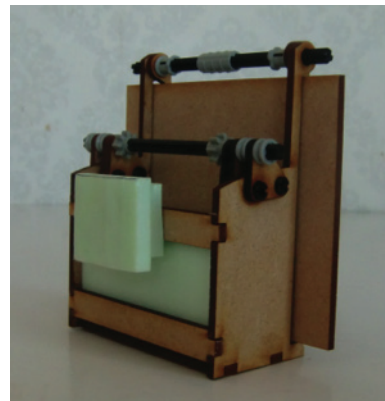


Figure 90. Chosen configuration

Foam Full-Scale Mock-Ups

Foam mock-up 1

Aim: Define key product dimensions and component topology/configuration

Findings

- Sharp edges, flat surfaces and blocky, additive forms made it appear extremely large and bulky
- User initially picked it up by pivot point (not from side handles)
- Side handles were not obvious enough
- Foam model couldn't reflect the weight and other physical barriers

Design Alterations

- Generate and explore sketch configurations which aim to reduce overall bulk, soften appearance and give more emphasis to carry handles.



Figure 91. Testing basic product dimensions, component topology and basic ergonomics

Foam Mock-Up 3

Aim: Incorporate the circle design theme and create a harmonious flow between main features; i.e. handle to main body

Findings

- When lifting by single handle, the balance was incorrect (**figure 92**)
- New way of getting to the battery was discovered and investigated. Instead of taking a small lid off the body of the unit, the larger body is pulled off a small base. This provides full access to the battery when the top is removed, making it easy to replace.

Circular aesthetics seem semantically inappropriate and don't provide ergonomically shaped weight carrying forms.



Figure 92. A) Pulling pins to release the body from the base. B) Removing body for complete access to battery. C) Identifying balance issue. D) Handle detailing

Foam Model 4

Aim: Use the fundamental form, derived from ergonomic usability, mechanical design performance, component layout and manufacturability, as a base for constructing a foam model which will form the foundation of the final design proposal.



Figure 93. Foam model 4

Foam Model 5

Aim: To closely simulate the most developed design and features to help describe the overall design from all angles.



Figure 94. A) Rear view. B) Front view. C) Side (Solar panel away). D) Side (Solar panel in use)

Development Sketches

Aim: To soften the harsh lines, relax surfaces and explore new appearance with quick sketches over photographs.

Findings:

- A frame visually and structurally integrated and unified key design elements and components of the product
- The frame concept presented a robust utilitarian image which seemed appropriate for the farming context.

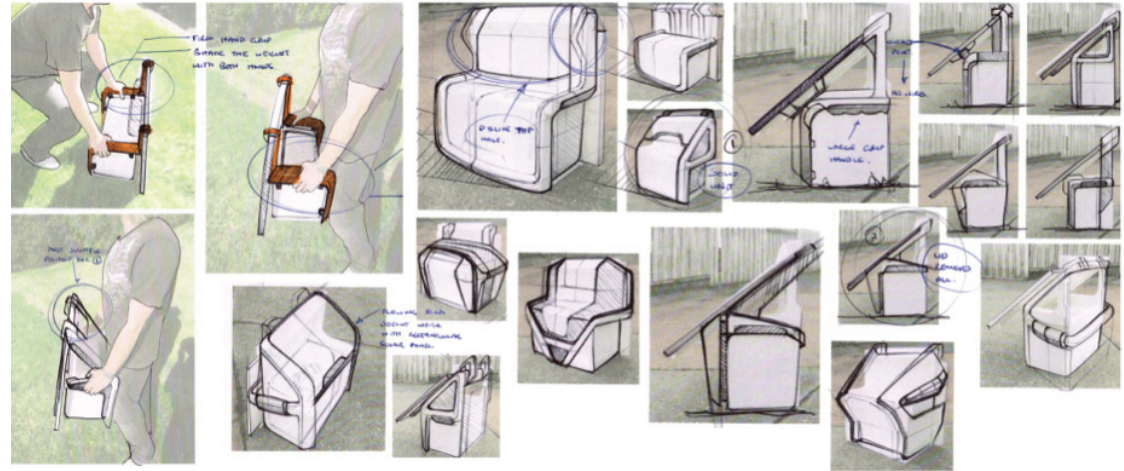


Figure 95. Development drawings (form exploration)

The following design sketches in **Figure 96** investigate alternative product configurations, aesthetic treatments and ergonomic handling features:

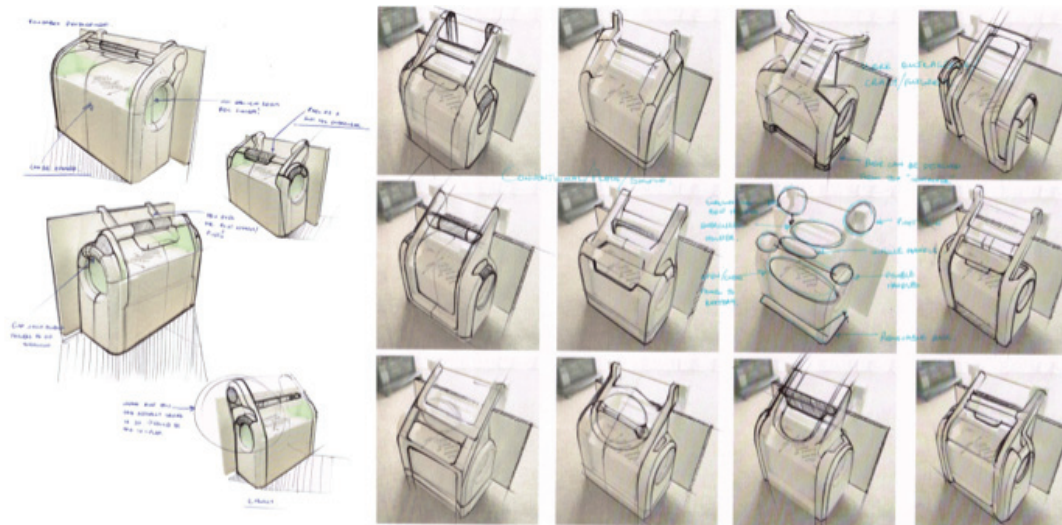


Figure 96. Development drawings (shape exploration)

Findings:

- The softer round shapes offer a humanistic identity for the product in an attempt to make the product appear user friendly and less technical than the utilitarian mechanical frame contrast.
 - The circular handles became an early theme for the design
-

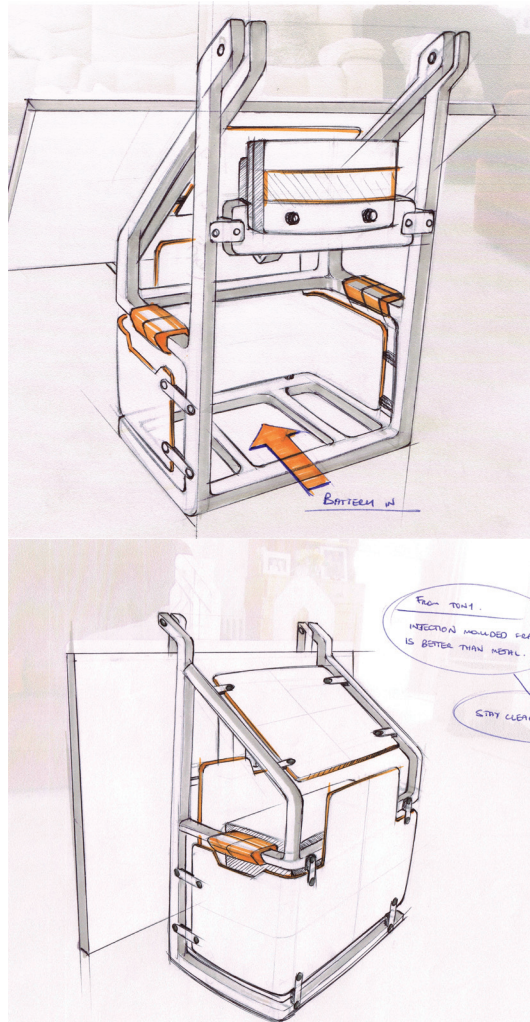


Figure 97. Option 1: Frame

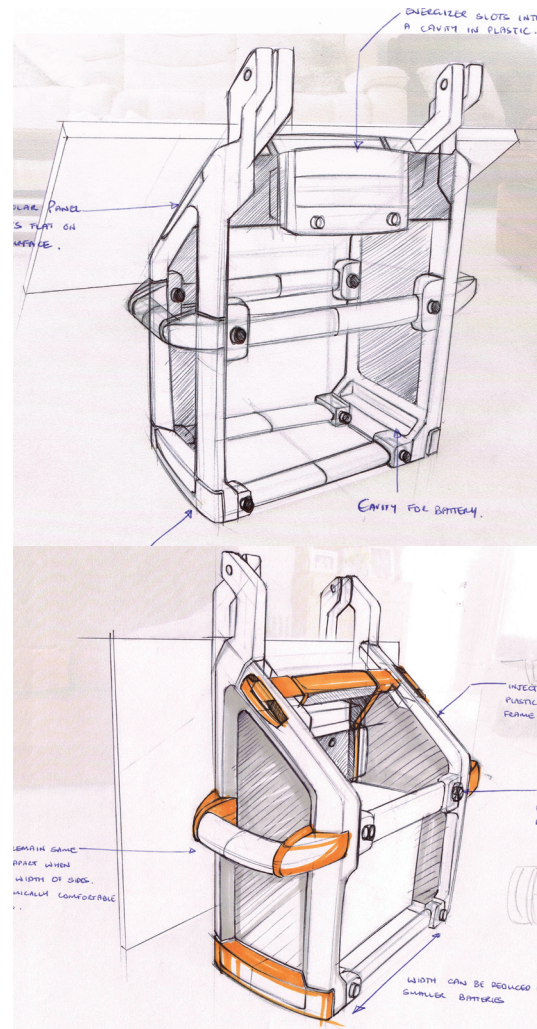


Figure 98. Option 2: Frame/Fully enclosed box combination

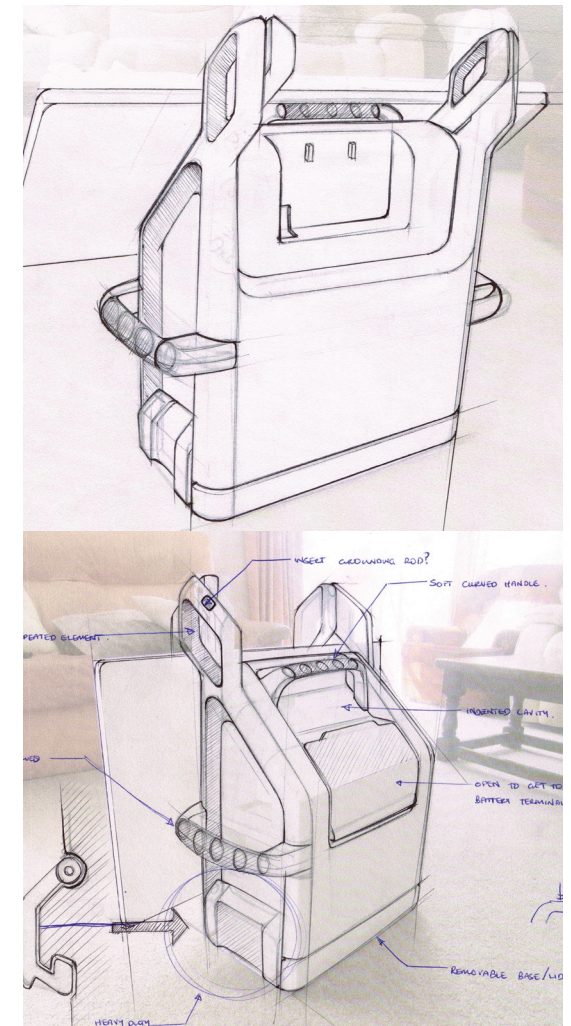


Figure 99. Option 3: Fully enclosed box

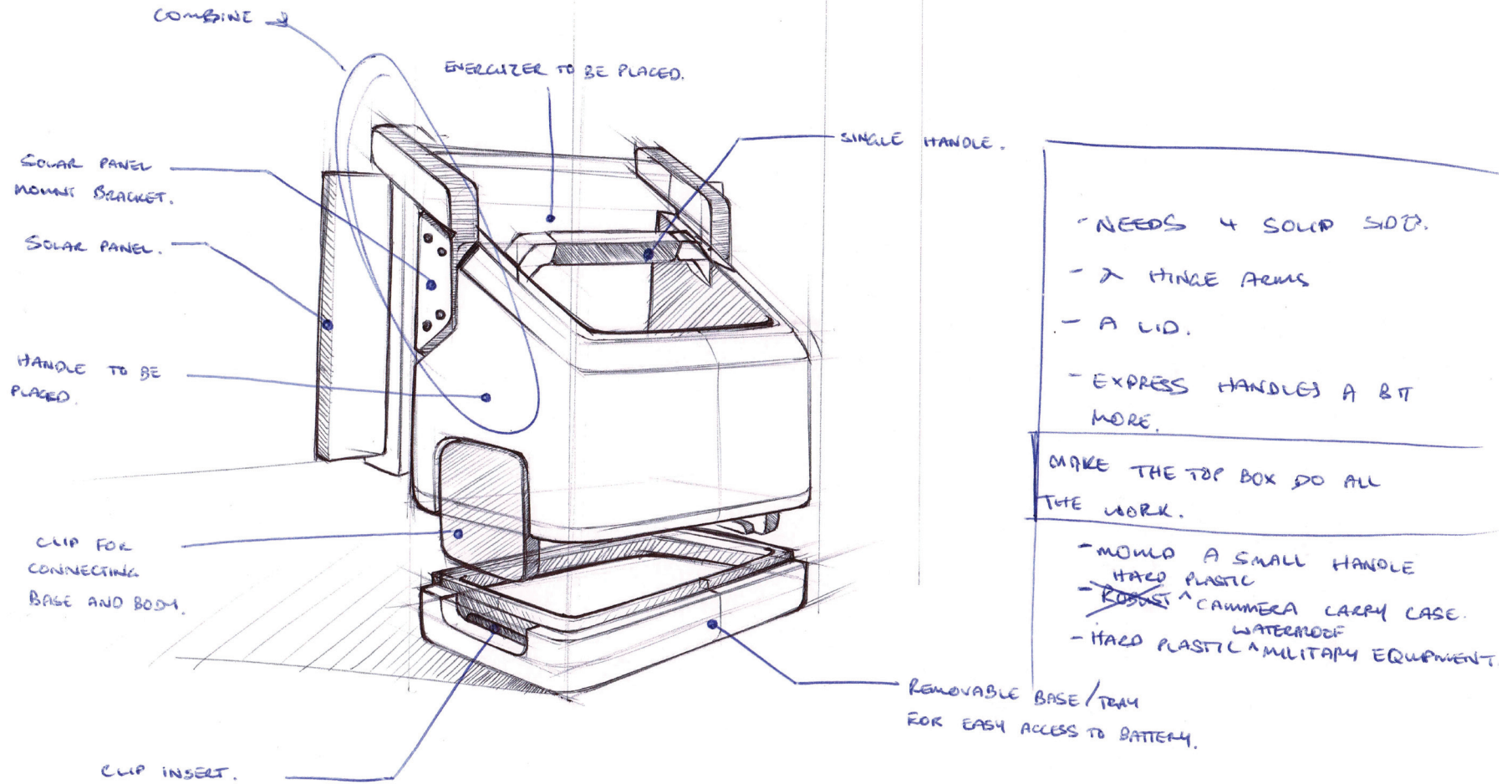


Figure 100. First developed concept idea

Full Scale Test Rigs

Test Rig 1

Aim: Create a test rig which can carry all components and test user interaction with the product.

The following test rigs were not made to include the aesthetic qualities of the product; they were used to provide a decent idea of basic dimensions, enable users to test ergonomic principles and get a feel for the product's weight.

Findings:

- Oversized, some wasted space.
- Fits all components
- Energizer proximity to central single handle forces the handle off centre, making it unbalanced and difficult to pick up
- Total weight of the overall package is 35kg
- Weight is a serious ergonomic concern

Changes:

- Reduce the vertical height of the test rig
- Try to rearrange the energizer/central single handle so it is balanced when picked up



Figure 101. Test rig build

Test Rig 2

Aim: Learn from the first test rig, build an improved version, test, analyse and identify weaknesses within this layout of product. The following changes were made:

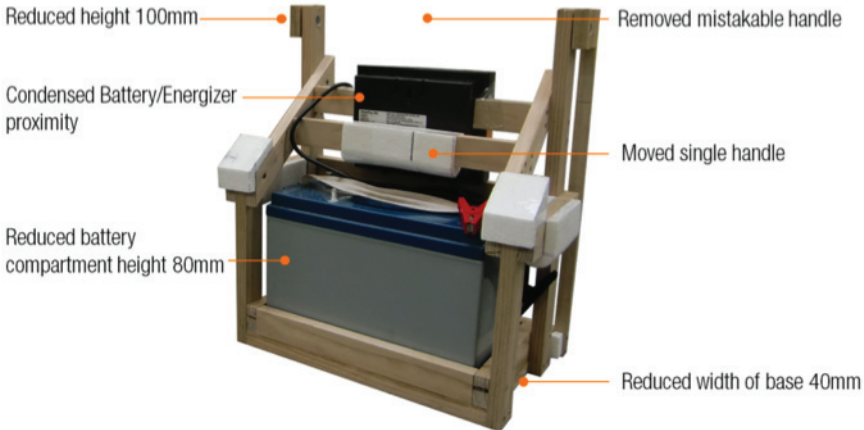
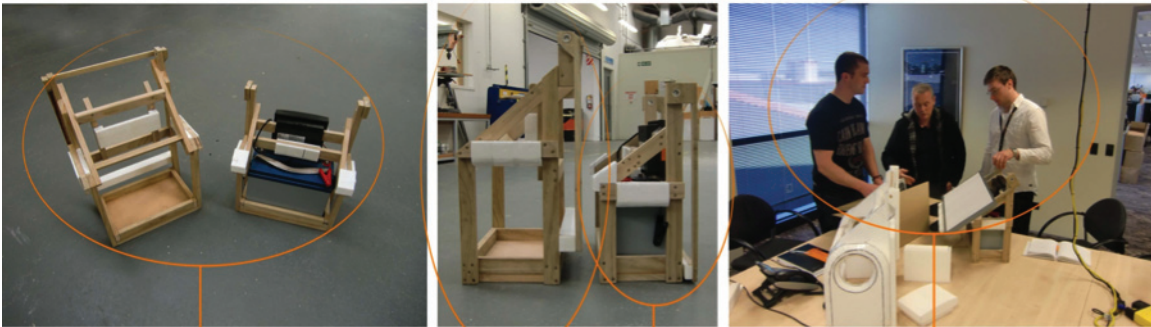


Figure 102. Test rig 2



First and Second Test Rig

Original Dimensions

Condensed/Refined

Discussion
06/09/2013

Figure 103. Test rig comparison

Findings:

- Size reduced considerably
- Reduction of size = Less space for components
- Hand space when using central handle is still compromised by close proximity of energizer
- Weight is unable to be reduced unless the battery size is reduced.
- Unit continues to have balance issues when lifted by the single handle

Changes:

- Remove handle or leave it off centre
-

Full Scale Test Rig Testing

Aim: Testing for ergonomic, functional, user interaction and basic dimensional properties.

Test: For this test, no end users were asked to participate: This informal design test intended to inform design concept development, regarding typical user limitations when interacting with the physical properties of the design, such as weight, handle positions, lifting and carrying.

Findings:

- Very heavy, but manageable for two-handed pickups
- Walking two handed: Was able to walk for over 1 minute and over 100m by the time the arms tired
- One handed lift pulls the body to one side, making it hard to walk
- Weight distribution is toward the solar panel side and battery
- Weight is manageable for short durations, picking up with both arms, plus double person lift
- Comfortable depth of product, providing balance when placed on flat surfaces (see **figure 104**)
- Ergonomically suitable width in relation to user's distance between shoulders.



Figure 104. A) All components fitted and connected to the fence. B) Two-hand Lifting – Arms straight. C) Two-hand Lifting – Lifted to stomach height, arms bent. D) Single handle lift – Straight arm, one sided weight

Group Discussion (University Critique)

Aim: The aim of this informal method was to show progress and instigate discussion about obvious issues, concerns, uncertainties and thoughts within the audience. A slideshow was presented along with various models to help describe the thoughts involved in the project. During the presentation, people could freely ask questions and give feedback which commenced discussions amongst the group.

Concerns:

- Have ACC/OSH Health and safety regulations been sufficiently considered regarding the weight issue?
- Gallagher could be held accountable for the safety concerns mentioned above.
- It is a designer's duty to address the human factors related to the weight of the unit.

Intentions:

- Discuss the seriousness of the health and safety with Gallagher, supervisors and farmers.
- Test the weight concern to see how serious it is.
- Research health and safety regulations in different countries.
- Take appropriate action with regard to the initial concern

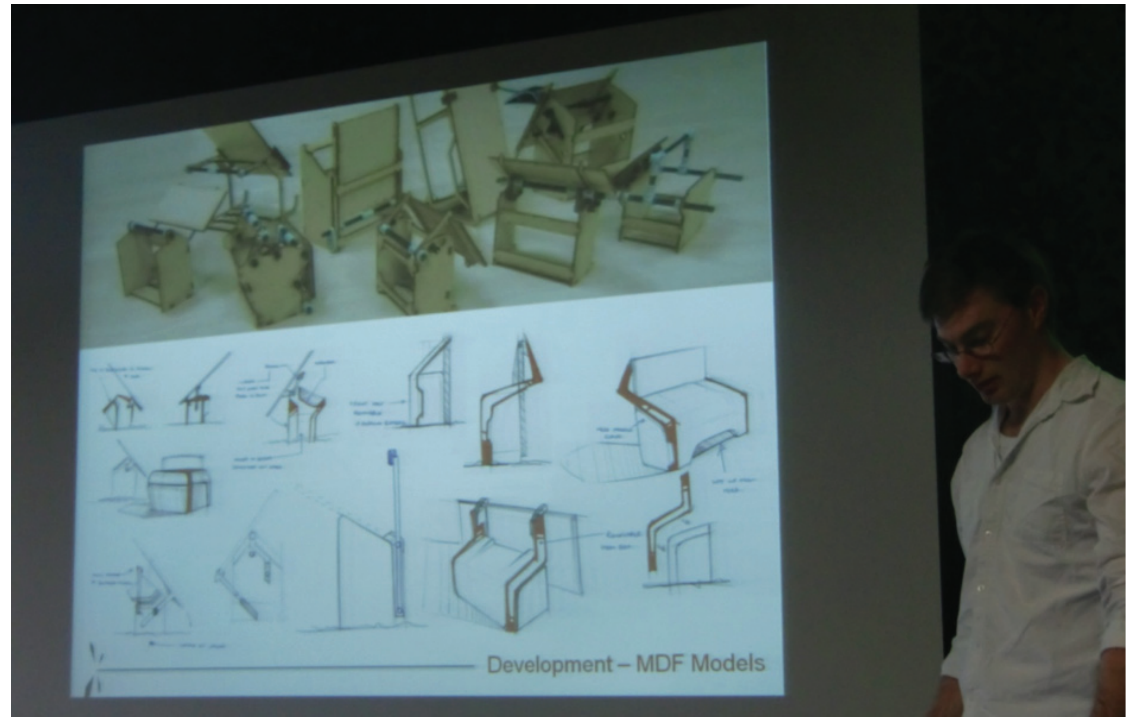


Figure 105. Presentation and discussion

Gallagher Visit (16/08/2013)

On the 16th of August, a meeting was organised to informally discuss the foam models constructed.

Informal discussion feedback (3 foam models)

- Modular unit is most marketable
- Modular unit can fit B80, 180, 280 and new future energizers
- If modular unit hits price point, all existing Gallagher box energizers can be removed from the market
- Most appealing design is the circular handles
- Prevent excessive (but not all) water entry to battery

A new design requirement was established regarding the products susceptibility to falling over during windy conditions because of the size and sail-like quality of the solar panel.

