

Net Zero Energy Demand Homes

Lessons Learned Report #1

30 November 2021



Artist's impression of net zero energy demand homes at Ed.Square, NSW.

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Purpose

The purpose of this document is to provide an initial update to the Australian Renewable Energy Agency (ARENA) and the industry regarding progress and lessons learned to date on the Net Zero Energy Demand (NZED) Homes project at Ed.Square, Frasers Property Australia's masterplanned community in Edmondson Park, NSW.

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ARENA Acknowledgement and Disclaimer

This project received funding from the Australian Renewable Energy Agency (ARENA) as part of ARENA's Advancing Renewables Program.

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ARENA Summary

Table 1: Project details

Activity title	Net Zero Energy Demand Homes
Ref	Lessons Learned Report #1
Reporting Period	December 2019 – November 2021
Contract No	2019/ARP045
Recipient Name	Frasers Property Australia
Partners	Real Utilities
Primary Contact	Rory Martin, Sustainability Manager
Primary Contact Email	rory.martin@frasersproperty.com.au
Secondary Contact	Julia Halioua, Sustainability Advisor
Secondary Contact Email	julia.halioua@frasersproperty.com.au
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Executive Summary

Frasers Property Australia with support from the Australian Renewable Energy Agency (ARENA) is participating in a study of the cost and energy efficiency of Net Zero Energy Demand (NZED) homes at Ed.Square, with the objective of understanding the potential and pathway to deliver these homes on a larger scale.

The Frasers Property Australia project will deliver 51 all-electric medium density homes in a range of sizes and designs as part of Frasers Property's Ed.Square masterplanned community in Edmondson Park, NSW.

This report summarises the key learnings to date from the NZED homes project. The project is in progress and will be completed in 2025.

Construction of the NZED homes commenced in October 2021. The lessons learned to date focus on the activities associated with:

- ▶ Planning
- ▶ Design
- ▶ Sales and marketing
- ▶ Early procurement

Planning

The in-ground and above ground infrastructure required to build NZED homes creates planning challenges that in the case of the NZED homes project at Ed.Square, have been supported by the scale of the development site and of the Frasers Property Australia business.

Access to a wholly-owned site capable of yielding 51 medium density homes in a community which offers a broad choice of housing products in different precincts, to be delivered by a reputable developer, enabled a smooth and transparent planning and approval process in partnership with consent authorities.

The ability to draw on the in-house expertise of Frasers Property's dedicated and resourced sustainability team to work through planning challenges was instrumental to the smooth planning and approval process.

Design

The NZED homes at Ed.Square utilise renewable energy generated on-site through solar PV, so the design of the homes takes into account a rooftop installation with the capacity to supply their energy needs.

However, energy retailers do not typically have expertise in property development. It was a distinct advantage to the design process for the project team to draw on the property development expertise of the embedded energy network provider Real Utilities, Frasers Property Australia's wholly-owned licensed energy retailing business, to design a fit-for-purpose solution appropriate and suitable to meet the projected energy needs of the homes.

Sales and marketing

The marketing campaign for the NZED homes at Ed.Square tapped into increased consumer preferences for sustainable and healthy products, including housing, driven by increased awareness of climate change issues.

A cohort of owner-occupier customers cited the environmental performance of the NZED homes as a driver for their purchase. However, among this cohort and other buyers, the cost-efficiencies attached to the increased energy performance were a more significant driver, demonstrating the need for developers to consider environmental and economic factors equally when investigating the potential of NZED homes in a demand context.

It is also important to consider traditional drivers of housing purchases, such as quality of design, choice of size and configuration, and access to amenity in the community. While the energy efficiency features of the homes resonated with customers, it has been important to position these features in a customer lifestyle context.

The marketing campaign for the NZED homes, branded as Balanced Energy Homes or BE.Homes, was extremely successful, with all 51 homes selling off the plan within nine months of their launch to the market.