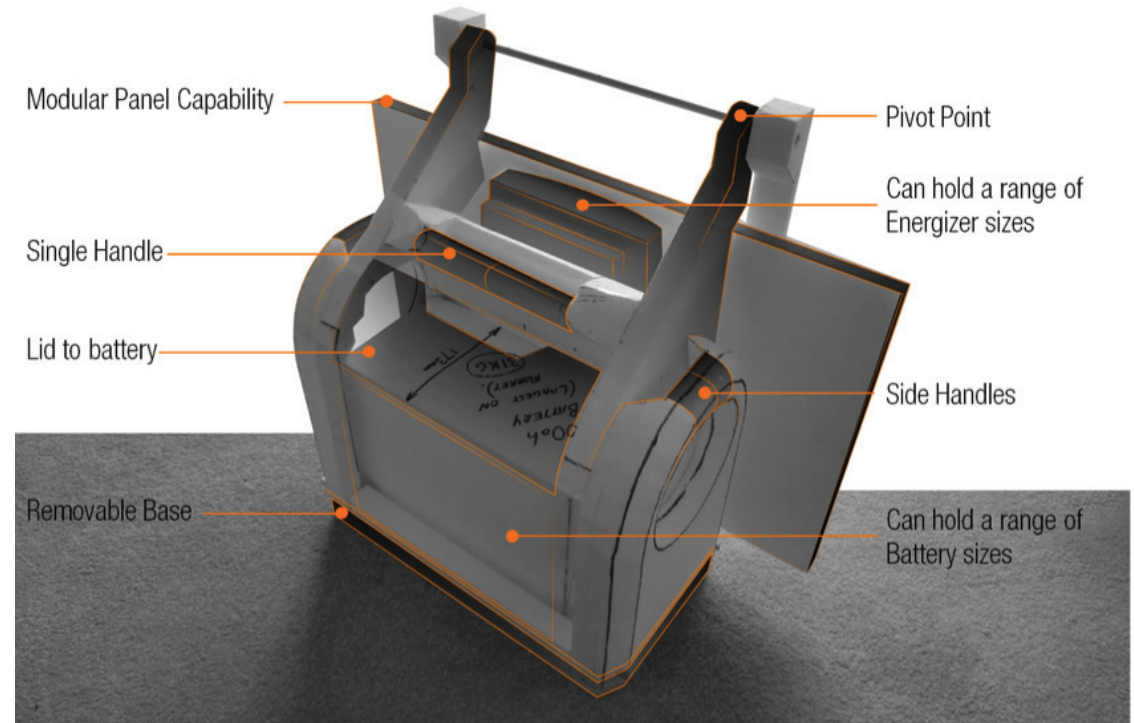


Figure 106. Key design features used for the Gallagher meeting

10. Health and Safety Study

10.1. Critique – Addressing Questions (Lifting Safety)

Why does the unit have to be so heavy?

Three quarters of the weight comes from the battery. The battery is heavy because it needs to be of a certain power rating in order to perform its intended use. The battery weight cannot be reduced unless technology development improves the power to weight ratio. For information regarding weights, refer to basic component information.

What are the effects of the weight on the product?

The unit has become very heavy (30+kg), due to component constraints. This weight will influence the method/s of lifting the unit.

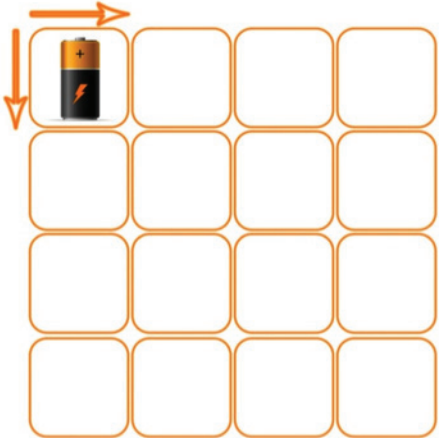
Why was this design chosen? Are there better ways to move this heavy unit to prevent injury caused to the user?

The design was required to factor in many aspects:

1. Safety concerns associated with lifting 30+ kg
2. Application of usage
3. How it would be used
4. Power output required
5. Physique of the user
6. Price point relative to farmer's budgets
7. Manufacturing and assembly constraints

Many concepts were explored, each with an emphasis on the previously mentioned factors. Safety was a major concern and a prime driver of each concept.

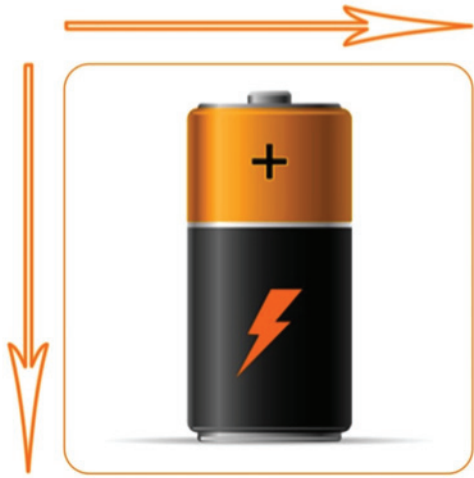
During the concept phase, it became apparent how seldom it would be moved and how small a distance it would be carried. Refer **Figure 101**.



Small Area to power
(1 field at a time)

Small Battery
Output: 10ah
Weight: 3kg

Energizer Setup
Moved frequently (every week)
Must be light
Carried 50m to power next field



Large Area to power
(1 large area)

Requires Large Battery
Output: 100ah
Weight: 30kg

Energizer Setup
Moved Seasonally (every 6 months)
Carried short distance to vehicle
Requires lifting

Figure 107. Battery power required vs size of area

With this in mind, it was realised that wheels were unnecessary, as other forms of transport were being used to move it. The choice between the concepts came down to; (1) how convenient it was for typical farm applications and handling; (2) how well handles were designed to encourage appropriate behaviours and discourage improper use; (3) how safety concerns were communicated; (4) and unit cost being contained so that it did not present a barrier to product uptake and distribution.

These factors were weighed up in terms of importance to the target market (the farmer) in order to fulfil the brief. From this, it was established that although 40kg is heavy, the weight was manageable for typical farm users.

- Unit is moved a maximum of two times/year
- Unit is moved short distances typically between installation site and vehicle transport. Wheels would add considerable cost to the unit price, make the unit awkward to lift onto vehicles for transport and would only be of potential value when moving the product medium distances over suitable terrain. It was felt

that these factors mitigate a wheeled concept and that wheels would become a major deterrent against purchase.

- User is regularly lifting heavy animals and equipment (Use to weights 30kg +)
- Farmers, by the nature of their profession, are generally very fit and strong, and well able to manage 30kg+ weights.
- Customers already use and move 30+kg batteries

Out of all concepts explored, the unit with handles for manual carrying was preferred because:

- Ease of manufacture
 - Lowest cost to build compared with other concepts explored
 - Able to hold all components in 1 package
 - Manual lift solar energizers are already accepted by the current market
 - No extraneous parts
 - Relatively uncomplicated
 - Practical for the type of job it will be used for
-

10.2. Health and Safety and Manual Handling

- A two person lift solution has been provided, allowing users to share the weight of the unit if required. This pragmatic solution adds no additional cost, but addresses the issue of not being able to manage the weight alone.
- Easy removal of the battery enables the user to separate the largest portion of the weight if required. The battery is built with a handle for manual handling.
- The possibilities of straps and winch devices (attached to handle lifting points) have been considered to help with lifting the unit. The use of these devices would be optional and up to the user. Farmers generally have such equipment, as dealing with heavy things is in the nature of the job.

10.3. Supervisor Meeting (Oliver Neuland/Tony Parker)

These points describe the main issues discussed:

1. Circular handle aesthetic of the unit is not working. This detailing is elaborate and irrelevant. Concentrate on fundamental shapes that satisfy ergonomic usability, mechanical design performance, appropriate component layout and design for manufacture. This will be different depending on whether it is a covered box or frame style construction.
Important features = dominant
Less important features =recessive
2. Concerns about safety and responsibility as a designer were covered. Good design prevents injury, which otherwise could result in court cases or a bad reputation. Ideally, the best solution would be a responsible product which offers the user an easy way to move, which does not cause injury or harm others around the user.
Solutions/changes
 - Allow 1 or 2 person lift
 - **Only** allow for two person lift
 - Reduce battery size/weight in accordance to ergonomic data

10.4. Background Investigation and Benchmarking Manual Handling

- Check product liability laws in EU and USA and other major markets
- Investigate what the NZ manual lifting limits are in the workplace. Workplace limits may vary according to the job. (eg. A 40kg bag of cement, which does not have handles, is commonplace in the building and construction industry).
- Change design specifications according to ergonomic research
- Enquire if Gallagher would pay for an initial commercial evaluation from ACC.

11. Additional Design Criteria

Ergonomic Criteria

- The unit, which includes all components, must weigh less than 23kg
- Must provide a two-man lift option

Gallagher Criteria

- Business managers are adamant that it must also have a single handle: It will not be accepted in the market without one

11.1. Reasons for maintaining existing design dimensions

Height

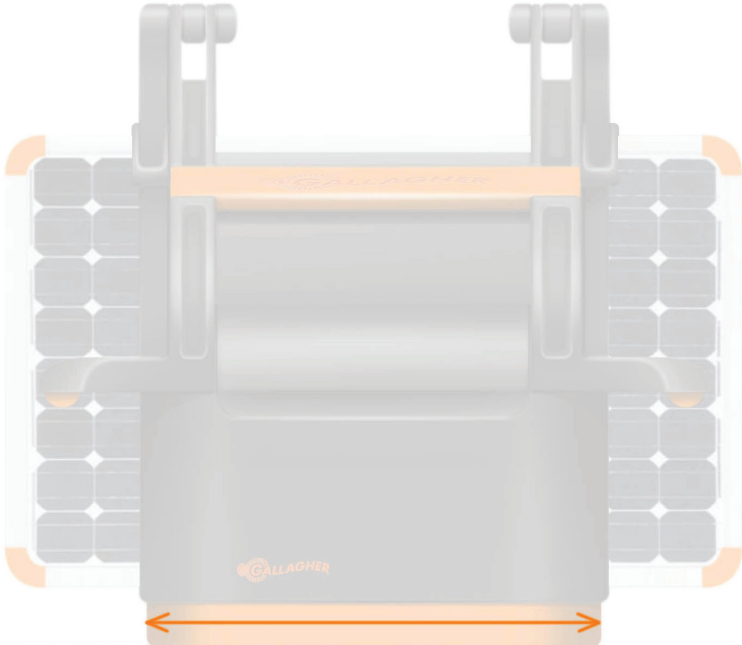
- Solar panels are different sizes and will require the existing height of the unit to accommodate the larger panel sizes
- The height of the battery determines where the lowest point of the energizer can sit. The height of both battery and energizer establish the height of the overall unit.

Depth

- This is the narrowest part of the product. The depth must be sufficient enough, to prevent being easily tipped over on sloping terrain or by high speed winds
- Required to accommodate unusually deep batteries

Width

- When picking up the unit with both hands, the handles are roughly the width of a person's shoulders.
 - Required to accommodate unusually wide batteries
-



Width of Unit
(Side to side)
380mm



Height of Unit
(Top to Base)
510mm

Depth of Unit
(Front to back)
230mm

Figure 108. Primary Dimensions

12. Development (Post New Design Criteria)

12.1. Research Methods Used

The following methods were used to develop the product concept:

- Development sketches
- 2D photoshop renders

The following design development sketches show key development stages and thoughts behind design decisions.

Development Render 1

Aim: Provide insight into possible aesthetic traits based on aesthetic focussed literature and concept development. The concept was taken to Gallagher manufacturing/tooling specialists to analyse its feasibility.



Figure 109. Early illustrations of product layout, features aesthetic form and colour

Gallagher Specialist Manufacturing/
Tooling Input

Aim: Work through the design, ensuring it can be injection moulded and marketed. The following diagram shows the exploded parts and how it could be manufactured.

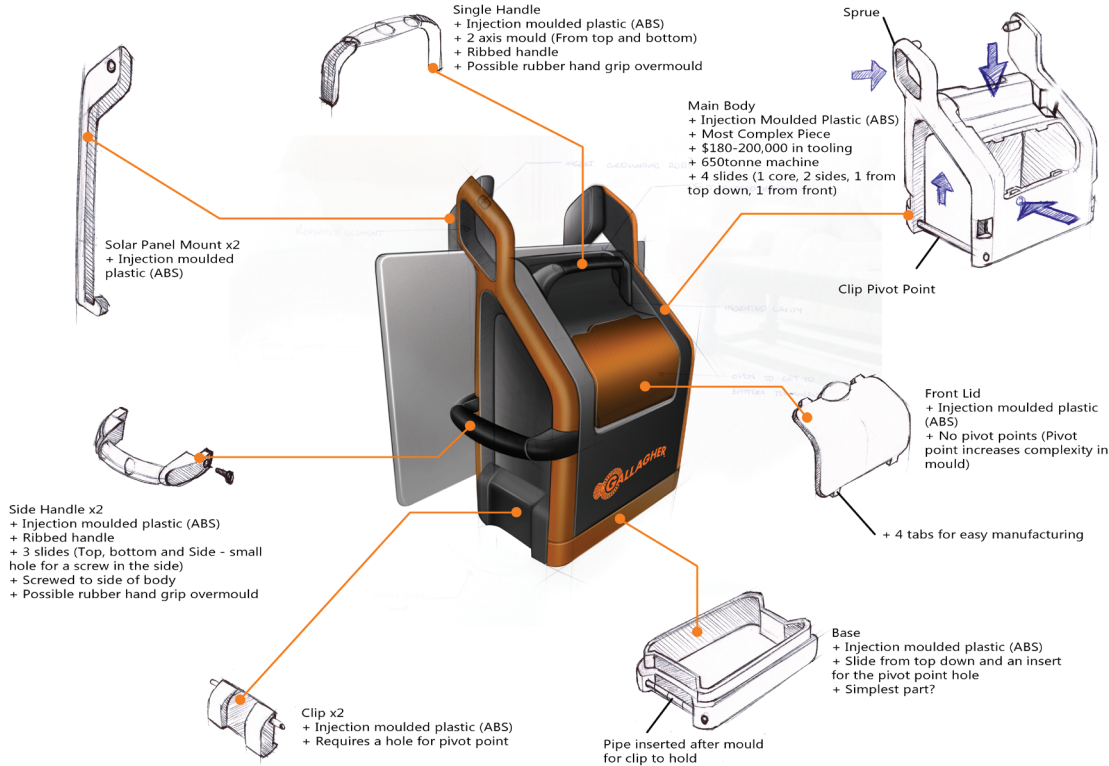


Figure 110. Manufacturing considerations

Things to Refine

Figure 111. illustrates the major changes recommended by Gallagher manufacturing/ tooling specialists.



Figure 111. Changes to be made

Development Render 2

Aim: Develop the design based on key points raised in the meeting with Gallagher manufacturing/tooling specialists

Outcome:

- Single handle: try using a metal rod and inserting it through the plastic body to ensure it is acceptably strong.
- Solar panel pivot point aesthetic does not correspond to rest of design.
- Side handles are not strong enough
- Reduce bulky appearance



Figure 112. Further manufacturing explorations

Development Render 3

Aim: Develop the design based on discussions with Gallagher and supervisors.

Outcome:

- Solar panel pivot point needs a complete re-work
- Handles require a complete re-work
- Solar panel arms need a re-work
- 4mm wall thicknesses required throughout the whole design. All objects must be hollow with no undercuts



Figure 113. Development render

Development Render 4

Aim: Develop the design based on further discussions with Gallagher and supervisors

Outcome:

- New handle design gets its strength from plastic body moulding
- Indent provides aesthetic theme corresponding to an evolving Gallagher design language
- Solar panel arms now fully injection moulded with 4mm wall thicknesses. The "H" shaped cross section provides adequate strength and a platform for solar panel modularity.
- Bulky appearance has now been resolved to express a strong and capable feeling
- Smooth top surface has been raised to meet the pivot point, eliminating the disjointed feeling in previous designs.

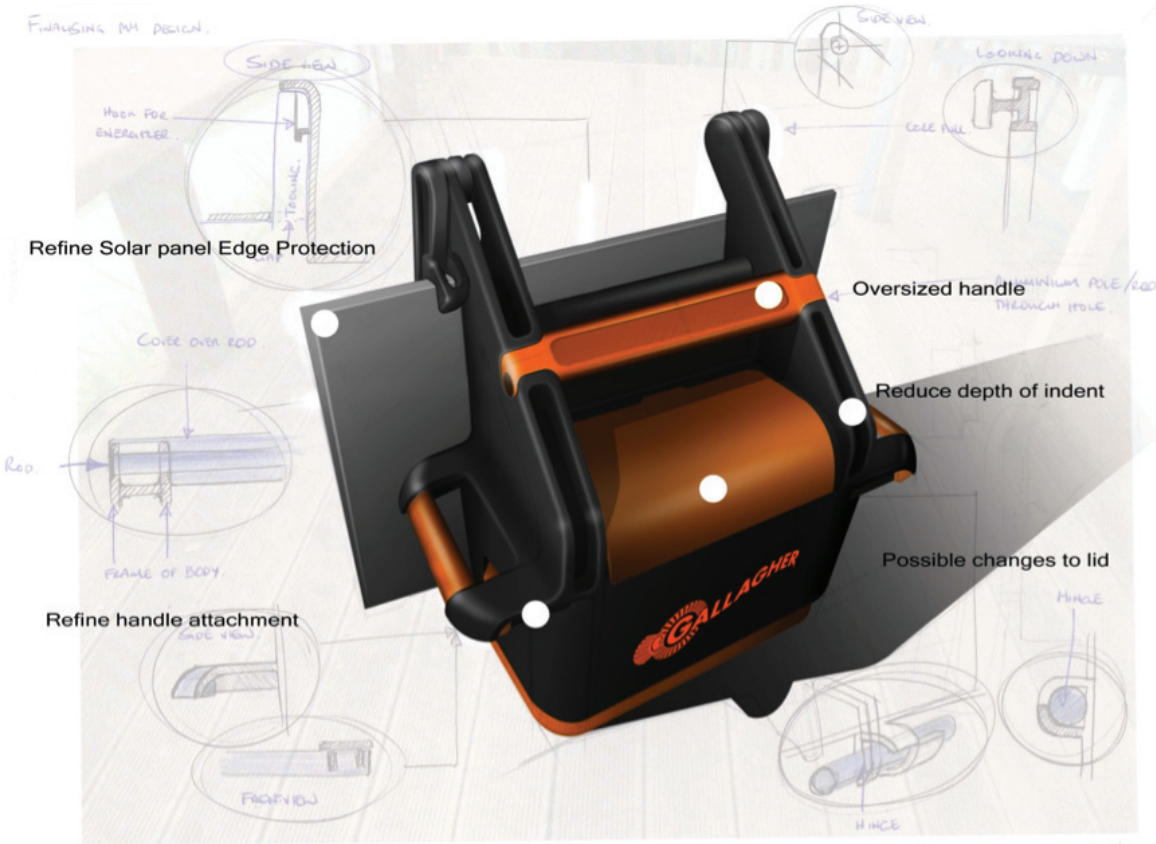


Figure 114. Changes to make

Development Render 5

Aim: Convert conclusive design discussions into a design which aims to guide the final design outcome.

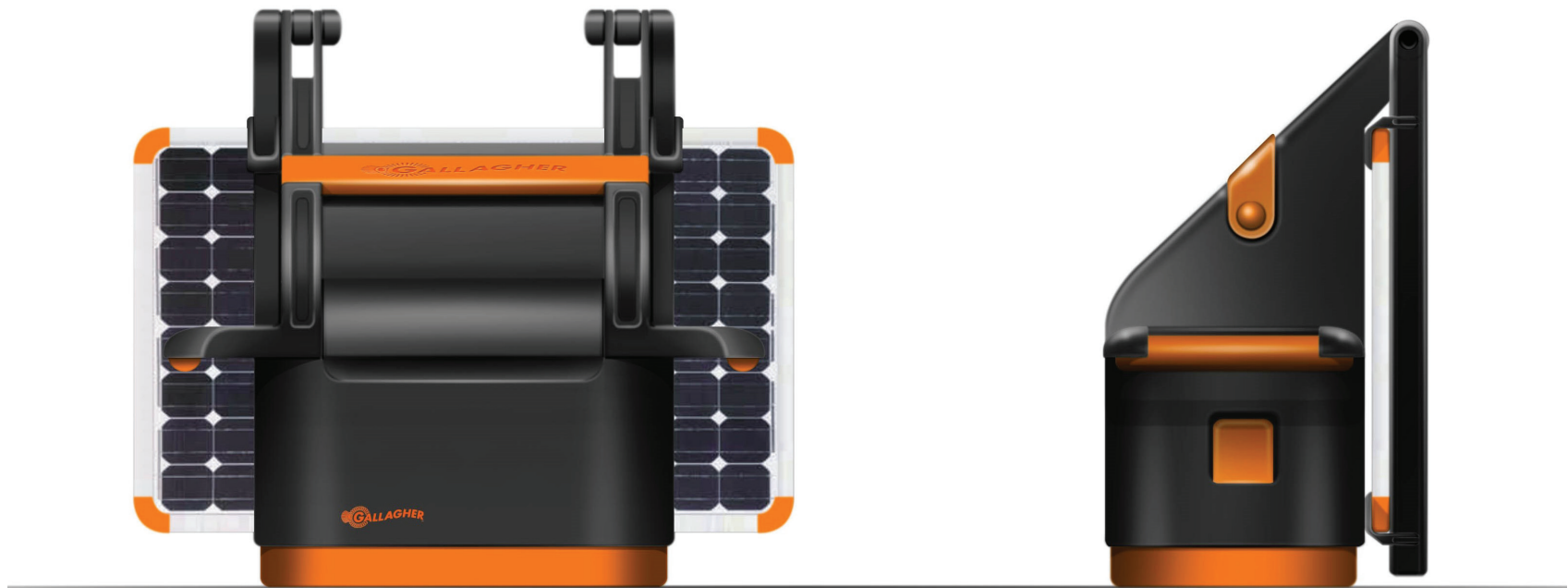


Figure 115. Front and side view

13. Final Design

13.1. *Research Methods Used*

The following methods were used illustrate the final outcome:

- 3D CAD drawings
- 3D CAD renders

CAD drawings (Rhino 3D)
CAD drawings were used to convert the developed concept into an exact, realistic interpretation of the design.

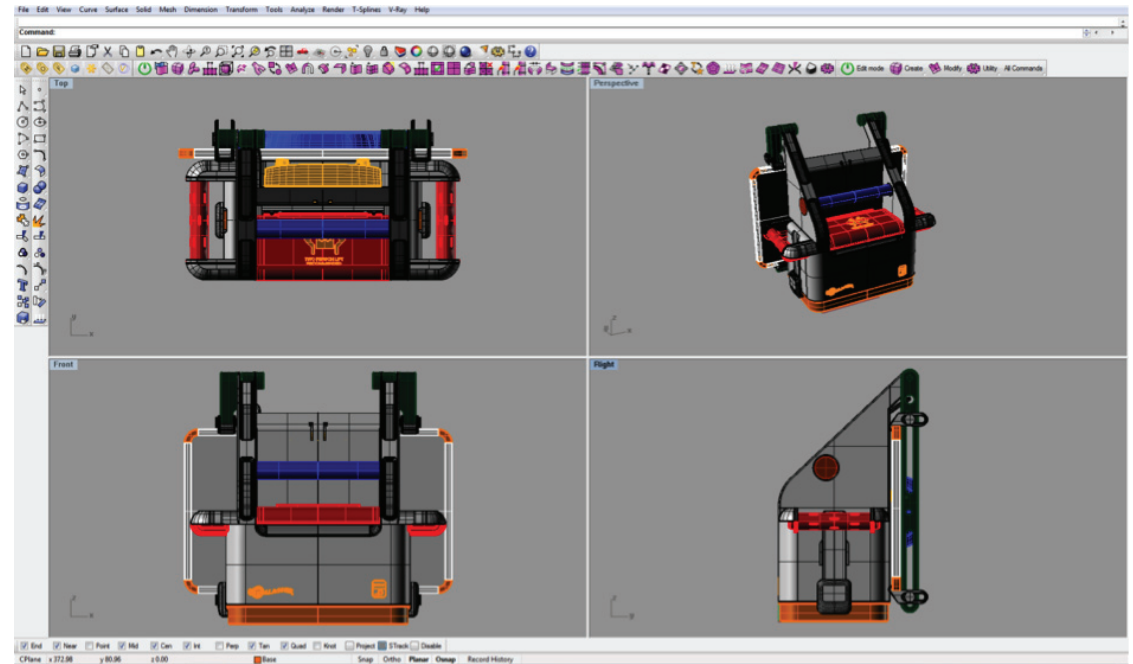


Figure 116. CAD on Rhino 3D

CAD Renders (Vray for Rhino)

CAD renders illustrate final design solutions and help describe the product. The following renders were shown to Gallagher as the final design:

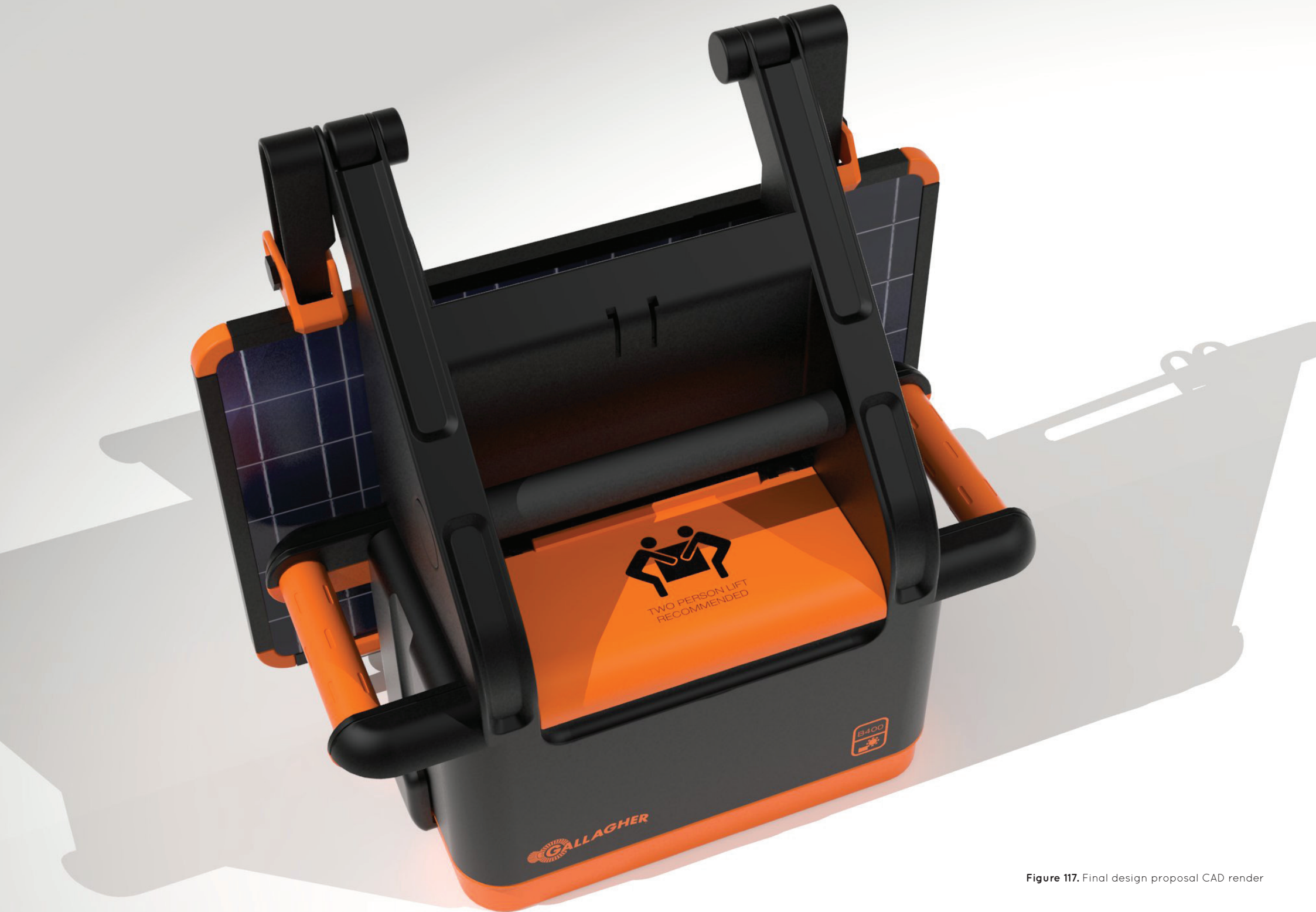


Figure 117. Final design proposal CAD render



Figure 118. Final design proposal: view front



Figure 119. Final design proposal: view rear



Figure 120. Final design proposal: solar panel working position

This setup opposite shows a fully operational solar powered electric fence energizer, containing a 20W solar panel, 50ah battery and Gallagher B180 energizer.

13.2. Parts and Components

1. Base
 2. Battery
 3. Body
 4. Clips (x2)
 5. Side handle (x2)
 6. Central handle
 7. Central handle cap (x2)
 8. Lid
 9. Pivot point cap (x2)
 10. Spacer (x2)
 11. Solar panel mount (x4)
 12. Solar panel arm (x2)
 13. Solar panel
-



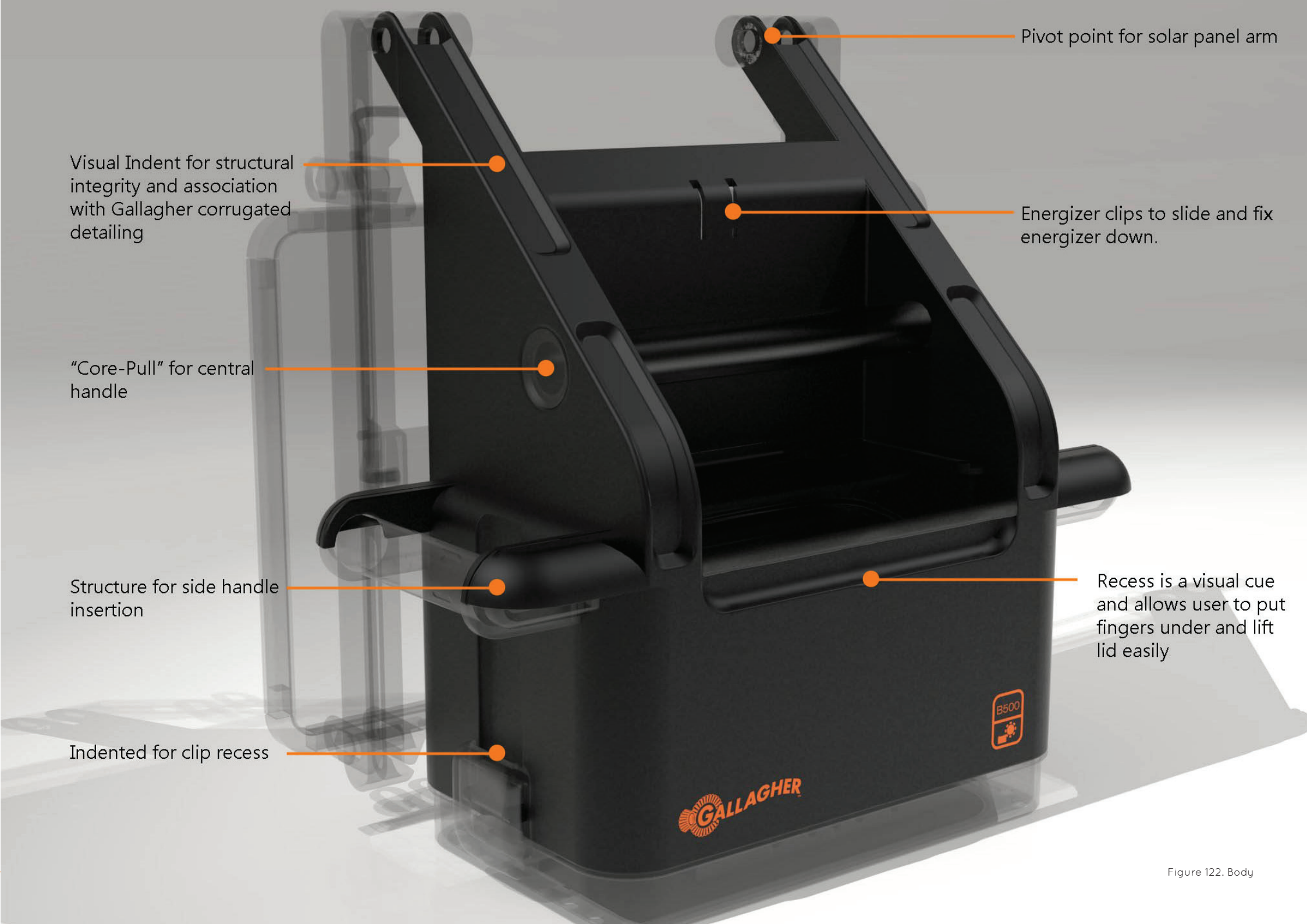
Figure 121. Components

Main Body

The main body is a single ABS plastic injection moulded part designed to include as many of features, detail and function as possible, to reduce the size of other components and provide the strength. The lightweight ABS plastic is modified at Gallagher to provide excellent water, fade and shock resistance for more extreme conditions and contexts of use. Emphasis was placed on incorporating ribs, radiuses and extra support in places where strength was needed, particularly around the clips, side handles and pivot points.

The internal compartment of the body allows unusually long, high or wide batteries to fit inside the containment area.

A single colour has been used to keep the cost of manufacturing low. The logo and model symbols are orange pad printed. The black colour has not only been applied to signify its connection with Gallagher, it to portray a sense of strength, power and visual robustness. The curved forms and soft edges also aid in providing a humanistic element to the design.



Pivot point for solar panel arm

Visual Indent for structural integrity and association with Gallagher corrugated detailing

Energizer clips to slide and fix energizer down.

"Core-Pull" for central handle

Structure for side handle insertion

Recess is a visual cue and allows user to put fingers under and lift lid easily

Indented for clip recess

GALLAGHER

B500

Figure 122. Body

Base

The base has been designed with low edges to allow full access to the battery when the body is removed. The base has been strengthened by incorporating ledges in the plastic and a landing on the exterior. Holes have been positioned in the lowest level to allow water egress.

Orange was chosen at the base to create the “banding” appearance from which it establishes its primary family identity. The orange ABS plastic has been used predominantly because of its excellent manufacturing properties and relatively affordable cost. It is uncomplicated to mould, with only two vertical slides.

A very simple, recessive visual aesthetic has been selected to focus attention on other more dominant parts which the user has interaction with.

On uneven terrain, the surface area of the base is extremely important to prevent the unit tipping over. This common problem has been considered but no remarkable, affordable solution has been integrated into the design.

(Opposite page: **Figure 123**. Base)

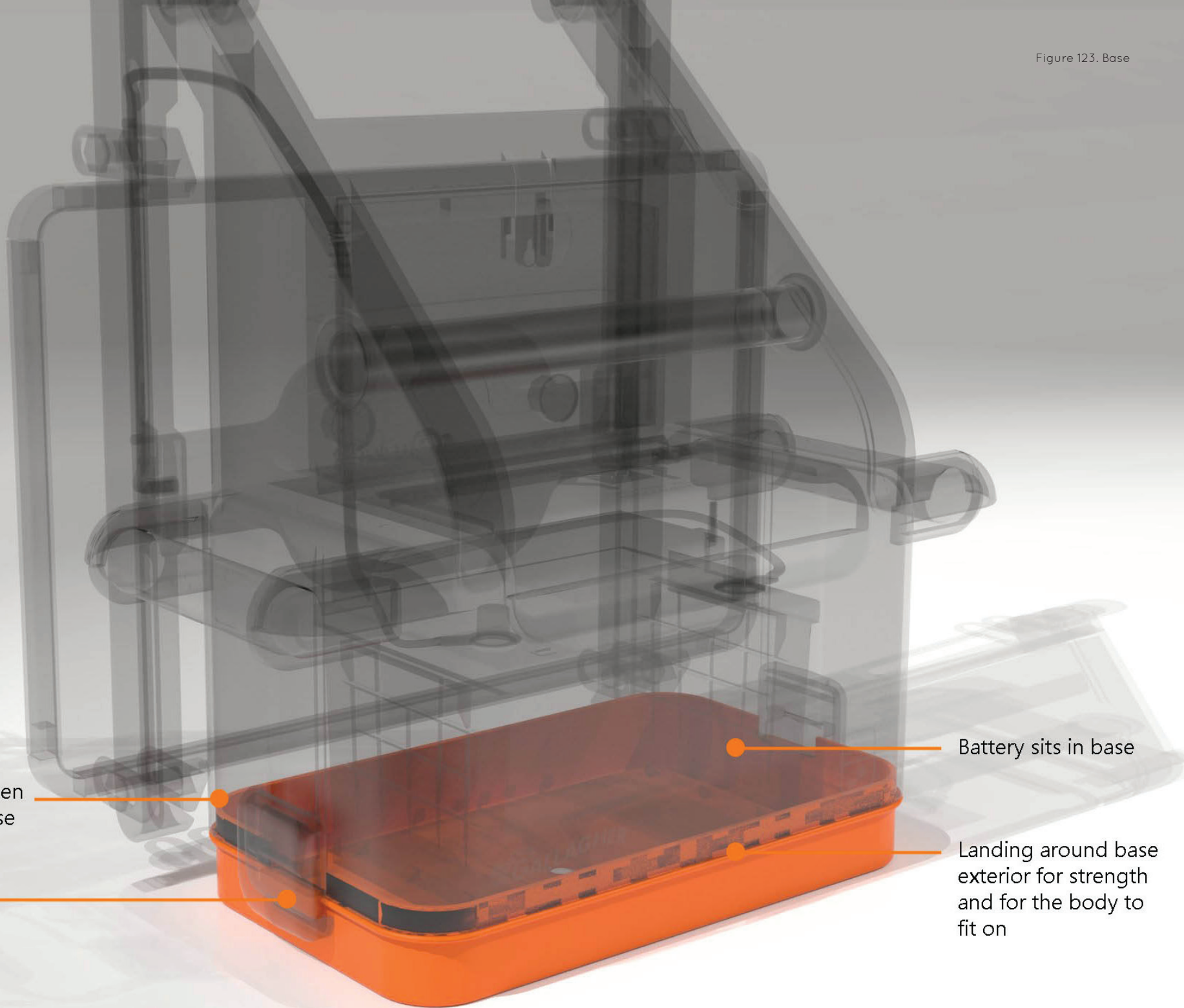
Figure 123. Base

Locator lip helps when placing body on base

Clip attachment

Battery sits in base

Landing around base exterior for strength and for the body to fit on



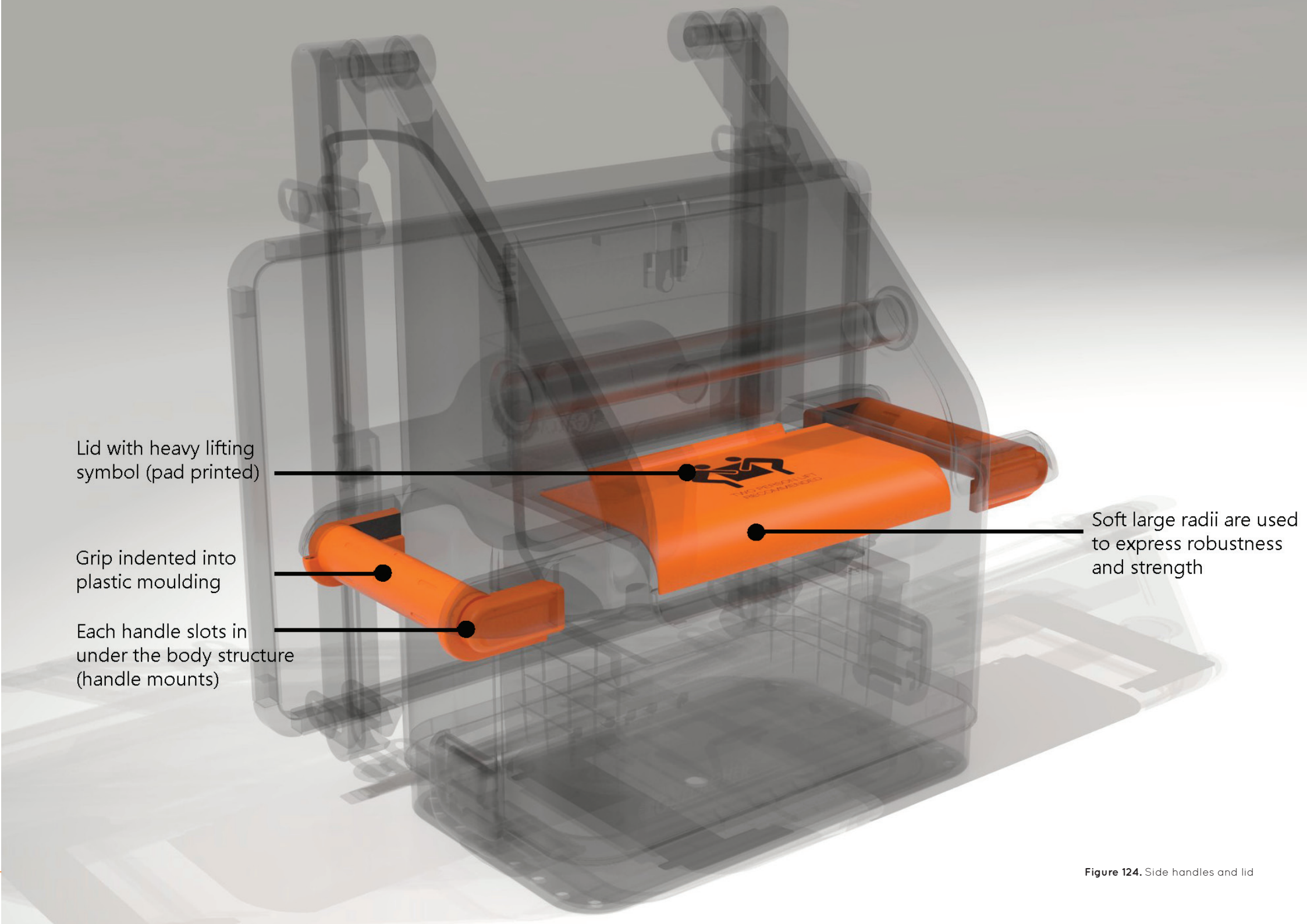
Side handles + Lid

The handles have been designed to be the primary method for lifting and transporting. They have been highlighted in orange ABS plastic with moulded indents and a comfortable location to encourage user interaction. When lifting, users can either pick the unit up with two hands, or share the weight with another individual (two man lift option).

Detailing on the handle ends correspond with the indenting on areas of the main body, solar panel arms and solar panel cover. Orange was chosen to repeat the “banding” appearance to unite the product parts. Contrast also emphasizes the parts of importance, helping the user instinctively understand the hierarchy and layout of the product.

The lid allows easy access to the battery terminals when it is necessary to connect them. This feature adds cost, but adds value through making it easier to use, ensuring the customer does not feel dissatisfied because they cannot access the battery without taking off the body.

A two man lift symbol was pad printed in black on the lid, to ensure it is seen while being used.



Lid with heavy lifting symbol (pad printed)

Grip indented into plastic moulding

Each handle slots in under the body structure (handle mounts)

Soft large radii are used to express robustness and strength

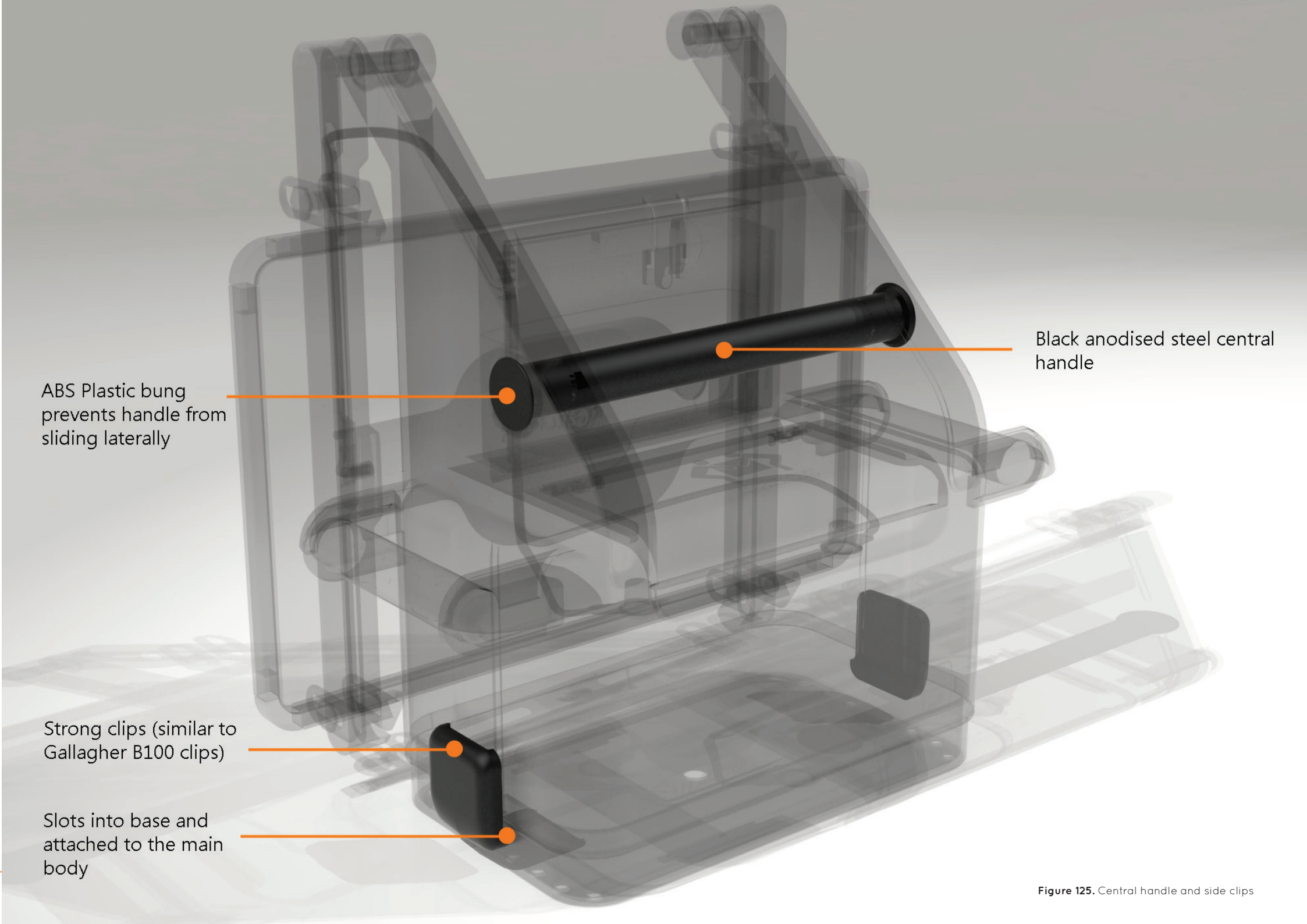
Figure 124. Side handles and lid

Single handle + Clips

The central handle has been incorporated as a Gallagher market requirement. As much as it is possible to lift one handed, it is potentially hazardous. In an effort to prevent users from using it as the primary method of transporting, it has been made recessive, off centre and with minimal ergonomic comfort.

In the event of a user picking up the unit by the handle, it must be capable of supporting the entire weight of the unit and all components. Therefore, a core-pull in the main body structure has been used to provide holes for inserting the steel tube. This method provides sufficient strength over and above general use.

Attaching the body to the base required dependable robust mechanisms which could handle weights of up to 32kg. Clips similar to the existing B100 were utilized because of their strength and reputation as the most reliable joining mechanism. The mechanism is designed to look, feel and be robust to psychologically assure the user it will not release and drop the base with battery.



ABS Plastic bung prevents handle from sliding laterally

Black anodised steel central handle

Strong clips (similar to Gallagher B100 clips)

Slots into base and attached to the main body

Figure 125. Central handle and side clips

Solar panel arms + Regulator cover

The solar panel has been designed to sit in two positions.

1. Stored (protects screen from physical damage, communicates that it is not working, compact for transporting, shipping, primary interacting feature)
2. In use (protects unit from sun damage, rain, highlights “in use”, communicates that it must be pivoted before picking up)

Due to the variations in solar panel sizes on the market, the mounts must be fully adjustable. **Figure 126.** shows how the mounts are able to slide laterally along the slider hole and vertically up the solar panel arm slider holes. To lock this position, basic 12mm nut and bolts have been supplied. This gives it a utilitarian feel, appropriate to the farming environment and is a common mechanism which end users are familiar with and can adjust themselves.

The regulator cover is an added aesthetic feature which protects the regulator on the back of the solar panel. The simple thermoformed sheet provides a blank canvas for minor detailing and a Gallagher logo.