Early procurement

The NZED homes project is a component of a much larger masterplanned community development of some 1,884 homes at Ed.Square. The scale of the overall project as well as the developer Frasers Property enabled cost efficiencies in services and contractor procurement that supported feasibility and will continue to do so through the construction phase.

Future lessons learned

Additional learnings from the procurement, construction, and operation of the NZED homes project will be shared in future reports.

Construction of the 51 NZED homes commenced in October 2021. Once the homes are complete and occupied by residents, a two-year study period will commence which will compare the homes at Ed.Square against a business-as-usual development in terms of energy efficiency, energy costs and more.

The data captured in this study will provide valuable new insights into the cost, efficiency, and effectiveness of new sustainable housing technology to help identify the optimum path for its widespread application.

Project Summary

In October 2020, Frasers Property Australia and the Australian Renewable Energy Agency (ARENA) announced a \$1.42 million project that will deliver 51 Net Zero Energy Demand (NZED) homes at Ed.Square, Frasers Property's masterplanned community in Edmondson Park, in south-west Sydney.

The project aims to create homes will feature technology that, over the course of a 12-month period, will produce on average more energy than they consume.

The project, receiving \$708,910 in funding from ARENA, aims to expand the knowledge and understanding of renewable energy technology so these innovations can be refined and developed to elevate the energy performance of Australian housing.

The 51 medium density homes are a mix of one, two, three and four-bedroom designs of up to three storeys and have been branded Balanced Energy Homes, or BE.Homes. The homes will integrate a suite of renewable energy, electrification and energy efficiency measures including 4 kW of solar PV per dwelling, ground source heat pump space conditioning, induction cooktops, electric boosted solar hot water, low-e glazed windows, LED lighting and roof insulation.

All appliances will be electric with no gas connected, delivering ongoing connection savings to residents, and supporting increased utilisation of the electricity network.

Once the homes are complete and occupied by residents, a two-year study period will commence which will compare the homes at Ed.Square against a business-as-usual development in terms of energy efficiency, energy costs and more. The data captured will provide valuable new insights into the cost, efficiency, and effectiveness of new sustainable housing technology to help understand the opportunity for its widespread application

The homes will be located at Ed.Square, in Edmondson Park NSW, and aim to demonstrate net zero energy demand by:

1. Excluding all gas infrastructure in lieu of electric infrastructure;
2. Maximising efficiency through on-site renewable technology and efficient systems design; and
3. Increasing customer awareness through targeted marketing and education on operating NZED homes efficiently.

As part of the NZED Homes project, Frasers Property has committed to:

1. Develop 51 NZED homes including:
 - ▶ 4kW of solar PV per dwelling
 - ▶ Ground source heat pump system space conditioning for all two and three-bedroom dwellings (representing 43 dwellings)
 - ▶ Induction cooktops
 - ▶ Electric boosted solar hot water
 - ▶ Low-e glazed windows

- ▶ R6.0 roof insulation
 - ▶ Master switch
 - ▶ LED lighting
 - ▶ Vertical shade screens where necessary
 - ▶ Confirmation of air tightness through blower door testing
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2. Provide all residents with access to an embedded energy network, installed and operated by Real Utilities, Frasers Property Australia's wholly-owned licensed energy retailer, with tariffs subsidised due to access to a rooftop solar PV installation.
 3. Undertake project, budget, and consultant management.
 4. Deliver built form construction and technology.
 5. Report on delivery in line with the Frasers Property & ARENA agreement.
 6. Calculate the overall economic benefits to the developer, residents, and energy retailer.
 7. Create specific, targeted marketing collateral to support the uptake of NZED homes by customers and utilise collateral to increase their education on the benefits of living in a NZED home.

1 Lessons Learned: Electric Boosted Solar Hot Water Units

Category

Technical / Legal (Titling/Strata By-Laws) / Risk

Objective

Key objectives of the NZED homes project are to exclude the use of gas infrastructure in lieu of electrical infrastructure in the homes, maximise the efficiency of the homes in terms of systems and design, and deliver the technology in built form. To meet these objectives, the NZED homes include the use of Electric Boosted Solar Hot Water Units (HWUs).