Rotate knob to
tighten pivot point

Circular attribute

Solar panel bracket
mount allows vertical
and horizontal slide
for variations in solar
panel sizes

Solar panel provides the
structural connection
between both arms to
give strength/rigidity

ABS injection moulded
solar panel arm. Cross
sectioned in an "H" for
strength and rigidity

Pivot point for solar panel arm

Regulator cover
made of ABS sheet.
Thermoforming

Slot in solar panel arm
allows solar panel
bracket mounts to slide
vertically

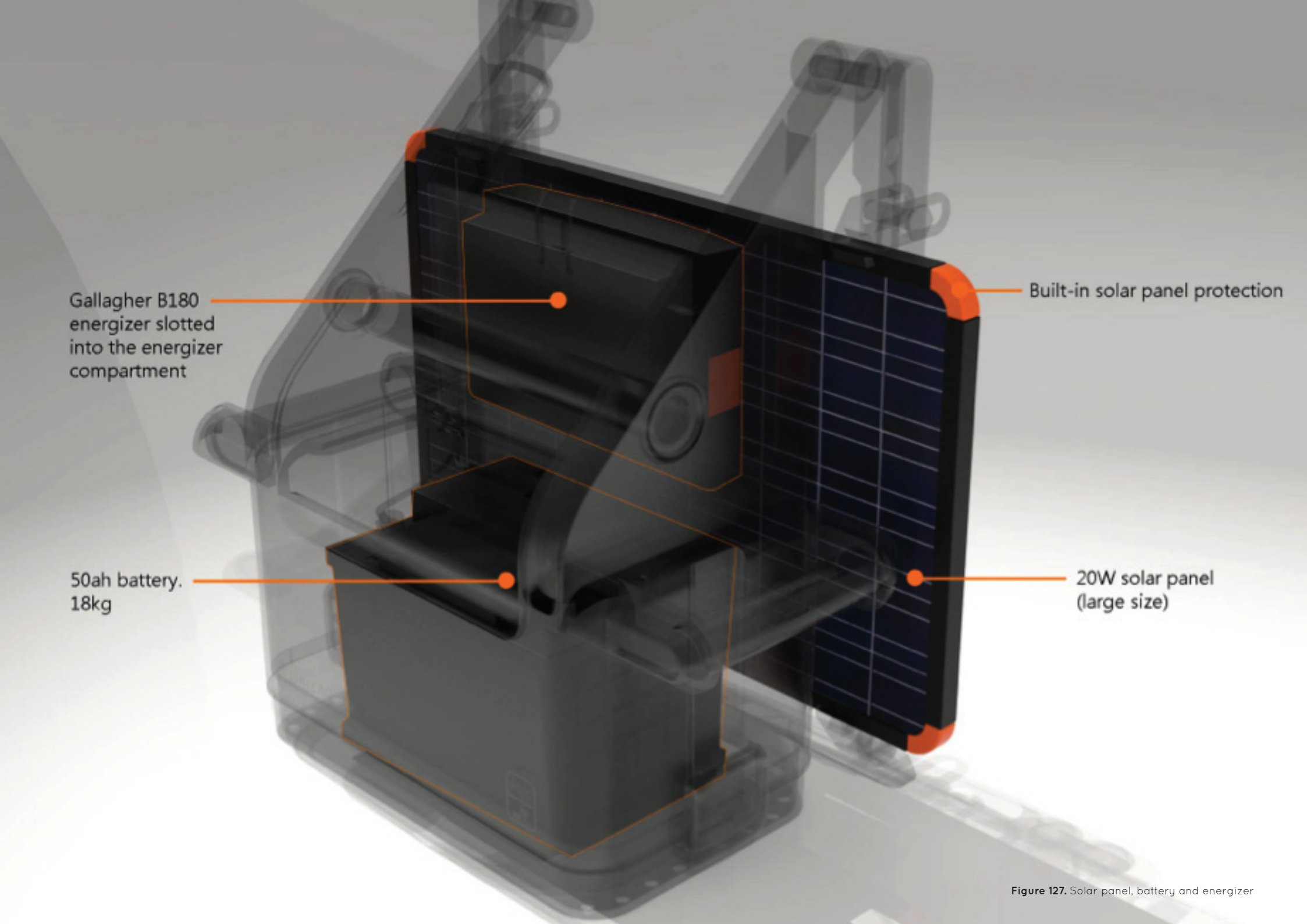
Figure 126. Solar panel arms, mounts and regulator cover

Components

The three components which have been incorporated into the final design illustrate how they relate with the final proposed design. One of the key features of this design is its modular capability.

The only minor modification made is the solar panel protection. If the solar panel protrudes out from the unit, any sharp corners become hazardous. To try to prevent harm to the end user, the frame edges have been softened and highlighted in orange.





Gallagher B180 energizer slotted into the energizer compartment

50ah battery.
18kg

Built-in solar panel protection

20W solar panel
(large size)

Figure 127. Solar panel, battery and energizer

13.3. Details

Clip

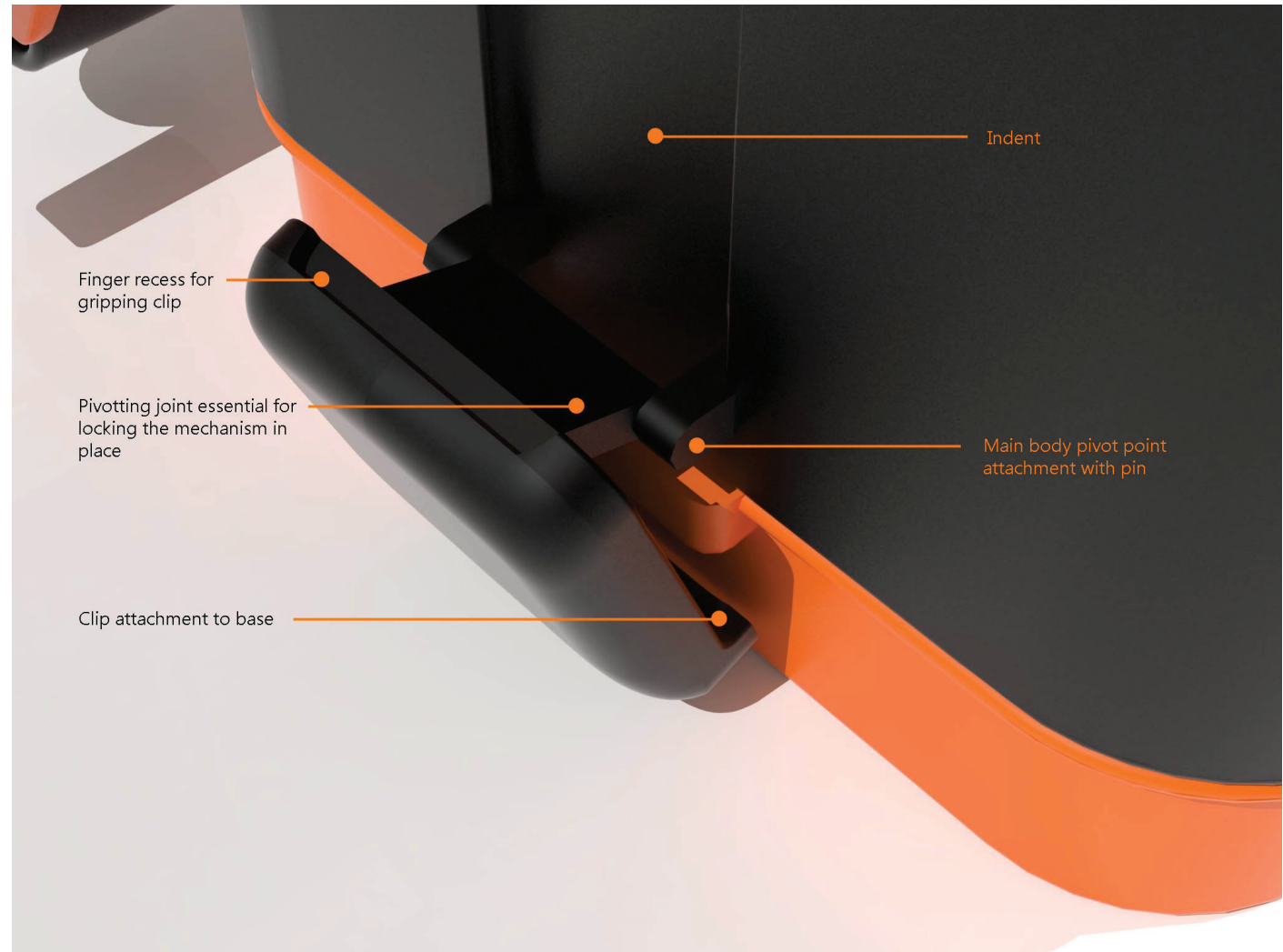


Figure 128. Unlatched clip

Lid

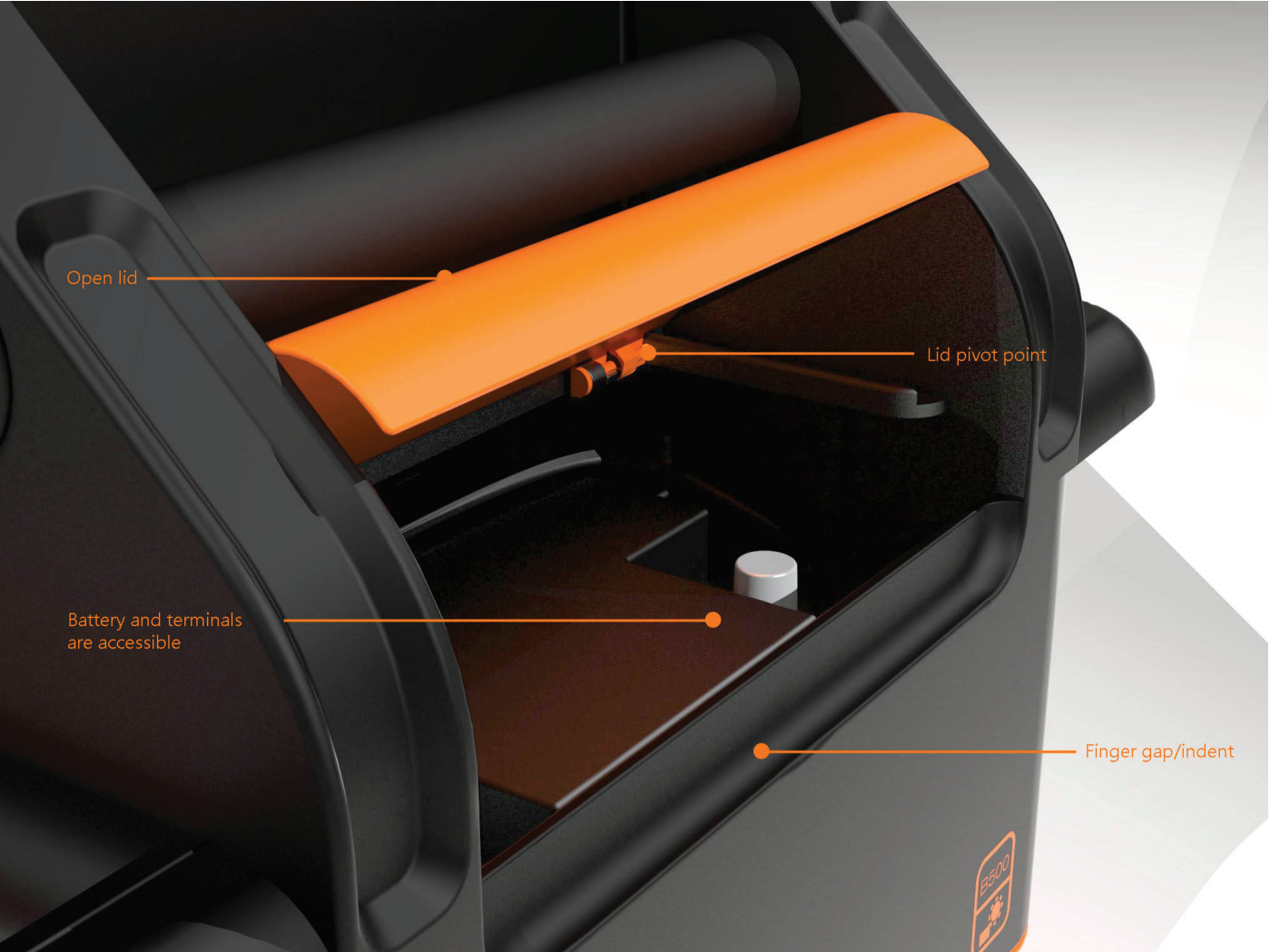


Figure 129. Open lid with exposed battery and lid pivot point

Side handle detailing

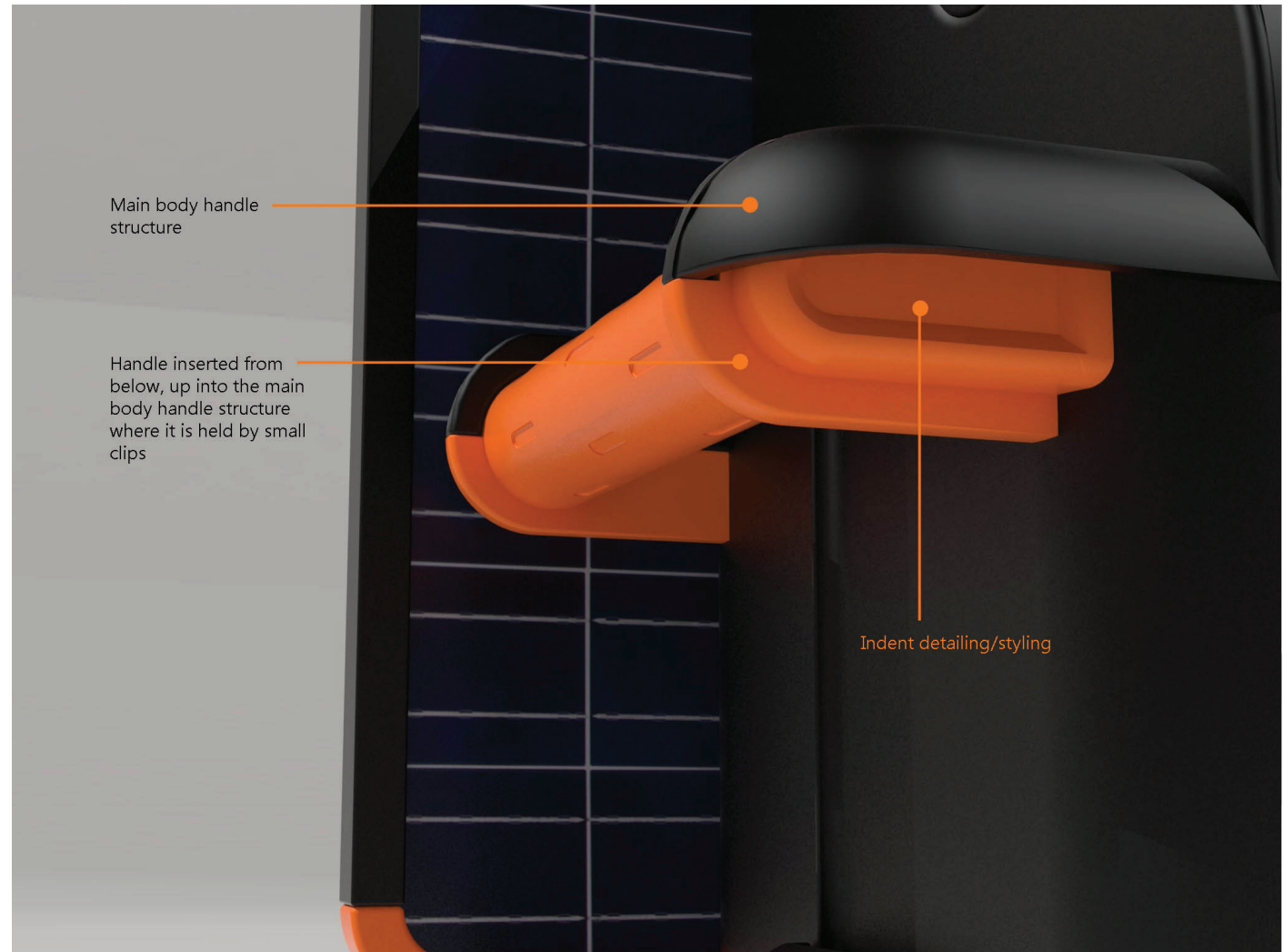


Figure 130. Side handle detailing and insertion

Pivot Point detailing



I
Solar panel arm cross section structure

Pivot point location.
It aims to communicate its intent (rotate)

Hole for solar panel cable to feed through to the battery

Indent detailing/styling

Figure 131. Pivot point

Solar panel positions



Figure 132. Solar panel "in use" position

In stored position

Solar panel sits flush against back side of energizer unit

Carefully located "sweet spot" for pivot point



Figure 133. Solar panel "stored" position

13.4 *User Interaction: Picking up/moving*

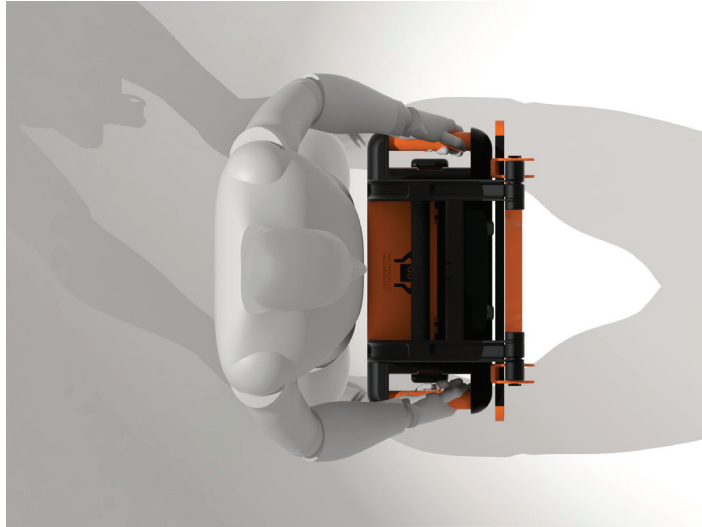


Figure 134. Top view of user hold

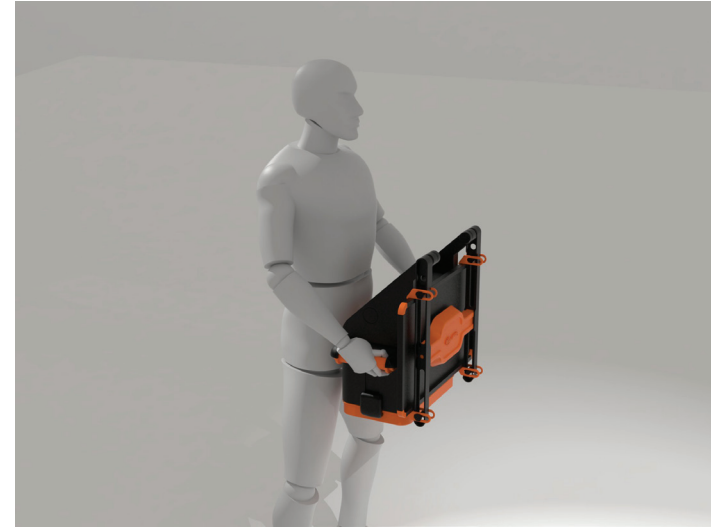


Figure 135. Holding energizer frontrear



Figure 136. Holding energizer rear



Figure 137. Holding energizer side



Figure 138. Recommended two man lift

14. Design Evaluation

To establish whether the design had accomplished the design goals and ultimately the research aim, an analysis of the final proposal was required.

This section outlines a basic internal evaluation of the final energizer design proposal. The evaluation placed importance on determining the extent in which the final outcome solved the design specifications in chapter 7.2. Tables 1 through to 7 contained the criteria in which the final outcome was evaluated.

Decisions were made based on the knowledge gained through the research phase.

14.1. Format analysis Matrix: Design Evaluation

Comments:
Using the format analysis matrix, (Warell, 2008) it is evident that the final proposed design assimilates the visual aesthetics of the Gallagher brand.

The final outcome provided visual characteristics seen in previous Gallagher products. The most prominent features include geometrical forms, black surfaces, orange detailing and the banding detail.

Although it did not contain obvious corrugated details, large indents were present. These indents were intended to be an evolution of the corrugated detail, however focussed on promoting a robust appearance.

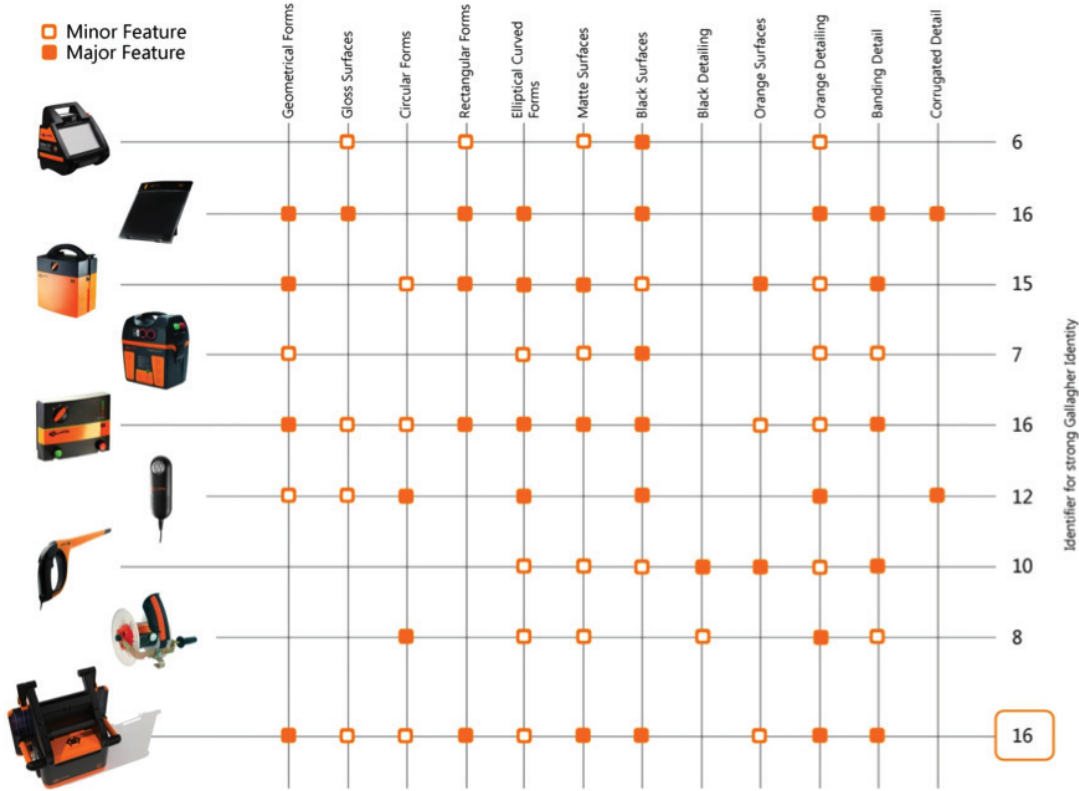


Figure 139. Design evaluation

14.2. Design Evaluation

Functionality Criteria







Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Perform well for the following uses: pest control, crop protection, horse control, orchard protection		In theory, the final design proposal will perform well in the context of use. Existing Gallagher products were used as inspiration and are testament to how well it will perform.		
Work for isolated farm blocks and small farm blocks where there is no mains power supplied			In theory this should work well as it does not need mains power. The unit is self sufficient when equipped with all components.	
"All in one" unit				The final proposal allows all required components to be fixed into the unit. Fully integrated
Usable with 1-5j energizers from Gallagher range		The completely modular setup allocates specific space for each component required for the unit to work. It also provides enough flexibility for future energizers to be mounted.		
Must enable the user to carry the unit up to 50m				
Comfortable to lift onto a vehicle at roughly waist height			This is dependant on the user, conditions, weight of components and height of lift. The final proposal aims to make it as easy as possible, but in some cases, this may not be possible.	
Stable on uneven terrain		Many variables influence the stability of the product. Effort has been made to keep a low centre of gravity, a wide base and prevent wind from pushing the unit over. Requires further testing		

Table 8. Functionality Criteria

Business Criteria






Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Reduce the number of SKU numbers/products on the shelves	 The flexibility of the final proposal enables many different components to be integrated into the product, effectively reducing the number of Gallagher products needed to be stocked on the shelves and ultimately the number of SKU's. The number of parts was kept as low as possible in the final design			
Reduce the cost of manufacturing so many different solar energizers		 Reducing the number of products required for manufacturing. I believe that through removing 3 or more products from the market, there can be a reduction in cost of manufacturing so many parts.		
Provide a platform for future associated products			 The modularity of the final proposal provides a firm platform for future products to be integrated into.	
Competitive Pricing		 The cost of the end product to the user has not been quantified. Further investigation from engineers and manufacturing specialists is required		
Designed for NZ, AUS, US, EU Markets			 The proposed design has been designed for these markets, aimed at satisfying specific customer needs and wants found in the research investigation	

Table 9. Business Criteria

User Criteria





Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Provide a flexible, modifiable, upgradeable semi-portable solar powered electric fence energizer		 The unit enables users to make modifications and upgrades without having to buy a complete new unit.		
Must be easy to set up, assemble, pack up (portability)			 This has not been tested or quantified among a large number of end users with minimal experience. Further testing required	
Must endure hot, cold, wet, dry, dusty conditions	 Material selections, manufacturing techniques and careful design aims to cope with these conditions. Existing Gallagher products served as exemplars to highlight good and bad design decisions			
Robust in construction		 All possible factors were considered when designing, to ensure a robust product		

Table 10. User Criteria

Manufacturability/Tooling/Assembly Criteria



Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Feasible to tool for injection moulding	 Completely feasible to tool in the most practical, affordable and appropriate way.			
Can be realistically manufactured at a reasonable price, with minimal complexity involved		 Huge emphasis was placed on finding the most realistic, simple solution for manufacturing the final proposed design. The result is a product which can be manufactured in its current state.		

Table 11. Manufacturing Criteria

Brand Identity/Aesthetic Criteria






Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Carry on with the form language strongly associated with the Gallagher range of products	 Final design proposal uses the design characteristics of the Gallagher brand language. Strong visual family identity			
Must aesthetically differentiate itself from competitor products in the market		 Completely new form topology, features and visual characteristics separate the design proposal from other energizer products on the market		
Aim for timeless, long lasting aesthetic styling			 Currently this product integrates Gallagher aesthetics very well, but the aesthetics applied in the final proposal may not be "timeless" as this can not be measured	
Look strong, durable and suitable for the job	 The solid appearance with robust visual characteristics conveys a sense of strength. Many solutions were explored and the strongest was chosen, for example: Clips instill a sense of security (battery and base wont detach and drop on users feet)			
Appropriate visual aesthetic in the context of use		 The use of colours, detailing and form provides a finished compact product appearance and relates to the fence structure when attached.		

Table 12. Brand Identity Criteria

Desirability Criteria

Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Integrate desirability features within the product that will appeal to the customer, above and beyond pure utilitarian function	 <p>Desirability was thoroughly integrated into the final proposal through the use of simple, clever features, consciously designed aesthetics, among other decisions.</p>			

Table 13. Desirability Criteria

Usability Criteria





Criteria	Imperative	Desirable (High)	Desirable (Moderate)	Desirable (Low)
Must express what it is and how it is used through its form	 <p>Features and form express what they are and what they intend to do. Visual symantics and affordance</p>			
Be understandable to a user with limited knowledge in electric fence systems		 <p>Currently untested. Effort has been made to create a simple product with features and well known mechanisms which are relatable to other products on the market</p>		
Ensures correct, safe assembly, installation and use		 <p>Holes, pivot points, catches, levers and other features have been designed to afford natural user interaction, aiming to ensure correct, safe and simple assembly, installation and use.</p>		
Safe to use	 <p>No sharp edges and obtrusive parts have been removed/modified to prevent user or animal from causing harm to themselves</p>			

Table 14. Usability Criteria

15. Research Investigation Conclusion

This project aimed to provide an innovative design proposal based on market gaps or opportunities found in the research phase. Through research investigations, the most commercially viable gap in the market was chosen (2-5J modular solar energizer system) along with identifying other opportunities and issues which were prevalent in the market. This unique market opportunity is a completely new concept, requiring knowledge gaps to be filled throughout the design process. With the guidance from Gallagher experts and relevant research literature, issues and challenges were identified and addressed accordingly.

Through an iterative design process, the project aimed to resolve objectives and criteria set out in the research phase. (See **Table 8-14** for criteria analysis) The majority of these were solvable, while others proved difficult and could only be answered to a certain extent. The unsolved areas were identified as issues for further development.

This project outcome focussed on providing the best solution with respect to user requirements, Gallagher business requirements, manufacturing requirements,

and idealistic industrial design input. Therefore, the design decisions that were made had to be prioritised due to these influences, meaning not all criteria were addressed to their fullest potential.

End user safety concerns, particularly lifting heavy weights and potential injury have proved difficult throughout the project. The final design proposal provided a solution which is safe (ergonomically prudent and stays within international safety standards) while still affordable and practical.

A recognised factor which requires more investigation is a full scale full working prototype, which would either validate the executed theories or identify any issues which challenge usability, functionality and context of use. A working prototype could be used to test strength, water ingress, balance and any other problematic issues that present over time.

In theory, a strategic move to replace the B100, 200, 300 is sensible. Further market verification is required to find out a consumer price point, estimated production numbers and manufacturing costs before replacing the B100 line of energizers.

The cost to manufacture this product is reflective of its size, complexity and material selection. A key challenge for this project was to condense all components into the smallest space possible to reduce the overall size of the unit, while making it simple to tool and still meet all other objectives. The final profile means that it has the capability of interchanging different sized components; however, the effect may be that it exceeds the price cap.

The final design analysis indicates that despite the immense number of challenges faced, most objectives were attained over and above the expected requirement. The result is a new product platform which has not only fulfilled Gallagher's brief to advance their solar powered energizer range, but has opened up a new market niche to pioneer.

(Opposite page: **Figure 140**. Final product design)



16. Recommendations for future work

The following work would be of further benefit to this project:

- Develop the next version of energizer to fit the energizer cavity in the unit
 - Look into additional ways of manufacturing parts or divide existing parts into smaller sections to try to reduce cost of manufacture
 - Provide additional devices to aid in lifting (pulleys, ropes, etc.)
 - Incorporate a specific location(s) for a grounding rod(s) of varying sizes
 - Build in a way to attach the energizer to the ground to prevent theft
 - Further market verification to find out a consumer price point, estimated production numbers and manufacturing costs
 - Incorporate the corrugated texture (without added cost) to create a strong Gallagher brand identity
 - Remove all cabling and use carefully placed conductive contact points to connect the solar panel, battery and energizer, improving simplicity and ease of use
 - The addition of a simple solar panel “catches” in both the stored and in use positions to prevent the solar panel from freely pivoting
-

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19. Appendices



18 December 2013

Dear Nick,

On Behalf of both Gallagher Group Limited and myself I would like to sincerely thank you for the hard work and long hours you have put into developing a new Energizer this year.

From the get-go your approach has been measured and scientific, the survey and other research gathering you conducted have provided insights into new project opportunities and other avenues for us to explore. I enjoyed the rapport between us especially through the initial ideation phase, your ability to provide left-field ideas and yet remain grounded enough that the ideas are in the realms of possibility helped stimulate a lot of good discussion.

I really appreciate the effort you have taken to further your understanding of manufacturing processes and options available. With the limited mechanical engineer contact that you have had you ended up becoming a well versed expert in injection molding yourself. Seeing this self-development in you, along with the ability to take criticism of your ideas compels me to believe your future in an integrated design environment is very bright. Engineers will enjoy working with you due to the fact you can quickly pick up their language and comprehend what their issues are.

Two parts of your work this year stand out as clear strengths, the first being the handmade models used to illustrate initial concepts and ideas. These semi-working models were a game changer for our discussions and really sped things along in terms of getting people on board with our ideas. The second part of your work that stands out to me is the quality of your 3-D Renders and the slick design of the final product option we have ended with. I am more than happy to take these drawings to potential customers as they are created in a very professional manner and well suited to the Gallagher branding requirement. Well done.

You seem to find yourself at home in both the design process and in the presentation of your ideas, because of that I would happily work with you on future projects and products and I think the world is going to see many Nick Marks designed products!

Thanks again,

Byron Arnold BE(Hons)
Product Manager – Energizers
Gallagher Group Limited

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Appendix D

MASSEY UNIVERSITY
Application for Approval of Request to Embargo a Thesis
(Pursuant to AC98/168 (Revised 2), Approved by Academic Board 17/02/99)

Name of Candidate: NICHOLAS MARKS ID Number: 09044167

Degree: MASTERS OF DESIGN (MOES) Dept/Institute/School: MASSEY UNIVERSITY

Thesis title: Modular solar powered electric fence unit (TBC)

Name of Chief Supervisor: TERRY PARSONS Telephone Ext: 62389

As author of the above named thesis, I request that my thesis be embargoed from public access until (date) ... March 2016 ... for the following reasons:

- Thesis contains commercially sensitive information.
- Thesis contains information which is personal or private and/or which was given on the basis that it not be disclosed.
- Immediate disclosure of thesis contents would not allow the author a reasonable opportunity to publish all or part of the thesis.
- Other (specify):

Please explain here why you think this request is justified:

The work conducted in this project has been based around the strategic direction of the Gallagher product range. Release of this information could damage the reputation of current products and provide insight to competitors about Gallagher future plans.

Signed (Candidate): [Signature] Date: 16/10/2013

Endorsed (Chief Supervisor): [Signature] Date: 16/10/2013

Approved/Not Approved (Representative of VC): [Signature] Date: 23/11/2013

Note: Copies of this form, once approved by the representative of the Vice-Chancellor, must be bound into every copy of the thesis.

To design a product ready for manufacture, it is important to understand the following key concepts:

The number of slides and slide directions

Slides are required to create the negative space which is then filled with liquid plastic. The following images explain how a product with two slides can create a product with holes in two directions. If this is not done with more than two slide directions, undercuts are created. See **Figure 21**.

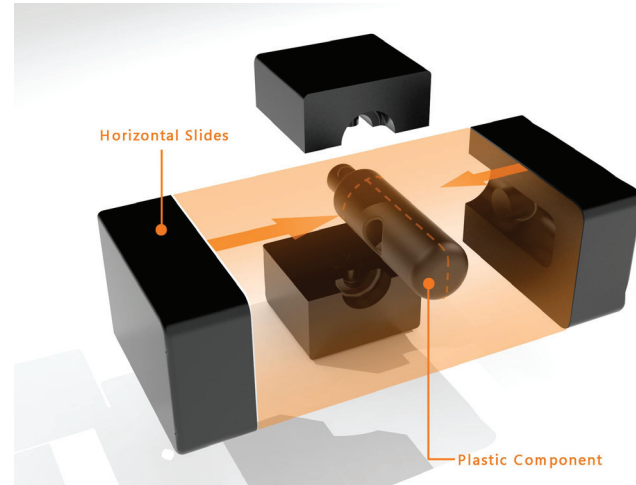


Figure 18. 2 Horizontal Slides Shown

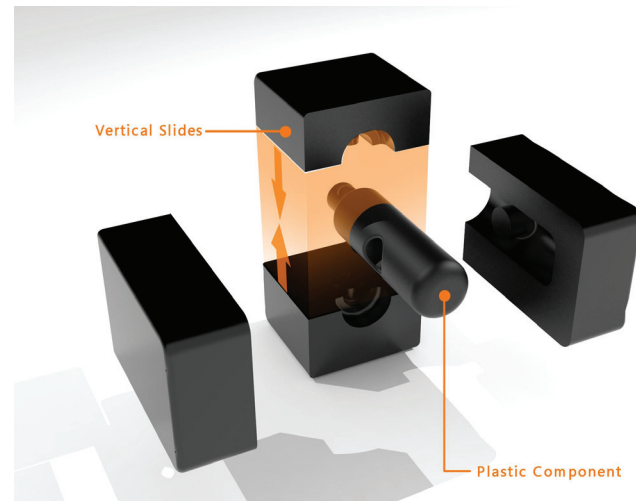


Figure 19. 2 Vertical Slides Shown

Cores

Cores are used when a product is hollow or needs wall thicknesses and are inserted before the plastic is injected into the mould cavity. **Figure 20** illustrates how a core is inserted before the plastic is injected.

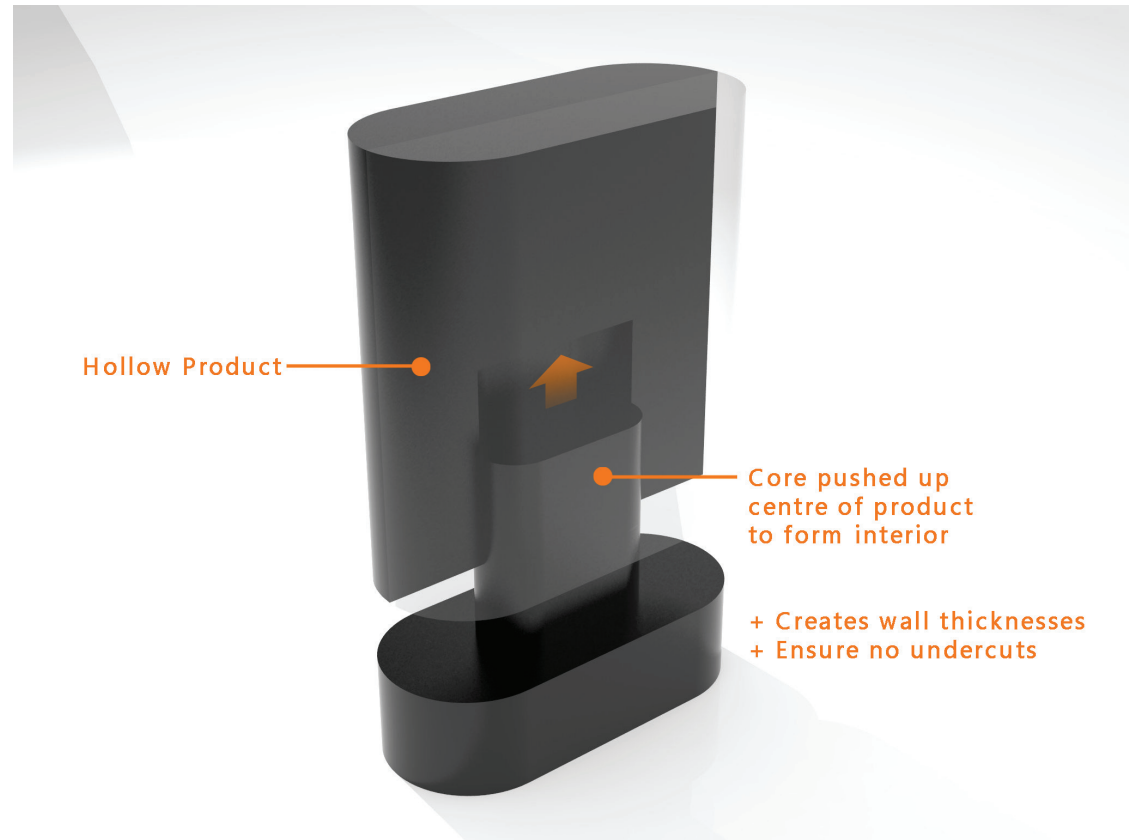


Figure 20. Hollow product made with a core tool

Undercuts

Undercuts prevent the product from being removed from the tooling and must be avoided. **Figure 21** shows what a product with undercuts looks like.

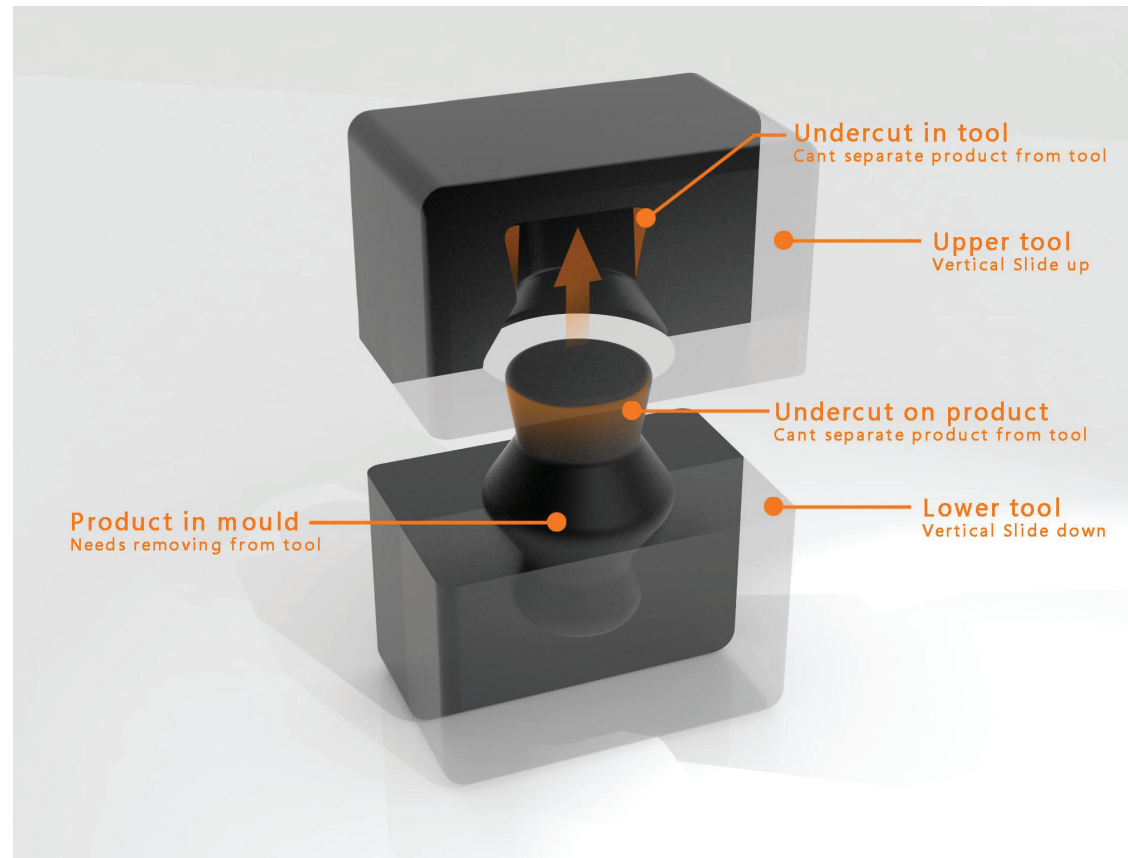


Figure 21. Product with undercuts, unable to be removed from the tool

4.10. Injection Moulding

In Process, Materials and Manufacture (pg.39) Daniel F. Cuffaro (2006) describes injection moulding as “a process by which melted plastic is injected into a negative cavity and cooled to create a positive part. Injection-moulded parts typically have a high level of finish and detail on exterior and interior surfaces.”

Cuffaro (2006) describes on page 40 important considerations such as draft angles, undercuts, sharp corners, uniform wall thicknesses, and complex machine features such as shut-offs, sliding parts, cam blocks and collapsible cores. These tooling features add cost, but can reduce parts, labour cost and add value to the final product.

These requirements were thoroughly considered when developing the final design proposal, and played a significant role in design decisions made in this process.

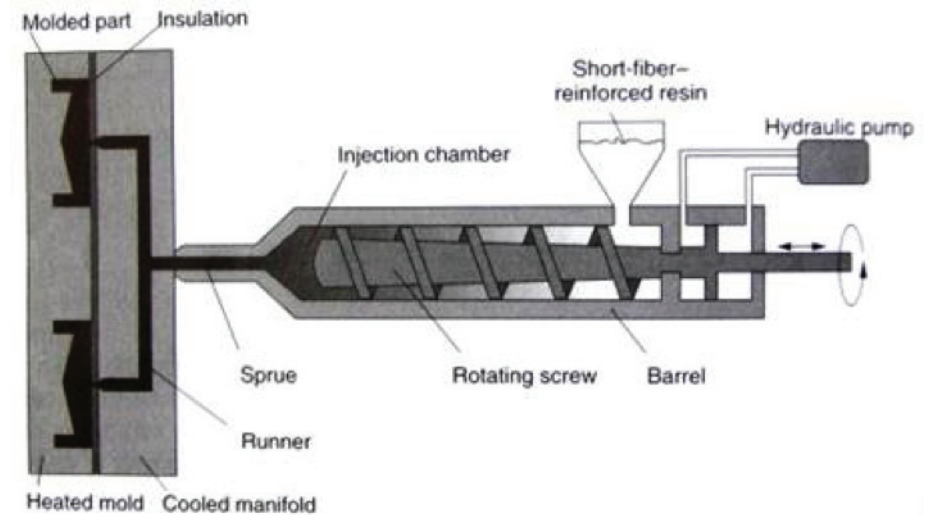


Figure 22. Standard injection moulding machine

Table 1.7 Hand and wrist sizes (in mm)

Hand measures	Population	Men		Women	
		Mean	SD	Mean	SD
1. Length	British	180	10	175	9
	British, estimated 1986	190	10	175	9
	Chinese, Taiwan	183	10	167	8
	French	190	nda ^a	173	nda
	Germans	189	9	174	9
	German soldiers 2006	191	nda	176	nda
	Japanese	nda	nda	nda	nda
	Russians, Moscow	188	9	168	8
	U.S. soldiers	194	10	181	10
	U.S. Vietnamese	177	12	165	9
2. Breadth at knuckles	British	85	5	75	4
	Chinese, Taiwan	86	5	75	4
	French	86	nda	76	nda
	Germans	88	5	78	4
	Japanese	nda	nda	90	5
	Russians, Moscow	87	5	76	3
	U.S. soldiers	90	4	79	4
	U.S. Vietnamese	79	7	71	4
	U.S. Vietnamese	79	7	71	4
3. Maximal breadth	British	105	5	92	5
	Chinese	nda	nda	nda	nda
	French	nda	nda	nda	nda
	Germans	107	6	94	6
	Japanese	nda	nda	nda	nda
	Russians	nda	nda	nda	nda
	U.S. soldiers	nda	nda	nda	nda
	U.S. Vietnamese	100	6	87	6
4. Circumference at knuckles	British	nda	nda	nda	nda
	Chinese	nda	nda	nda	nda
	French	nda	nda	nda	nda
	Germans	nda	nda	nda	nda
	Japanese	nda	nda	nda	nda
	Russians	nda	nda	nda	nda
	U.S. soldiers	214	10	186	9
	U.S. Vietnamese	nda	nda	nda	nda

Hand and wrist sizes (in mm) (Continued)

Measure	Population	Men		Women	
		Mean	SD	Mean	SD
Circumference	British	nda	nda	nda	nda
	Chinese	nda	nda	nda	nda
	French	nda	nda	nda	nda
	Germans	nda	nda	nda	nda
	Japanese	nda	nda	nda	nda
	Russians	nda	nda	nda	nda
	U.S. soldiers	174	8	151	7
	U.S. Vietnamese	163	15	137	18

Source: Data taken from Imrhan et al. (1993), Kroemer (2006), and Leyk et al. (2006). Adapted from Kroemer, K.H.E. (2006). "Extra-Ordinary" Ergonomics: How to Accommodate Small and Big Persons, the Disabled and Elderly, Expectant Mothers and Children. Boca Raton, FL: CRC Press.

^a nda: No data available.

and guards are taller and heavier (males by 7 kg, females over 10 kg) than persons in all other occupations⁹.

Design principles

Before we begin to design a glove, helmet, or other object that must fit its user exactly, we must decide which range of relevant body sizes we want to accommodate. For this aim, we have a choice among five approaches.

1. *Custom-fit each individual.* This is a laborious and expensive solution, justifiable in a few exceptional cases.
2. *Have several fixed sizes.* This can be a reasonable solution, but all sizes must be available and "between-sized" users may not be accommodated well.
3. *Make it adjustable.* This is usually the approach that provides the best fit to all people, but the adjustment features must be easy to use.
4. *Design for the extreme bodies.* This is the appropriate solution when you want to assure that any individual:
 - Can operate a gadget, so locate an emergency stop button within the shortest reach; or
 - Can fit through an opening, so make a door or escape hatch wide enough for even the largest person; or

Ergonomics

Hand

Table 4.1 Maximal push forces in N of female and male U.S. workers

Height ^a	Percent ^b	One 2.1 m PUSH every						One 30.5 m PUSH every					
		6	12	1	2	5	30	8	1	2	5	30	8
		sec	min	min	min	min	hr	hr	min	min	min	hr	hr
Initial push forces													
Males	90	106	235	255	255	275	275	334	95	167	186	216	265
	75	275	304	334	334	353	353	432	75	206	235	275	343
	50	334	373	422	422	442	442	530	50	265	294	343	432
Females	90	137	147	167	177	196	206	216	89	118	137	147	177
	75	167	177	206	216	235	245	265	75	147	157	177	206
	50	196	216	245	255	285	294	314	50	177	196	206	255
Sustained push forces													
Males	90	98	128	159	167	186	186	226	95	79	98	118	157
	75	137	177	216	216	245	255	304	75	108	128	157	206
	50	177	226	275	285	324	334	392	50	147	167	196	265
Females	90	59	69	88	88	98	108	128	89	49	59	69	88
	75	79	108	128	128	147	159	186	75	79	88	88	128
	50	108	147	177	177	196	206	255	50	98	118	118	167

Source: Adapted from Snook, S.H. and Ciriello, V.M. (1991). The design of manual handling tasks: Revised tables of maximum acceptable weights and forces, *Ergonomics*, 34: 9, 1197-1213.