Detail

Energy reduction: In addition to being all electric, the solar hot water units in the NZED homes deliver significant energy savings in comparison to a standard unit in a comparable home. The energy modelling suggests a reduction in energy use of more than 25%, though this will be further assessed through energy monitoring during operation.

Hot water lag: The ability to service the three-level NZED homes requires treatment of hot water lag given the length of service lines from the system. Frasers Property is investigating the potential introduction of a small electric instantaneous booster to service the ground floor and to remove the 'dead leg', with minor implications in terms of costs and energy use.

Access limitations: The rooftop location of HWUs servicing individual homes means they are on common strata property and residents would not each have roof access unless all 10-14 residences serviced by the HWU were given easement access through a single property. This raises issues concerning the potential burden put on this single residence, in which residents could possibly be contacted by other residents for access. This introduces safety and privacy concerns, including as it relates to accessing the roof. To mitigate this, Frasers Property restructured the ownership and titling structure of the HWUs.

On this basis, the repair, maintenance, and replacement of HWUs was made the Owners Corporation's responsibility including the increased cost and maintenance exposure associated with this. Electricity running costs remain with individual purchasers.

Implications for future projects

Dead leg assessment: A more detailed understanding of the risk of dead legs associated with rooftop HWUs over three levels should be acknowledged as a key consideration in the early assessment process. If understood earlier, and with greater product flexibility, alternative measures could be considered including the separation of the tank and relocation to lower levels, to be more central to the servicing points.

Servicing changes: With earlier and more detailed consideration of the full impacts of technology and servicing changes within Class 2 type housing including the impacts on common property, there is an opportunity to analyse access safety in a more complete respect. Specifically, sales contract and titling implications including Strata By-Laws should form part of technology checklists in assessments.

Specification design: There is value in an even greater upfront commitment to fully design potential specification upgrades in the form of more complete construction documentation for design resolution and budget finalisation.

Conclusion

While the Electric Boosted Solar HWUs facilitate the objective of an all-electric energy use, and reduce energy use substantially, there are some challenges associated with home height and titling that should be assessed in the early stages.

2 Lessons Learned: Strata home typology constraints (spatial/contractual) and selling off the plan

Category

Technical / Legal

Objective

To position NZED homes to appeal to consumers in an off the plan context to understand their potential for the mass market.

Detail

Off the plan sales compliance: Like other off the plan housing projects, the NZED homes project at Ed.Square faced constraints in selling off the plan which have increased as a consequence of regulatory changes, such as the Conveyancing Act (NSW). The level of upfront design development required to limit exposure to consumers has escalated, and this is amplified in high density and complex medium density homes such as the NZED homes.

Site (Spatial) / Commercial (Contractual) constraints: These constraints mean changing specifications should be fully detailed upfront and detailed design and investigation costs expended earlier to avoid future complications.

Implications for future projects

Frasers Property see an opportunity at a masterplan and individual home level to build into the design process a greater margin to accommodate changes and design development. Though minor changes can still be made, it is at a cost.

Conclusion

Due to titling, design and commercial constraints, the energy strategy for the building fabric and the equipment selection should be investigated and defined/detailed at an early project stage to avoid future complications.

3 Lessons Learned: Embedded network

Category

Technical / Regulatory / Legal

Objective

To provide all NZED homes access to an embedded energy network which delivers renewable energy generated on-site, with the energy supply and infrastructure to be provided by Real Utilities, Frasers Property Australia's wholly-owned licensed energy retailing business.

Detail

Embedded energy network: Without an embedded energy retailer, the mechanism to validate and verify energy consumption data to prove the ability for homes to be net zero energy becomes effectively impossible. The embedded network structure allows for data to be gathered, whilst also ensuring residents are supplied from either rooftop solar PV, or Climate Active certified carbon neutral energy. It is noted from 2024, as per the commitment from Real Utilities, that all energy supplied will be procured from wind and solar farms in Australia under its agreement to purchase produced large-scale generation certificates (LGCs) up to 2030.