^a Vertical distance from floor to hands (cm).

^b Acceptable to 90, 75, or 50% of industrial workers.

Max
CARRY WEIGHTS
Ergonomics

Table 4.2 Maximal carry weights in kg acceptable to male U.S. workers

Height from floor to hands (cm)	Percent of industrial population	2.1 meter carry						4.3 meter carry						8.5 meter carry								
		One carry every		hr		min		One carry every		hr		min		One carry every		hr		min				
		6	12	1	2	5	30	8	10	16	1	2	5	30	8	18	24	1	2	5	30	8
90	90	10	14	17	17	19	21	25	9	11	15	15	17	19	22	10	11	13	13	15	17	20
	75	14	19	23	23	26	29	34	13	16	21	21	23	26	30	13	15	18	18	20	23	27
	50	19	25	30	30	33	38	44	17	20	27	27	30	34	39	17	19	23	24	26	29	35
	25	23	30	37	37	41	46	54	20	25	33	33	37	41	48	21	24	29	29	32	36	43
	10	27	35	43	43	48	54	63	24	29	38	39	43	48	57	24	28	34	34	38	42	50
79	90	13	17	21	21	23	26	31	11	14	18	19	21	23	27	13	15	17	18	20	22	26
	75	18	23	28	29	32	36	42	16	19	25	25	28	32	37	17	20	24	24	27	30	35
	50	23	30	37	37	41	46	54	20	25	32	33	36	41	48	22	26	31	31	35	39	46
	25	28	37	45	46	51	57	67	25	30	40	40	45	50	59	27	32	38	38	42	48	56
	10	33	43	53	53	59	66	78	29	35	47	47	52	59	69	32	38	44	45	50	56	65

Table 4.4 Techniques of carrying weights of about 30 kg (Continued)

	Estimated energy expenditure for carrying 30 kg on a straight flat path	Estimated muscular fatigue	Local pressure and ischemia	Stability of loaded body	Special aspects
On one shoulder	?	High	Very high	Very poor	May free hand; strongly affects posture Suitable for short-term transport of heavy and bulky loads
Across both shoulders by yoke, held with one hand	High, about 6.2 kcal/min	?	High	Poor	May free hand(s); affects posture Suitable for bulky and heavy loads; pads and means of attachment must be provided carefully
On back	Medium, 5.3 kcal/min with backpack; 5.9 kcal/min with bag held in place by hands	Low	?	Poor	Backpack frees hands; forces forward bend of trunk; skin-cooling problem Suitable for large loads and long-time carriage. Packaging must be done carefully; attachment means shall not generate areas of high pressure on body
On chest	?	Low	?	Poor	Frees hands; easy hand access; reduces trunk mobility; skin-cooling problem Highly advantageous for several small loads that must be accessible

CARRY TECHNIQUES
ERGONOMICS

Distributed on chest and back	Low, 4.8 kcal/min	Lowest	?	Good	Frees hands; may reduce trunk mobility; skin-cooling problem Highly advantageous for loads that can be divided or distributed; suitable for long-durations
At waist, on buttocks	?	Low	?	Very good	Around waist for smaller items, distributed in pockets or by special attachments; superior surface of buttocks often used to partially support backpacks
On hip	?	Low	?	Very good	Often used to prop up large loads temporarily
On legs	?	High	?	Good	Requires pockets in garments or special attachments
On foot	Highest	Highest	?	Poor	Usually not useful

Source: Adapted from Kroemer, K.H.E. (1997), *Ergonomic Design of Material Handling Systems*, Boca Raton, FL: CRC Press.

Material handling

mind, and using improved mathematical modeling of human characteristics, the assessment of lift/lower capabilities can also employ physiological, biomechanical, psychophysical, behavioral, and epidemiological criteria and their combinations^o.

Physiological criteria relate to metabolic, circulatory, respiratory and musculoskeletal events; see Chapter 10 in this book. Among the biomechanical issues, pressure within the discs of the spinal column is a major concern^o. Psychophysical assessments should integrate the physiological and biomechanical criteria while also considering behavioral aspects. With injuries, particularly of the lower back, frequent among material handlers (such as warehouse workers and nurses), epidemiological statistics and accident investigations can pinpoint causes of work-related injuries and, based on such knowledge, indicate ways to avoid risks and to strive for safer conditions.

Lift and lower guidelines

The combination of those disciplinary approaches led to the development of guidelines on lifting and lowering by the U.S. National Institute of Occupational Safety and Health in the 1980s. Notable among the physical criteria used to develop the guidelines was the highest acceptable disc compression in the lumbar spine. The latest 1991 NIOSH^o guidelines contain recommended weight limits (RWLs) that 90% of U.S. industrial workers, male or female, may lift or lower.

In the 1991 NIOSH guide, the maximal weight is 23 kg, but the actual recommended load is usually lower, depending on several factors, which include

- The horizontal and vertical paths of the hands, determined by the start and end points
- Whether the action is in front of the body
- The frequency of the lifting and lowering actions
- The quality of coupling between hand and load

These and some other factors become multipliers in an equation by which one calculates the RWL that applies under the given conditions.

At about the same time as the NIOSH developed its equations, Snook and Ciriello conducted psychophysical tests with American workers to determine the efforts that they were willing to exert in lifting and lowering^o loads. Some of their results appear in Tables 4.5 and 4.6; these are excerpts from their full recommendations, which contain more complete information.

LIFT
FROM TO WAIST
ERGONOMICS

Table 4.5 Maximal lift weights in kg of female and male U.S. workers

Width (a)	Distance (b)	Percent (c)	Floor level to knuckle height One Lift Every					Knuckle height to shoulder height One lift every					Shoulder height to overhead reach One lift every														
			5	9	14	1	2	5	30	8	5	9	14	1	2	5	30	8	5	9	14	1	2	5	30	8	
			sec	min	min	hr	sec	min	min	hr	sec	min	min	hr	sec	min	min	hr	sec	min	min	hr	sec	min	hr		
Males																											
		90	9	10	12	16	18	20	24	9	12	14	17	17	18	20	22	8	11	13	16	16	17	18	20		
34	51	75	12	18	18	23	26	28	29	34	12	16	18	22	23	26	29	11	14	17	21	21	22	24	26		
		50	17	20	24	31	35	38	39	46	15	20	23	28	29	30	33	36	14	18	21	26	27	28	31	34	
Females																											
		90	7	9	9	11	12	12	13	18	8	9	10	11	11	12	14	7	7	8	9	10	10	11	12		
34	51	75	9	11	12	14	15	15	16	22	9	10	11	12	13	14	17	8	8	9	11	11	11	12	14		
		50	11	13	14	16	18	18	20	27	10	11	13	14	15	15	17	19	9	10	11	12	13	13	14	17	

Source: Adapted from Snook, S.H. and Ciriello, V.M. (1991). The design of manual handling tasks: Revised tables of maximum acceptable weights and forces. *Ergonomics*, 34: 9, 1197-1213. Data updates according to Dr. Snook's personal communications of January 1 and 3, 2007. Note that this table is an excerpt from the much more detailed data for North American workers (Snook and Ciriello, 1991), which are regularly updated at www.libertymutual.com.

(a) Handles in front of the operator (cm).

(b) Vertical distance of lifting (cm).

(c) Acceptable to 50, 75 or 90% of industrial workers.

Conversion: 1 kg = 2.2 lb; 1 cm = 0.4 in.

Table 4.6 Maximal lower weights in kg of female and male U.S. workers

Width (a)	Distance (b)	Knuckle height to floor level One lower every			Shoulder height to knuckle height One lower every			Overhead reach to shoulder height One lower every																
		Percent (c)	sec	min	hr	sec	min	hr	sec	min	hr													
Males																								
34	90	10	13	14	17	20	22	22	29	11	13	15	17	20	20	20	24	9	10	12	14	16	16	20
	75	14	18	20	25	28	30	32	40	15	18	21	23	27	27	27	33	12	14	17	19	22	22	27
	50	19	24	26	33	37	40	42	53	20	23	27	30	35	35	35	43	16	19	22	24	28	28	35
Females																								
34	90	7	9	9	11	12	13	14	18	8	9	9	10	11	12	12	15	7	8	8	8	10	11	13
	75	9	11	11	13	15	16	17	22	9	11	11	12	14	15	15	19	8	9	10	10	12	13	16
	50	10	13	14	16	18	19	20	27	11	13	13	14	16	18	18	22	10	11	11	12	14	15	19

Source: Adapted from Snook, S.H. and Ciriello, V.M. (1991). The design of manual handling tasks: Revised tables of maximum acceptable weights and forces, *Ergonomics*, 34: 9, 1197-1213. Data updates according to Dr. Snook's personal communications of January 1 and 3, 2007. Note that this table is an excerpt from the much more detailed data for North American workers (Snook and Ciriello, 1991), which are regularly updated at www.libertymutual.com.

(a) Handles in front of the operator (cm).

(b) Vertical distance of lowering (cm).

(c) Acceptable to 50, 75, or 90% of industrial workers.

Conversion: 1 kg = 2.2 lb; 1 cm = 0.4 in.

LIFTING / CARRYING / ERGONOMICS ISSUES

Altogether, there is good overlap among the recommendations. However, the NIOSH values are unisex whereas the Snook and Ciriello data are different for female and male workers. Both sets of recommendations indicate that, as to be expected, the quality of coupling between hand and load determines how much people are willing to exert in lifting and lowering (and carrying, pushing, or pulling). Missing handles, or objects that are so wide that they are difficult to grasp^o, reduce the acceptable load values. Also, deep and repeated bending or twisting of the body and far reaches decrease the acceptable efforts. Of course, if several kinds of material handling occur together, the most strenuous task elements establish the activity level limits.

4.5 Designing for easy load handling

Back problems

Lifting, lowering, pushing, pulling, carrying, holding, and dragging loads involve static and dynamic efforts, often heavy work. However, the main problem with load handling is not the strain on muscles but mostly the wear and tear on the back with the risk of lasting injury, especially of the lumbar intervertebral discs. Low back pain^o (often simply abbreviated LBP) reduces one's mobility and vitality; it often leads to long absences from work and, as statistics from North America show, is currently one the main causes of early disability. LBP is common even in the younger age groups, with certain occupations particularly likely to suffer from it: nurses, laborers, farmers, baggage handlers, and warehouse workers frequently suffer from back disabilities.

Injuries, especially in the lower back, account for about one quarter of all reported occupational cases in the United States, where some industries report that more than half of all injuries are due to overexertion. Accident and health statistics in the United Kingdom and Germany, for example, show similar figures. Clearly, low back pain is among the most common causes of injury and disability in many industrial populations.

Spinal loading

Many LBP victims cannot pinpoint when their back problems started. In most cases, there is not a certain moment or a specific action when pain appeared, but, rather, the problem developed slowly until it was strong enough to disable. The human spinal column has the shape of an elongated S, as shown earlier in Figure 2.9 of Chapter 2, with intervertebral discs providing elasticity and mobility. As we consider the body weight from the head on down, it becomes obvious that the loading on spinal

a weak person who is stronger than just 5% of his fellow users. (This is the statistical technique to establish minimal and maximal design limits, discussed in Chapter 1.)

Identifying critical strength values

Figures 3.7 and 3.8 in Chapter 3 illustrate such statistical exercises: the first figure contains mean values with their standard deviations, the second lists 5th percentile strength values. Note that we can calculate an unknown value of SD from a table that lists percentiles. For example, the 5th percentiles in Table 3.8 are 1.65 SDs below the mean. The mean lies, of course, halfway between symmetrical percentiles, such as 5th and 95th, or 10th and 90th.

Nonnormal datasets

Calculations involving average and standard deviation are easy with normally distributed data; but such procedures lead to false results if the dataset is severely skewed or otherwise non-Gaussian. Unfortunately, many collections of strength data show nonnormal distributions. To determine specific points in a nonnormal data distribution, nonparametric procedures are appropriate; they are explained in statistics books^o. In some cases, designers might be able to just “eye-ball” or otherwise estimate the percentile values of interest.

Making load handling easy

Machines don't have backs to hurt; therefore, load handling, especially lifting and lowering, is better performed by machinery than people. The second most effective way to avoid lifting and lowering is to convert those activities into carrying, or even better, into pushing and pulling, as shown in Figure 4.10. Carrying is best done on both shoulders, such as with a yoke, depicted in Figure 4.11. Of course, dollies or carts, as in Figure 4.12, can take over the carrying job, converting it into the least risky load-handling category, pushing and pulling. If a person has to generate the needed push or pull, rollers as shown in Figure 4.13, conveyors, or similar ways to facilitate the motion are the technical solutions of choice.

Learning to lift safely

It seems that one should be able to learn how to lift objects safely,^o likewise, to do lowering, carrying, pushing, and pulling, and all other “manual material handling”^{oo} in safe ways. For example, one should learn not to exert strong force with the body twisted or the trunk severely bent, or in sudden movements. It should be natural to follow such simple advice, but apparently it is human nature as well to not always remember the proper ways. Numerous agencies and commercial outfits have developed systematic and often rather sophisticated ways

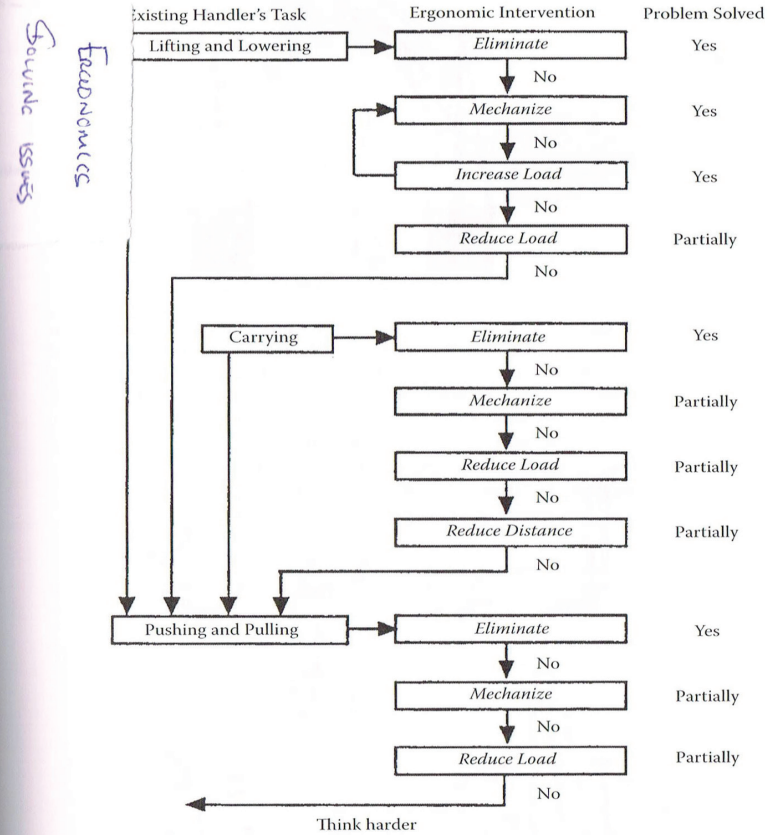
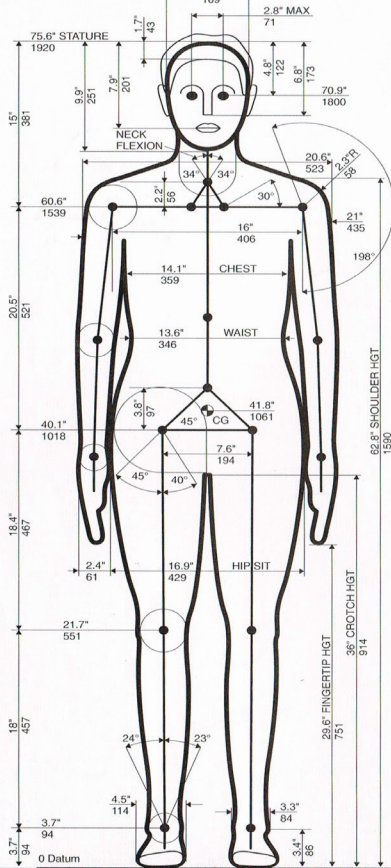


FIGURE 4.10 Converting lifting to carrying or, better, pushing or pulling. (Adapted from Kroemer, K.H.E. (1997). *Ergonomic Design of Material Handling Systems*, Boca Raton, FL: CRC Press.)

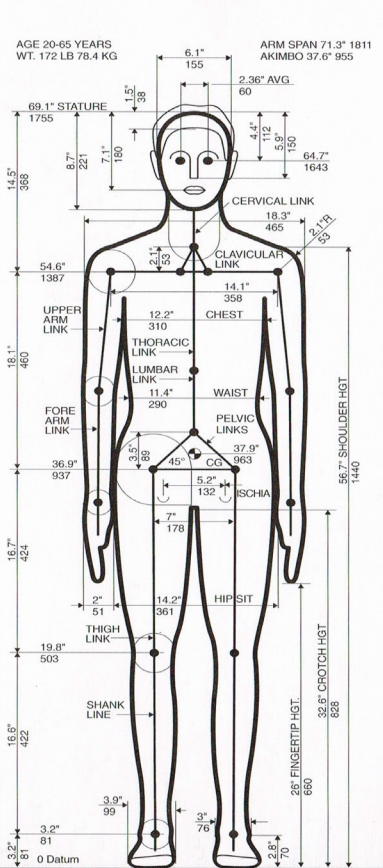
99 PERCENTILE MAN

AGE 20-65 YEARS
WT. 244 LB 111.2 KG
ARM SPAN 79" 2007
AKIMBO 42" 1067



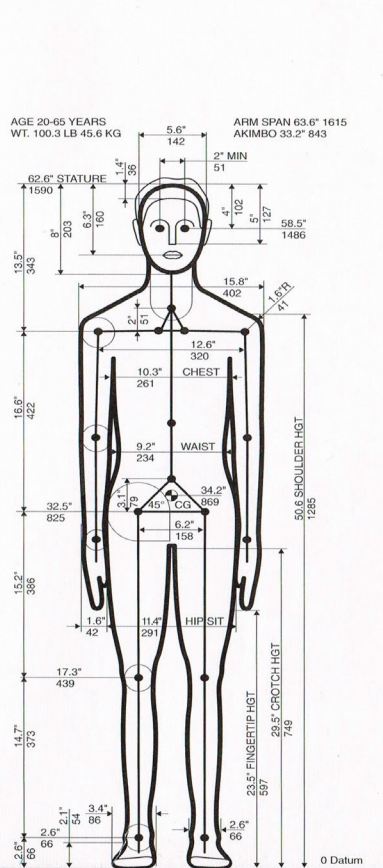
50 PERCENTILE MAN

AGE 20-65 YEARS
WT. 172 LB 78.4 KG
ARM SPAN 71.3" 1811
AKIMBO 37.6" 955

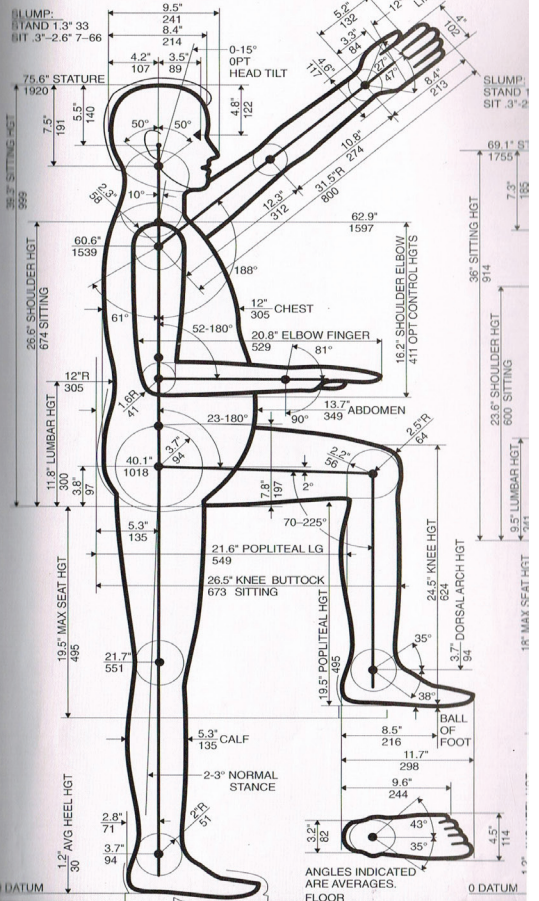


1 PERCENTILE MAN

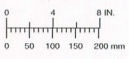
AGE 20-65 YEARS
WT. 100.3 LB 45.6 KG
ARM SPAN 63.6" 1615
AKIMBO 33.2" 843



99 PERCENTILE MAN



22



by showing the range with this. ice pivot points x-rays and t improved data thing is certain: a ometric data. One h must equal (for vot to shoulder to-elbow and

are for full example, the man are 99

Reach Additions with Arm Horizontal

Below are listed gains in reach by men and women bending forward, to the side, and 45° in between. Numbers are approximate, in inches and millimeters.

Men				
Direction	Extend Shoulder	Rotate Trunk	Bend Trunk	Total
Forward	4 (100)	2 (50)	10 (250)	16 (405)
45°	3 (75)	1 (25)	8 (200)	12 (305)
Side	2 (50)	0	6 (150)	8 (200)

Women				
Direction	Extend Shoulder	Rotate Trunk	Bend Trunk	Total
Forward	4 (100)	1.8 (45)	8.2 (205)	14 (355)
45°	3 (75)	0.9 (20)	6.4 (160)	10.3 (260)
Side	2 (50)	0	5.6 (140)	7.6 (190)

Angles other than horizontal ones must be computed or solved graphically.

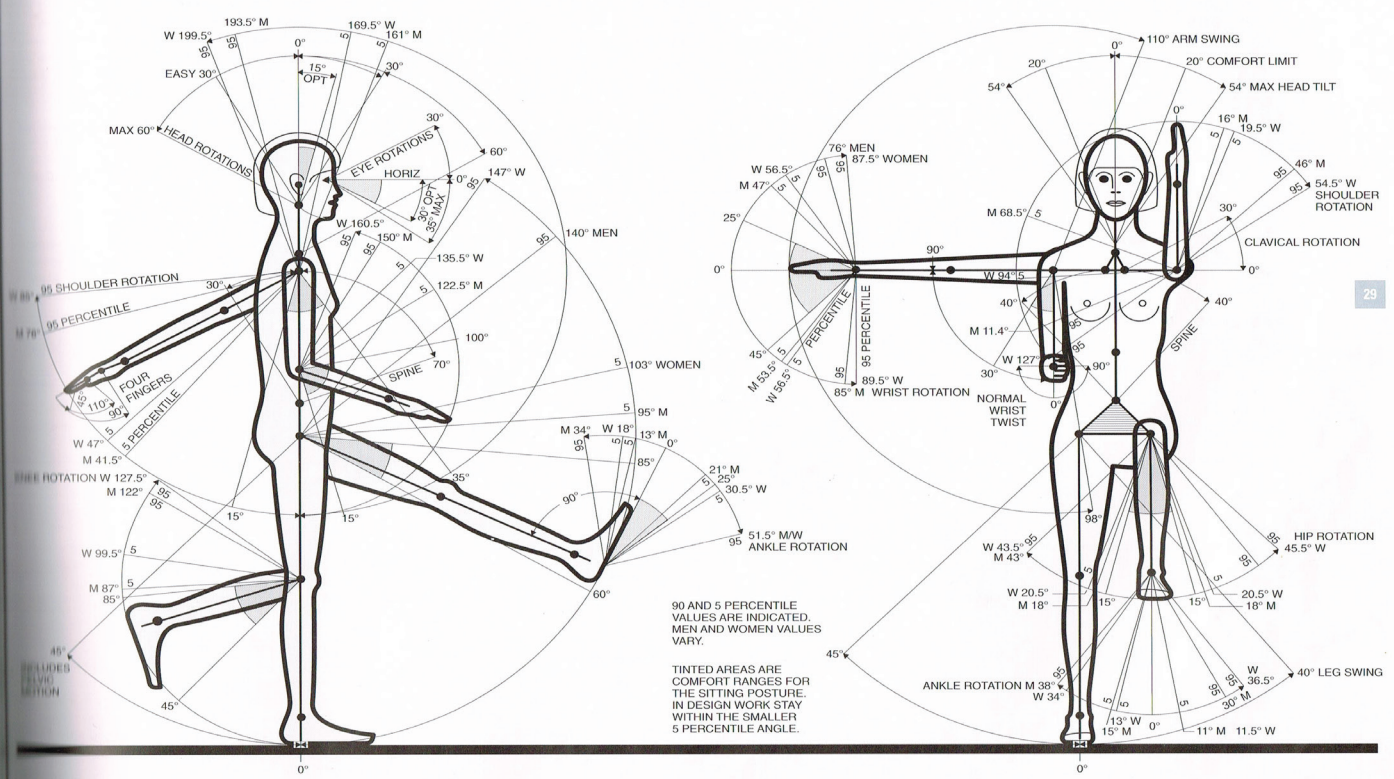
Designs intended to confine the operator or otherwise encompass the entire body—such as driver compartments, cockpits, etc.—can be drawn in orthographic views (side, front, and plan) on the board or computer screen as a guide to constructing a full-size model or mock-up. Three-dimensional manikins or dummies can be used to analyze space requirements. Some dummies have correct weights for each body component and can be used in dynamic tests for safety.

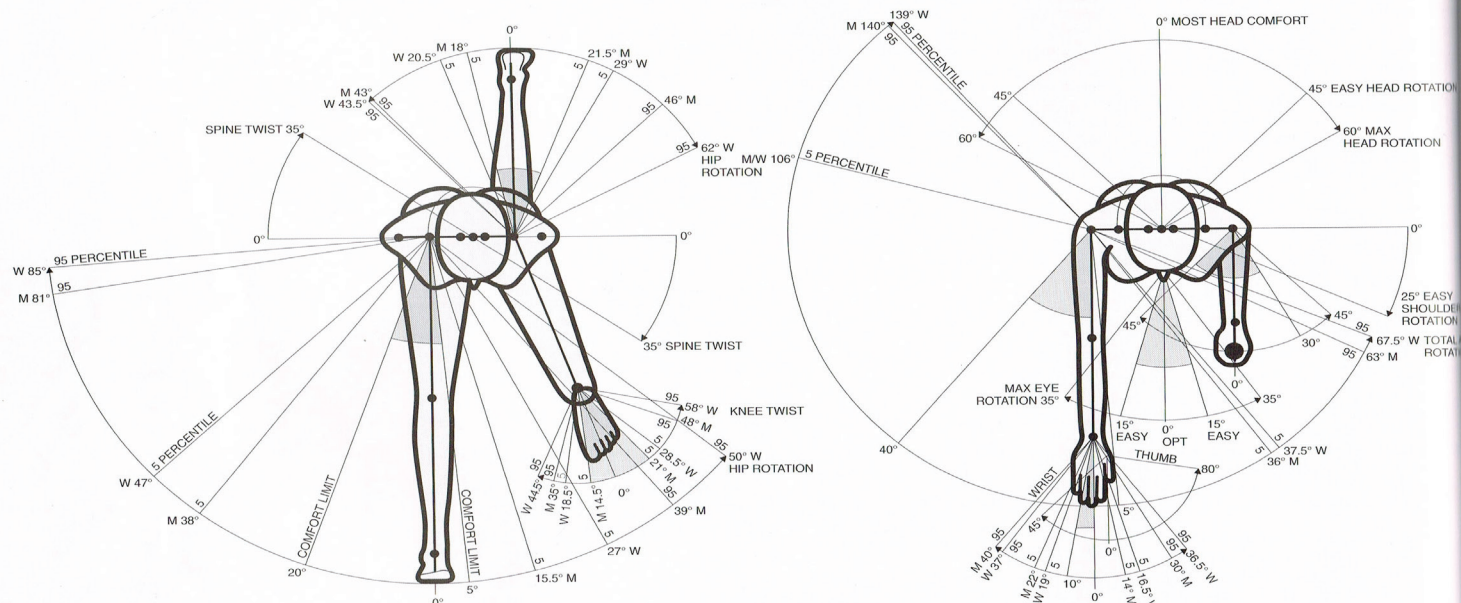
The use of live models is recommended to check out mock-ups. People corresponding to the largest and smallest operators of the equipment should be chosen. Typically, many new factors will be revealed as a result of this evaluation.

The figures in the Measure of Woman diagrams also indicate frontal clearance required at various stages of pregnancy, the maximum being indicated on the large woman and the minimum on the small woman. However, this is not always realistic; the small woman may have larger dimensions or a higher hip pivot-to-seat distance than the 1 percentile shown. These dimensions do not necessarily correlate with stature.

Users between the man. The mean mal applications. sources were used to ind females: nd U.S. Department and 1979. fants to youths 18 ed from SAE, 1975

dy ay be extended by k, and/or bending these movements e complex. nd the reach of the e shoulder until the





TINTED AREAS ARE COMFORT RANGES. IN DESIGN WORK STAY WITHIN THE SMALLER 5 PERCENTILE ANGLE.

CLOTHING CORRECTIONS

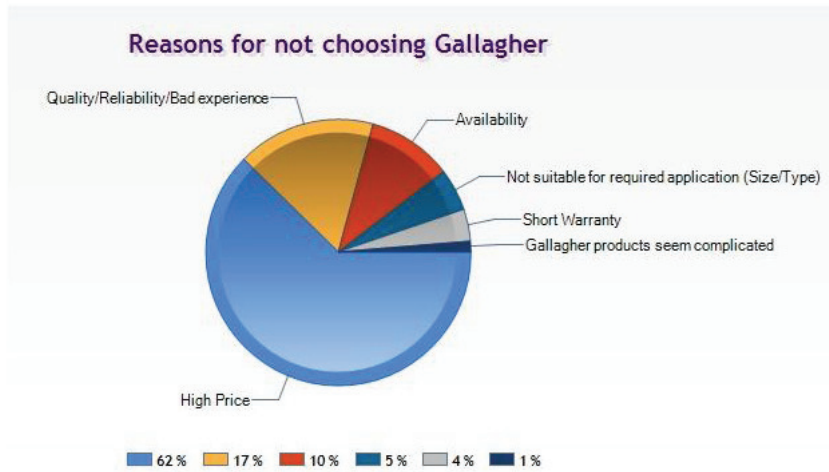
Clothing must be taken into consideration when designing compartments and seating arrangements. If a condition exists that must accommodate the 99 percentile man and the 1 percentile woman, add the heaviest clothing required to the large man and add the lightest clothing to the small woman. Hats are important; include a 2" clearance between the highest hat and the ceiling to allow for rising and falling during walking. Shoe heights are important to determine ceiling clearance and seat heights. Spacing between arm rests will depend on the sitting buttock width, with the bulkiest clothing anticipated.

Gloves affect space requirements. A bare hand opening of 1.5 x 3.8" (38 x 97 mm) has to be increased, for heavy gloves, to 2 x 4.5" (51 x 114 mm). Gloved hands are not as sensitive. A push-button travel of 0.1" (3 mm) must be increased to 0.3" (8 mm) for heavy gloves.

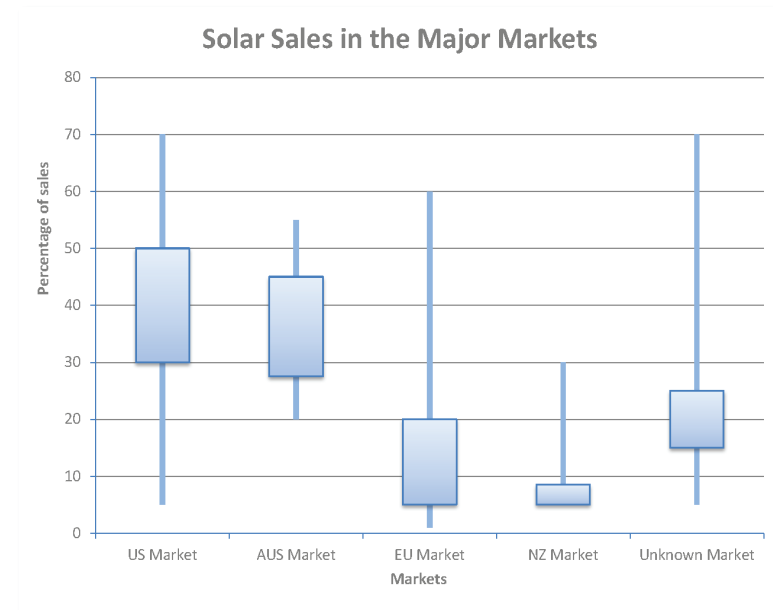
The tables of data that follow show the increase required on each side for various types of clothing. The first table is for civilian increases for men and women, and the second table is for military men. Values are approximate, for styles of clothing change. Military and safety helmets are about 12 x 10.25" (305 x 260 mm).

Survey Data

Reasons for not choosing Gallagher



Percent of solar related sales in the main markets



CONCLUSION

1. The major markets are USA followed by AUS. (Highest % of solar energizers sold)
2. Within these markets, the majority of TM's are selling solar energizers over 30% of the time.
3. These markets accept solar technology and are geographically located well.

Survey Data

Most Common Solar Energizer Type Used for specific applications

<u>Strip Grazing</u>		
Permanent	Semi-Portable	Portable - 83% <ul style="list-style-type: none"> • Break feeding • For sheep (Move around regularly) • Ease of use to move constantly • Trouble free fencing • Grazing small paddocks • Pasture maintenance

<u>Small Farms <100 acres</u>		
Permanent - 31% <ul style="list-style-type: none"> • Splitting Paddocks • Seen as more environmentally friendly than mains. • No mains power – Closest power to mains • Versatility of options • No hydro available 	Semi Permanent - 39% <ul style="list-style-type: none"> • Appropriate size for job • Ability to pack up when not in use • Moveable battery/solar units are easier • Cheap stock control 	Portable - 22%

<u>Lifestyle Blocks</u>		
Permanent – 22% <ul style="list-style-type: none"> • Splitting Paddocks • No mains power – Closest power to mains • Versatile – Options available 	Semi Permanent - 31% <ul style="list-style-type: none"> • Appropriate size for job • When there is no mains power • Splitting paddocks • Seen as environmentally better than mains • Cheap stock control • Trendy Technology 	Portable - 43% <ul style="list-style-type: none"> • Grazing • Before Mains-Power Connection • Easy to set up no cables required • Cottages/Campers/Hunters

<u>Isolated Farm Blocks with no mains power</u>		
Permanent – 68% <ul style="list-style-type: none"> • Set and forget • Cattle • No way to charge battery • Amish/Mennonite/Hutterites have no electrical power. • Game fences and predator control • Cheaper than installing mains power 	Semi Permanent - 21%	Portable - 8%

- Ideal for run off blocks for dairy

<u>Pest Control</u>		
Permanent – 44% <ul style="list-style-type: none"> • Reliable power • Battery always charged and keeping out pests 	Semi Permanent - 30% <ul style="list-style-type: none"> • Farm Houses • Gardens 	Portable - 24% <ul style="list-style-type: none"> • Easy to move • Garden and bees

<u>Pet Control</u>		
Permanent – 32%	Semi Permanent - 17% <ul style="list-style-type: none"> • Can be permanent or temporary 	Portable - 49% <ul style="list-style-type: none"> • Back yards • Prevent pets from digging garden • Easy to move • Attached to existing fence • Use with smart fence • Lower priced

<u>Horse Control</u>		
Permanent – 31% <ul style="list-style-type: none"> • Eco friendly • Remote locations 	Semi Permanent - 25% <ul style="list-style-type: none"> • No mains power • Versatility/Options • Customer has lack of knowledge • Medium priced 	Portable - 39% <ul style="list-style-type: none"> • Small holding day yards for horse. • Can be moved with the horse when transported to events • No installation required • Grazing Pastures/Fields • Portable corral

<u>Crop Protection</u>		
Permanent – 29% <ul style="list-style-type: none"> • Usually on feral fencing • Set and forget 	Semi Permanent - 40% <ul style="list-style-type: none"> • Short term use • Around hay bailage • Critical feed preservation • Research Plots for Ag Chemical companies. • Versatility/Options • Blueberries • Rotation use 	Portable – 25% <ul style="list-style-type: none"> • Garden use • Needs to be removable to harvest

<u>Tree and Ditch Protection</u>		
Permanent – 39% <ul style="list-style-type: none"> • Set up to protect the trees from animals Set and forget 	Semi Permanent - 37% <ul style="list-style-type: none"> • No mains power 	Portable – 22% <ul style="list-style-type: none"> • Temporary

Survey Data

- Only used when there is no mains power
- Orchard farmers to protect their fruit trees
- Set and forget
- Summer use
- Multiple remote locations

Bee Hive Protection

Permanent – 22%

- When there is no mains power
- Bear protection is big in Canada
- 60% of solar sales in USA
- Bear control

Semi Permanent - 38%

- No mains power
- Seasonal usage (Summer)

Portable – 38%

- Portable and easy to use
- Multiple remote locations
- Can move to/with different hives

Bridge Crossings

Permanent – 43%

- So it is not destroyed from flooding

Semi Permanent - 15%

Portable – 38%

Other uses

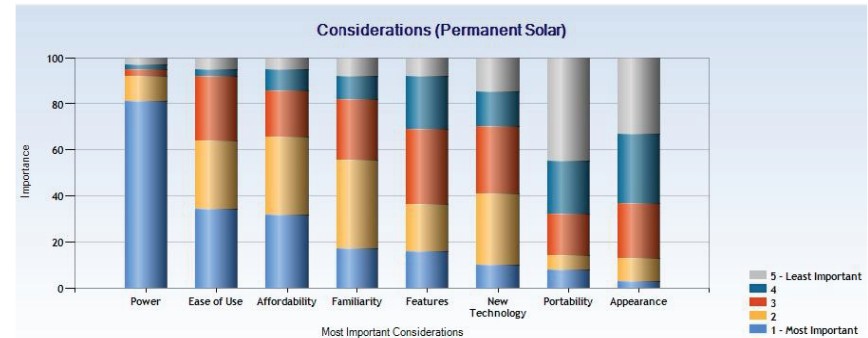
Permanent

- Wild dog/Dingo Fence in Australia
- Fencing dams on stations
- Mine water sites stopping animals getting in and fouling water supply
- Pump water from rivers or streams
- Nature reserve parks
- Nature project with cows
- When there is very poor mains power

Semi-Permanent

- Temporary Raceways

Most important considerations for customers when buying a Permanent solar powered energizer

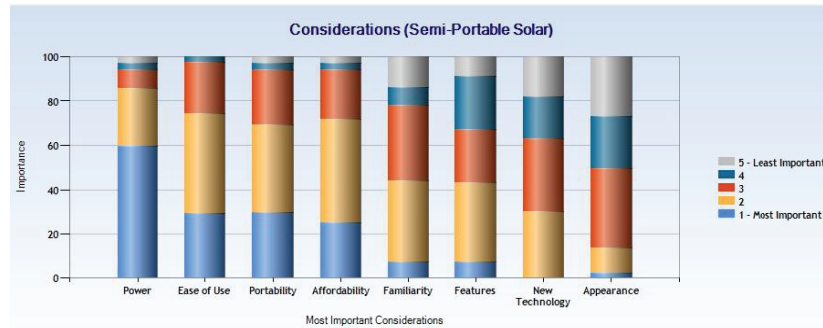


Interesting Comments

- “Good looking energizers work better right??” - Appearance
- “It could be “pink with polka dots”, as long as it works they won't care?” - Appearance
- “Those who have already will appreciate new bells and whistles if warranted” - Technology
- “Something tough that can roll around in a wheeler or side by side or pick up bed and get tossed about but still work.” - Reliability
- “people do not like change”
- “If it is too complicated to install then it will not be used or understood”

Survey Data

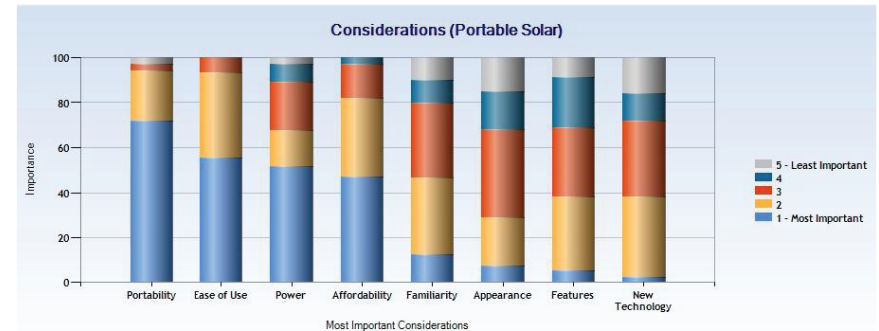
Most important considerations for farmers when buying a Semi Permanent solar powered energizer



Interesting Comments

- “Must be able to be turned on and GO when required” - Reliability
- “There are lots of competitive options” - Affordability
- “often moved by farm worker not owner” - Portability
- Don’t care about brand as long as price is good” - Affordability
- “Farmers like to see high voltage” - Power

Most important considerations for farmers when buying a Portable solar powered energizer



Interesting Comments

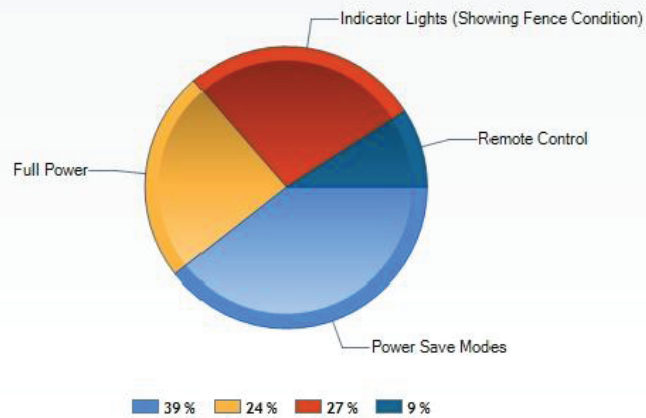
- “Half shocks don't teach stock” - Power
- “they do not get used full power all the time” - Power
- “A lot of hobby farmers needing to outdo their neighbours” - Appearance
- (Farmers) “don't seem to know brands of products so buy on price” - Affordability
- “If the stock eat feed at the wrong time, then the farmer is losing \$\$”

Survey Data

Features are most commonly used in the range of solar powered energizers

Permanent Solar

Features most commonly used in Permanent Solar Energizers

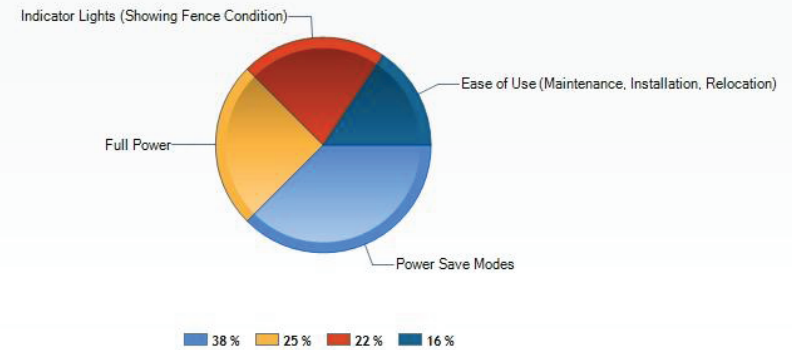


Findings

- Many customers don't use all the fancy features that are offered.
- Require an energizer that has "Full Power" but also saves battery life.
- Indicator lights appear to be important for assessing the fence condition, but the important one is "Fence O.K."
- Some TM's have asked for a remote, similar to the i-series mains energizers. (This added feature would put up cost considerably, which conflicts with the price aspect)

Semi Permanent Solar

Features most commonly used in Semi-Portable Solar Energizers



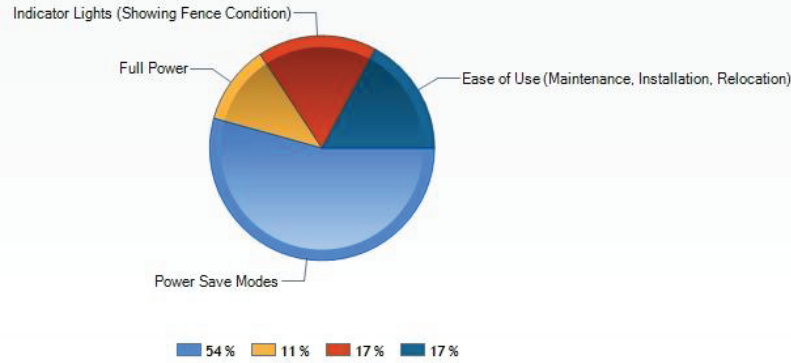
Findings

- Semi permanent solar energizers seem to require similar features to the permanent solar.
- **Basic requirement:** Power save modes, a full power mode and indicator lights to display its status.
- "Ease of setup" became a trend: Points to the fact that these units are commonly being relocated and set up.
- When **setting up**, customers want a product which is close to instant as possible with no steps involved.

Survey Data

Portable Solar

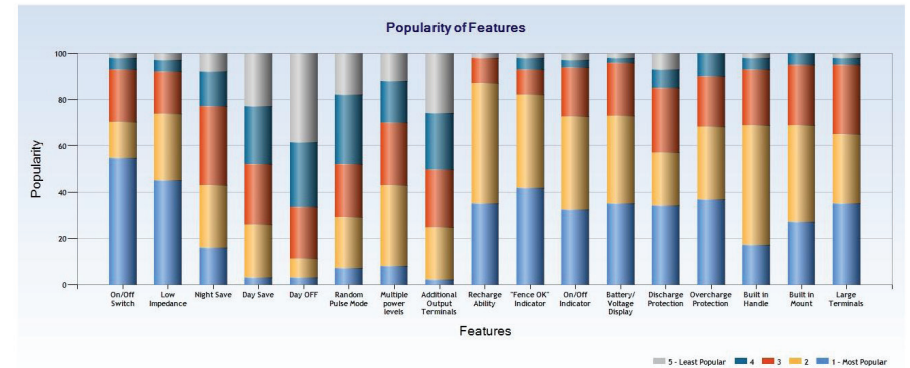
Features most commonly used in Portable Solar Energizers



Findings

- Portable solar units appear to need power saving modes more than the other two.
- Could be because portable units have smaller power sources and/or are required to run for long lengths of time off the battery (where there is no sun)
- "Ease of use" was highlighted multiple times in different ways. A carry handle is an example of a feature which makes it easier to use.

Popularity of features

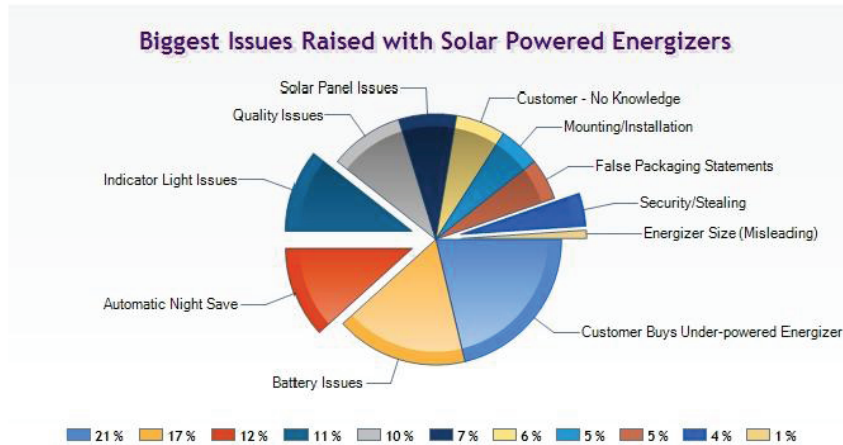


Interesting Comments

- "people seem t like the S15 style switch S20 and S50 switch is nothing but problems"
- "Farmers think units are already protected by regulators"
- "THE MOUNT SUPPLY CURRENTLY ARE NOT STRONG ENOUGH IN SOME AREAS"
- "all want full power"
- "LED bars seem to be more popular and give more guide on how fence is working"

Survey Data

Biggest Issues with Solar Energizers



Additional Issues raised

- Winter (Less sunlight = less charging = drained battery = fence failure)
- Brackets which connect solar panels to energizers are weak and break
- Horses tangling in fences
- Semi permanent box sitting on hilly terrain. Balance issues
- Portability of larger energizer units (built in battery)
- Powering a 100 acre farm with a portable solar energizer

Most common questions customers ask about solar powered energizers

Regarding EFFECTIVENESS – 35

Will it work in **** area? Will it work when there is no sun? How long will the battery last?