Titling constraints: The relationship with Real Utilities has been advantageous to the project; there is a lack of carbon neutral or renewable energy suppliers in the market. While there are no issues in providing these homes with access to an energy retailer, attempts to replicate this in future Class 1 Torrens-titled home stages has presented challenges. Specifically, without common property, such as strata-titled rooftops for example, to facilitate the embedded network infrastructure such as solar panels and the requirement to bulk meter multiple homes, the additional titling and creation of substantial easements, communication and marketing to purchasers is not currently viable.

Implications for future projects

Replicating the embedded network structure in Class 1 Torrens-titled homes is not seen as viable and therefore will need a change in approach to deliver NZED homes in the future.

Embedded networks in medium and high-density projects are the norm, making it relatively easy to apply learnings at Ed.Square to future projects. However, the application in Class 1 Torrens-titled homes remains a challenge to be solved. There is a concept for private energy infrastructure to be owned and reticulated through public roads, however this concept has not been deployed so far as Frasers Property are aware.

Conclusion

The embedded network supports the delivery of net zero energy through the year, even when the solar PV is not producing energy, however embedded networks are best suited to strata titling in NSW and could not be replicated on future Torrens-titled homes.

4 Lessons Learned: Battery storage

Category

Technical / Regulatory / Legal

Objective

To provide homes with battery storage to further reduce energy costs and reliance on the electricity grid.

Detail

At the time of design, fire-safety considerations prevented battery systems to be installed in the carpark, and there was no other space available for their safe installation. It is noted battery energy storage is a key method to drive the NZED home supply / demand balance.

Implications for future projects

The integration of battery storage should be assessed at an early design stage in a dense housing typology context and space allowance should be made. Even if not installed directly, this will future-proof installation by residents that could be driven by a reduction in battery storage cost.

Conclusion

Battery storage is critical to drive absolute zero energy homes, however there can be challenges with space available for safe installation if not planned at an early design stage.

5 Lessons Learned: Geothermal air-conditioning

Category

Technical / Procurement

Objective

To provide individual geothermal air-conditioning for each dwelling on strata-titled homes.

Detail

Geothermal air-conditioning has been available in the market for some time but remains a specialised field. This is further challenged by strata titling complexities, as the system is required to have individual thermal bores for each home rather than a communal system that feeds multiple town homes (which would need to be committed to earlier in the project if intended). There are currently limited viable sub-contractor options in the market with the capability to deliver individual systems required for this project. This has implications such as cost and time, given the small field of contractors which consequently hold considerable bargaining power.

Implications for future projects

The implementation of geothermal air-conditioning requires very early upfront procurement to ensure impacts on the project are controlled. Frasers Property sees an opportunity to investigate alternative high-quality energy efficient systems, potentially leveraging increased solar PV capacity, to deliver comparable energy use and resident comfort outcomes.

Conclusion

The availability of geothermal air-conditioning systems can be limited based on design and titling constraints on the system selection. These challenges should be considered early in the design process to assess the commercial viability of the system.

6 Lessons Learned: Ground Source Heat Pump (GSHP)

Category

Technical / Procurement

Objective

To deliver Ground Source Heat Pump (GSHP) space conditioning, also known as geothermal, to the two and three-bedroom dwellings.

Detail

Many geothermal (or GSHP) systems use a refrigerant gas-filled system in loops which reach underground to take on the constant temperature of the earth and leverage this to control the in-home temperature in a way that uses less energy.

For the NZED homes project, Frasers Property investigated procurement options to deliver the GSHP through systems that would provide an alternative to a refrigerant gas-filled system, to mitigate environmental and safety impacts in the very unlikely event of a refrigerant gas leak. Our research identified the water-cooled system as the most appropriate alternative, with this system delivering a reduction in the refrigerant gas load to the heat pump equipment.