Regarding POWER – 23

How far will it power? How does it compare against mains?

Regarding PRICE/COSTS – 18

Why is it so expensive? How much does it cost?

Regarding THEFT PROTECTION – 5

Can it be protected? Do you have something to stop people from stealing it?

Regarding SOLAR INFORMATION – 4

How does solar work? Why should I choose solar?

Regarding INSTALLATION/USING/CONNECTING – 3

How do you use? How do you connect it to the fence? How do you mount/install?

Regarding DURABILITY – 2

What is the durability of the solar panel like? Is it easily damaged?

Regarding PORTABILITY – 1

Can I carry it in a backpack? How heavy is it? How big is it?

Regarding ADD-ONS – 1

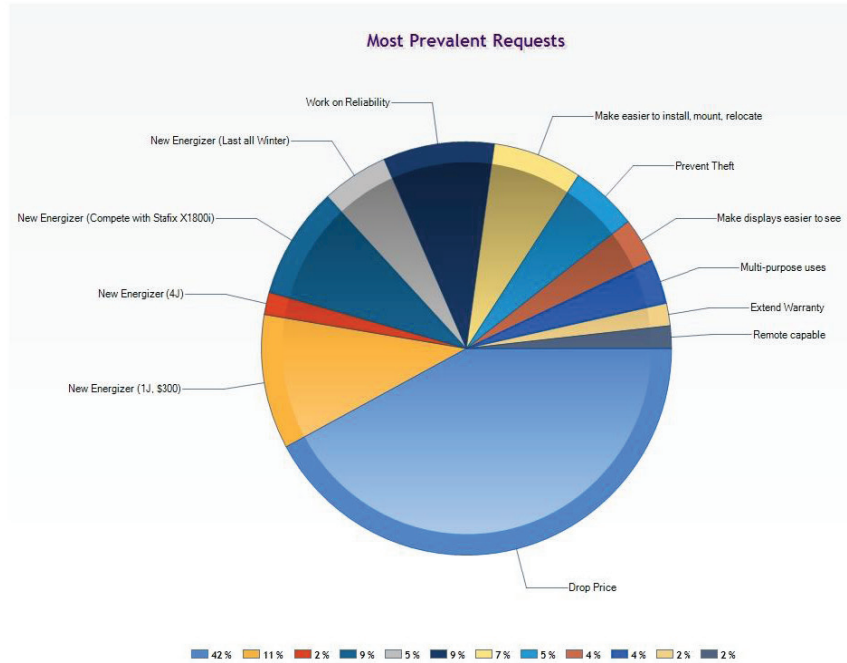
Can I get a specific post to mount it on?

Biggest Issues Raised

- Lack of sun in certain areas/at certain times of year
- Batteries can't last forever when the energizer is running solely from it
- Energizers are not powerful enough to create trust in solar power
- Solar panels are expensive
- Solar powered energizers are complicated for most users
- Customers are sceptical about solar power
- No theft protection

Survey Data

Most prevalent requests to grow solar energizers



MARKET GAPS

- Design an energizer with simplicity in mind. It must be understandable to any customer, easy to use and only use the most important features. It would require a design where virtually no setup steps are involved, making it an instant solution for customers who need to relocate energizers regularly.
- Design a unit which focuses on a high power output which is able to be moved regularly, easy to use and understandable to a customer with no knowledge of electric fencing.
- Design a portable solar powered energizer that can power 100 acres of farmland.
- Design a permanent solar energizer which has its own mount, and requires no installation. It must reduce the cost of the energizer to the end user, making it the ideal permanent solar energizer.
- Design a solution to prevent stealing of the energizer and solar panel
- Redesign a semi-permanent solar energizer and its bracket system to make it easier to carry with the solar panel attached. It must be strong enough to handle extreme winds without being damaged or falling over.
- Design a system to prevent energizers which are placed on the ground from falling over on hilly terrain.
- Design a Small Portable Solar Energizer which competes in the North American Market with the following constraints (0.75J-1J, \$250-\$300)
- Design a solar energizer to power a lifestyle block which uses the solar panel regulator for output energy which does not compete with the S50
- Investigate why the Australian TM's do not want semi-portable solar units (B100, 200, 300). Design a unit which meets their needs and requirements to enter the AUS Market.
- Question the current layout/topography of a solar powered energizer. Propose a new solution to add to the solar powered energizer family. Aim it at a specific market and context.
- Design a multi-purpose solar energizer
- Make a permanent solar setup (Energizer, solar panel and battery) portable
- Create a new charging solution

USA, May 2013

Byron Arnold Trip report, 28th May - 5th June

ByronA
6/9/2013



Trip overview

1 – Day 1 & 2

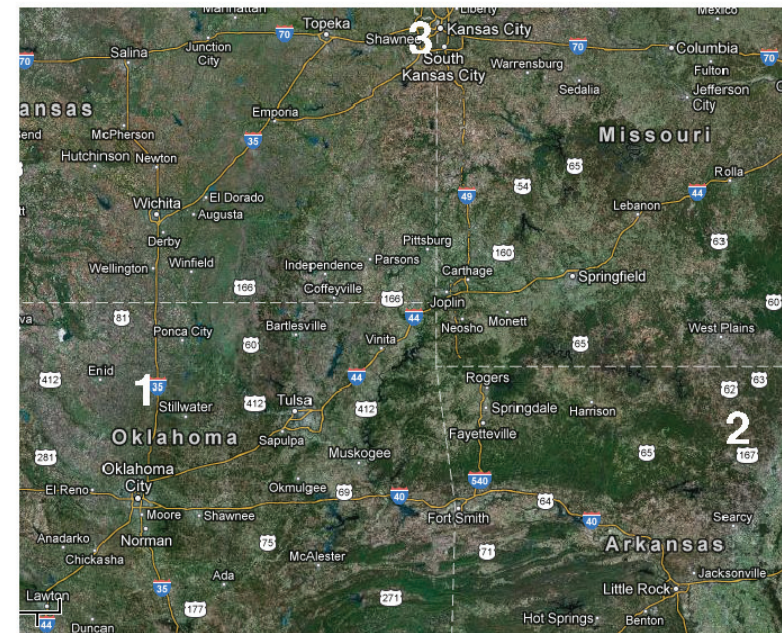
With Robert Fields (Gallagher TM), visiting a combination of dealers and customers. All customer visits were S17, S20 and S50 installs. We did see a few mains units as well (M300, M400).

2 – Day 4 (Day 3 was spent at Dallas airport due to thunderstorms cancelling flights)

With Evan Bartley (Gallagher TM), travelling to Batesville, Arkansas, visiting a dealer and a couple of B100SP sites.

3 – USA Sales conference (starting 3rd June)

Market overviews, New product overviews (HR4, Live fence indicator, Multi strand gate, Reel lock, Tread-in). Discussions on Miraco benefits and product range. Day 2 involved I series and Weighing/EID four hour training sessions.



General Comments

- Single wire fencing. A lot of it.
- If people talk fencing and they don't say what it's for, then it's for cattle.
- S20 and S50 were the only 'bad Gallagher' comments we received.
- Patriot are showing a lot of growth, TT are putting a focused drive on the brand to take over in places where stores don't want to deal with Zareba.
- US team very excited for I series release.

Robert Fields – Stillwater, Oklahoma



Figure 1 - Roberts Truck.

Dan May – Cattle farmer

Dan owns a 13 acre block with his homestead, he rents a further half a dozen or more blocks around the area that he grazes.



Figure 2 - Dan's M400 is over 22 years old. Going strong apart from one time when he dropped it on the ground and needed a new case for it. This unit is why he loves Gallagher.

For almost all his rented blocks Dan's using S17's and quickly erected T-post fences. Dan doesn't know how long land rental is for, therefore doesn't want to put money into developing it. The fence system that he builds needs to be cheap and removable. He wants quick to install semi-permanent energizers that also need to be removed if he loses the lease on the land. However while he holds the lease these Energizers are installed permanently.

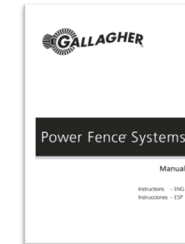


Figure 3 - 3E1978 Gallagher power fence systems manual.

Dan's understanding of electric fencing is almost 100% from the Gallagher power fence booklet. He loves that book, referred to it often in conversation.



Figure 4 - S17 gone bush. I was worried about the limited sunlight available, while Robert was more concerned about the poison Ivy.

All of the S17 installations we saw were mounted on T-posts. Most S17's delivering 6-7 kV to the fence. One S17 was installed in the bush, and when quizzed about the battery going flat, Dan said when that happens he gets one of his boys to swap it over with one of his other units.

Dan's fencing is one or sometimes two hot wires (either braid or 14 gauge wire, rarely 12 gauge) that run for at most a ½ mile. He wouldn't expect to get more from an S17 than a half mile... However, he does have one S17 powering a 40 acre block with a 2 wire fence. This is the exception, but Dan is happy with the performance and stock control.



Figure 5 - A temporary (Permanently installed) corral beside Dan's cattle yard. This will be used as a holding pen when sorting cattle. Pictured are Dan May and Robert Fields.



Figure 6 – Dan's temporary corral using braid. The T-post on the right is where the S17 would be mounted, you can also see the bailing wire used to connect the energizer to the fence – he used that in most locations, rust and all.

Dan has recently had problems with grounding, due to drought conditions, but was pleased to share his way around this. He ran a 3rd wire of braid connecting his T-posts together. I suggested this benefit would be even better if he connected that 3rd wire to the Energizer earth terminal.

Action – Byron – Create collateral for customers on “Super-charging your charger” (using earth return systems in situations with low earth conductivity).

Dan had no idea that the S17's had night save mode. Isn't bothered by it.

For fault finding he has a DVM and will break off sections of the fence to find the fault. No gate switches are used.

All Dan's S17's were more than 2 years old – most had been serviced at least once. He has lost the Alligator clips for all of them, but instead uses bailing wire – which rusts, and also rusts out the braid that it is attached to. Robert gifted him some new clips, I doubt he will use them, likes the Bailing wire too much.

S8 opportunity

Dan would love a product smaller than the S17, for around the \$80 price point. For an experienced user like this the low power output would be ok for his purpose, however the product would get a hard life (e.g. to be dropped from the height of a T-post is fairly likely).



Figure 7 - Typical of Dan's two wire fences.

Parting comments were – if it ain't broke don't fix it. And he pleaded with us not to change anything on the S17. He loves it. “Do not do a Dodge” he said, in reference to their truck manufacturing going downhill.

Ok! State Uni - Pure bred center (Jeff Mafhi)

Very nicely built fences, using almost entirely GGL product. A good show case of Gallagher wire, insulators, fibre glass posts. Although Jeff has had problems with white under gate cable, less than 2 years old, corroding/cracking due to UV.

Byron to follow up on under gate cable issue.

Still water milling company

Currently managed by Denise (new to store management)

One of Roberts top stores and a very Gallagher loyal fencing store, like the support they get from Gallagher (via Robert).

They have ¾ of their fencing shelf Gallagher and the remainder A mix of red snapp' and patriot. Gallagher definitely have better placement in store while the other brands are hidden towards the back.

Denise said she only would sell Gallagher to any customer she talks to because it's all she knows.

S17 is by far their highest seller. Don't sell many of the other solar units in comparison. Not a big area for B100 or B200, but both were in stock. They had 8 S20 promo versions in stock, none of which had sold yet.

Also no movement on the B10 garden kit, which both people in the store we talked to thought might possibly due to the weather and the late growing season.

Some prices in store.

Gallagher		Patriot	
S17	165	S50	110
S20 (promo)	215	S155	180
S50	325		
B100 sp	325		
B200 sp	475		
B10 kit	150		

University owned plot – Mark Anderson

On this farm they need to keep all the cattle close to a central receiver point as each cow has a sensor device relaying a signal to advise when ready for AI (artificial insemination).



Figure 8 - Mark Anderson describing the layout of the research farm.

S20 for single fence wire
 S17 control stock to keep them near receiver
 S17 for control around lake edge (T-post mounted).
 All installs are semi-permanent, but done in temporary fashion. No intention to move them at this stage, they have been in place for quite some time (many months).



Figure 9 – Mark's S20 sitting on a concrete block. Block was already there, easier than mounting on T-post.

Vet supply store, Enid



Figure 10 - Front of store... Good - prominent place in store. Bad - exposure to sunlight has severely faded cartons.

Met Johnny and Darin, Gallagher product at front window, prominent position when entering the store, but due to window most cartons are faded (at various levels). Speaking to staff all issues are regarding warranty and support for S50's. Pain for dealer to pay for Freight on Warranty units (so they have started not sending the battery back). But the cost of freight eats most of the profit they make on these units, frustrating product to deal with.

Were worried that customers are working S50's too hard which is causing them to break. I explained that doing so wouldn't increase likely hood of Energizer failure, and that we have made significant improvements to the S50's over the last year...

Atwoods, Enid

Large Gallagher display, beside a 4 foot parmak and 4 foot Red Snapp'r display. Parmak a lot more appealing to the customer as 'higher' joules for similar price.

Action – Byron/Jenn – Parmak have false claims on their Joules, can we do anything about that?

Parmak 6 (0.75 J) - \$165 (actually 0.16 J output).

Parmak 12 (1.1 J) - \$300

Pollard Farm, Waukomis - Jesse



Figure 11 - M300 mains unit. Outside. This picture warranted a full page. Words can't describe it.



Figure 12 - The M300 mains cable plugged into an extension cord and exposed to the elements.

Pollard farm are a well known Purebred Angus station and we met with the current manager Jesse Bias – who has been working on the farm for about 3 years. The first thing we encountered on farm was the previously pictured M300 Mains unit outside.. Ignoring the barbed wire, the outside location and the power plug which wasn't plugged in properly, the most upsetting part of the Energizer installation was the mains extension cord which ran over ground at his main gate way. This cord was getting visibly damaged from all the traffic driving over it.

We warned Jesse that this is not recommended and dangerous as well as suggesting he move the Energizer inside inside, or at least not leave the mains lead exposed. Jesse said this had been outside since before he had come on the farm, (over 3 years).

Jesse has a few S50's which he loves for the convenience. Moves them about once a year and uses the Alligator clip sets to connect them to a fence. Has no issues with the unit. Doesn't need bigger, is only powering ½ a mile to a mile from each one, and could use a S20. Jesse had a S50 in the back of his truck that he had collected from getting serviced, and was yet to get around to installing it back on the farm.

The farm has a B280 on a separate block working in half power on single wire fence. This is at 5.3 kV.

Rother Brothers – Jim Kraus

Tractor, 4WD, ATV store. Not normal fencing retailer. Met with Jim Kraus.

Have had electric fence on shelf since 2007. Good shelf as it mostly looks after itself. Sell S20 in high volume (around 10 a year on average). S17's are not often stocked. They don't want to stock the S17 as they want a point of difference from Atwoods (Larger box store, just down the road). Minimal mains units. All customers building a fence with 14 gauge wire for a single wire fence.

Robert's own farm, and comments as TM



Figure 13 - Roberts S20 (what terminal caps!?)



Figure 14 - S17 and S20 mount on the T-post in a different direction. Frustrating to install.

Robert was frustrated because S17 mounts on T post at different angle to S20. T-post will be installed flat side facing the installer. Therefore easier if flat side always faced the sun direction.

Voltage measured

	I series remote (Latest)	DVM
S20	6.1	4.8
S17	8.0	7.1

Both energizers control cattle – plenty of grass, so easy to control at the moment. No issues with slow pulse night save.

Robert's thoughts.

S20 Solar cover is awesome, that thing can get hit by hail and protect the panel.
 S50 Good product, but priced too high (equal to B100)
 14 Gauge wire – everyone uses it. Not ideal, but it's most common.

Parmak has a loyal following – more loyal than GGL.

S17 switch is innovative, much better than S20/S50 design. Although some appreciation to the visibility of the S20/S50 switch from a distance. But this is minor – esp with LFI now available.

Could we put a lip around S20/S50 switch to protect for moisture ingress – Byron to keep in mind in case of further problems past previous changes.



Figure 15 - My parting thoughts of Oklahoma - this place is as windy as Wellington! (Actual fact - the average wind speed here is 21 kmph, while Wellington is 22 kmph)

Evan Bartley – Arkansas (one day only)



Figure 16 - The Bartley mobile. In white.

North Arkansas Farm Supply Coop, Batesville

Store stocks Gallagher, Patriot and Stafix. All on a single Aisle, but the Stafix also have solar panel and brackets that get end of Aisle treatment due to size. Jason is responsible for electric fencing in the store and spent a considerable amount of time with us, including joining us on a farm visit and going to lunch.

Brian. Angry about how many modules we have. “See this he says” as he shows me the Stafix module for all their 1-3 J product, “that does all their products. See that shelf over there full of boxes” as he points to a shelf full of GGL module boxes, “they are all our stock for Gallagher.”

Problem with no board similarities between our products as well as the old (M400, M800 etc) Vs new range, means they have to stock a lot of different parts.

“The S20 and S50 are horrible”, they don’t want to stock or deal with these products due to the high warranty/support issue. Not profitable for them as a business.

While in store Evan and I repaired a M150 – transformer replacement, and a B180 which had a broken switch mechanism.

Jason claimed that Patriot/Stafix sell more than 3:1 of Gallagher. Big sellers are the X6 and the SG155. A few customers with large plots have bought the X6i for the remote. Customers will go to the SG155 because it can do 40 acres, where our S17 can only do 10 (most customers of the store have 20 to 40 acres of land).

In store.

Manufacturer	Model	Area (acre)	Joules stored	Price	Qty this year
Patriot	SolarGuard155	40	0.21	\$179	22
Patriot	SolarGuard50	12	0.07	\$120	2-4
Gallagher	S17	10	0.17	\$139	12
Gallagher	S20	14	They refuse to deal with this.		

Customers love the bargraph, will buy Trutest products because they have the bargraph and we don't (M150 and small mains).



Figure 17 - Stafix cash n' carry solar solution, X3 with 15W panel and battery case.

Patriot pet kits - \$65 including mains energizer – are not selling at all. Jason thought they'd be a good idea, but no one buys them.



Figure 18 - Patriot pet kits, not selling. \$65 retail. (GGL B10 pet kit is \$150)

Larry, Shane (Son) and Braxton (Grandson), outside Batesville

A family operation, Jason took Evan and I to show the fence installation, then we visited Larry and family at his house. The fence had been in part built by Larry before Jason arrived to help, Larry didn't use a spinning Jenny and had major issues with HT (High Tensile) wire tangling. They ended up still using the wire, but Jason commented that if it had been his wire he would have thrown it away and started again.



Figure 19 - Evan Bartley and Jason (from North Ark Farm supply coop) on Larry's property.



Figure 20 - One very large 200+ acre paddock, powered by a B100 SP.

The fence was powered by a B100SP running on full power/fast mode, powering over 200 acres of mostly two wire fencing. We measured 2.8 kV on the fence, in very wet conditions, they normally get 3.8 kV.



Figure 21 - B100 SP, running full power with 2.8 kV on the fence. Note no protection to stop cattle knocking over or removing the Alligator clips.



Figure 22 - Jason helped Larry build his fence, but before Jason arrived some of the fence was already installed.



Figure 23 - There is no method to this...

Although low voltage on fence, there were many comments from the family about how much it hurts to touch the fence and the animals don't like it at all. In terms of stock control they have had no issues.

The Battery they were using is too large for the powerbox, it doesn't fit. They don't care.

Greenfield Farm, outside Batesville

Lastly we went to a block of land farmed by Larry from the Farm supply coop store. While we only saw one bull on the property (and a turtle and lizard!) the fencing was all setup and there was plenty of grass. Larry didn't join us in the visit but had told us we'll see how he's sprayed the fences – which he was most proud of.



Figure 24 - Electric fence used to control stock drinking area around the lake.



Figure 25 - Evan measuring 5.6 kV on the single wire fence powered by the B100SP (running full power).

B100SP installed, running at 5.6 kV at energizer. Single wire fences, with grass sprayed underneath. At least 100 acres fenced (estimate only, not confirmed)

He was very proud of his fence installation and setup.

Down the line about 500m voltage was 10kV or higher (as measured by I series remote). Evan was certain this fence line came from the same Energizer, I had doubts, but we needed to get back to airport.

Evan Bartley

Loves the S17 and M1000. They 'get his motor running', Evan has some impoverished farmers in his territory where money is a big issue for customers. As such he doesn't sell above a W210 and Energizers are always bought from a manufactures claim – which puts us at a distinct disadvantage to the competition.

Evan felt that customers usually use a S17 for 0.5 to 10 acres – but is aware that it can be more.

Like the dealer we met with Evan is frustrated with the S20 and S50. These products have a horrible switch. Constantly have problems and dealers don't want to take them.

Gallagher North America June sales conference



Figure 26 - Conference room in the new Gallagher building.

The Gallagher North American team had a very successful 2013 year. However the first few months of 2014 has not gone as well, emphasis on the team looking to take market share in situations where the market isn't growing.

Orscheln's - Are looking at an arrangement where a customer could order a product off the Orscheln website and it will be delivered direct from Gallagher. This will be shipped in a pack to look as if it has come direct from the store.

Patriot is frustrating our TM's in a lot of places. Showing large growth and not a cheap product. They are stealing shelf space. An example was given of a store where Patriot bought all the existing Zareba stock and GAVE 24 foot of stock to the store to get things going.

Tru-Test reps visiting stores weekly planning orders in some areas – action for team to find out what areas have reps. In areas without reps a distributor sells with a 30% margin.

Patriot provides better warranty service, with 5 year warranty and freight free on warranty returns. Stores are clearly appreciating the freight free benefit after some comments we got regarding the S20 and S50 shipping cost.



The B11 is being used successfully in Canada (Leonard) for bear control around Bee hives. Sold 150 so far, but have market for around 400 total. He has reservations about using a B11 to control Bears, but the customers are asking for the product by name and have used it in the past.

Action – Byron – Is this an opportunity for Small solar?

AJ did a big push for TM's to try get more real information from stores. Gut feel is good, but Real facts are better. This would be highly beneficial right though our business, especially back in NZ.

I Series session

Went exceptionally well. Product well received by the team, and everyone excited.

Comments on pricing was that it was lower than what they had expected, but they were advised that Canadian prices are subject to change.

SMS capability very exciting, but cost is frustrating.

Extensive discussion on the M1200i not being a 'full I-series capable' Energizer.

Action – Byron – Get update on delivery volumes and when.

Additional Comments

In discussion with TM's around the conference the following came up.

Drive through electric gate – several TM's want that for the US market,

Action – Graham/Jenn explore further.

Other companies are offering a 'Timed release gate latch', can we do this?

Action – Graham - Add to opportunity list.

HR4 is awesome, but also good would be a HR6 for sheep. A lot smaller device.

Action – Dan – Add to opportunity list.

B180/280 are too high priced – B280 \$400 vs TruTest \$230 (including mains adapter).

Hard to sell a lower value product (meaning Gallagher brand matters less) when ours doesn't include the mains adapter. As per rest of world, some TM's didn't even appreciate that our B80/B180/B280 could be powered from 110V mains. Very rare for product to be placed in store with Mains adapter alongside it.

Retail prices for TT product.

Speedrite 1000 – \$119

Speedrite 2000 – \$165

Speedrite 3000 – \$199

Fault finder – \$119



Figure 27 - Speedrite 5500, 0.63 J stored.

Smartfix – would love a tab with a hole to allow for a wrist band to be added.



USA, May 2013 Trip report

Actions

Action	Who	Date
Small solar opportunities added to A3	Byron	18/6/13
I Series delivery volumes and dates	Byron	18/6/13
Parmak false Joules claim	Byron/Jenn	Dec/2013
Super charging your charger idea	Byron	Sep/2013
Sheep hand held reader – add to opportunity list.	Dan	June/2013
Time release gate latch	Graham	June/2013
Review drive through electric gate into US market	Graham/Jenn	Sep/2013

Small Solar

All stores visited would most likely be able to sell it. Majority of stores would stock it.

Large Powerbox model

Not one customer, or any positive comments about the opportunity of a more powerful solar powered unit. All Cattle farmers with single wire. Therefore S50 is enough power. B100 is pretty awesome. B200 is the upsell for those that want lots of power.