Additional benefits of this alternative GSHP system included:

- ▶ Shorter lead times to order loop material
- ▶ More cost-effective than copper alternatives
- ▶ Fan coil unit on each level eliminates ridged ducting and provides better control
- ▶ Eliminates additional split system unit to downstairs

Implications for future projects

While the water-cooled system is slightly higher in price, given Frasers Property's experience, the safety and running cost benefits of the system are viewed as justifying the additional upfront cost. A potential downside of the water-cooled system its slightly larger size and additional water pump require additional space.

Conclusion

There are viable market alternatives to the use of GSHP refrigerant gas-filled systems for the loops and there are substantial benefits in using a water-cooled system.

7 Lessons Learned: Market Acceptance of Induction Cooking

Category

Social / Commercial / Marketing

Objective

To deliver induction cooktops to all residences as part of the project's commitment to deliver all-electric homes.

Detail

Feedback from residential customers collated over time indicated a general preference for gas cooking due to **familiarity and perceptions of lower cost**.

The fact there was to be no gas in the home was a challenge faced by the sales team in liaising with customers. Additional resources in customer interaction were required and a **customer education** process was necessary to explain the **benefits of induction cooking**, including efficiencies in time and energy use, aligned with the objective to create all-electric homes.

Investing time in educating customers, including education around the vision of the NZED homes project objectives, was found to be worthwhile. 'Big picture' discussions around the fact that Frasers Property had been selected as part of an ARENA-associated study to help understand market demand and facilitate a pathway for widespread adoption of more energy efficient homes resonated with customers, as did the fact this project represented an industry-first.

Frasers Property's reputation as a **trusted developer** and provider with significant sustainability credentials enabled these interactions to achieve the desired outcome.

Implications for future projects

Satisfying customer expectations in terms of cost efficiency and product effectiveness remain important but some residential customers are willing to 'buy in' to project visions where there is a demonstrable positive sustainability outcome.

Over the course of the sales campaign, much of the hesitation expressed to the Frasers Property sales and marketing team as a result of the negative perception of electric induction cooktops eroded.

Conclusion

All-electric homes – including the use of induction cooktops – were well received by customers after the benefits were explained by the sales team.

8 Lessons Learned: Branding of the Net Zero Homes

Category

Social / Commercial / Marketing

Objective

To create specific, targeted marketing material to support the uptake of NZED homes and utilise collateral to increase customer education on the benefits of living in a NZED home.

Detail

Customer focus groups revealed a perception that more energy efficient equated to being more expensive. An all-electric home was perceived as being overly focused on energy use, without a balance of energy generation. Therefore, a branding of Balanced Energy Homes (or BE.Homes) was recommended.

This branding aligned with the proposition of balance and lifestyle and the features of the house design. It was a simple and easy to understand description of what the house does, where the energy a customer creates is balanced by the energy one needs.

'Balance' has associated meanings of relaxation, assurance and peace, and customers resonated with aspirational phrases like 'live a balanced life'.

It was also identified that the determining factor in achieving a perfect energy balance is how residents 'use' the home, not just the specifications that the homes offer. The fact these homes give the customer the power to live a greener, happier, healthier, more balanced, and potentially more cost-effective lifestyle were core drivers to purchase.

Implications for future projects and conclusion

A broader lifestyle branding approach is more appropriate when marketing aspirational projects like the NZED homes, as opposed to narrower targeting of building specifications.

9 Lessons Learned: Marketing focus – Needs-based approach

Category

Social / Commercial / Marketing

Objective

To create specific, targeted marketing material to support the uptake of NZED homes and utilise collateral to increase customer education on the benefits of living in a NZED home.

Detail

The need to continue to consider customers through a needs-based approach became clear through research and focus groups. These were conducted to understand how best to communicate and sell the benefits of NZED homes and meant considering what makes for a better life for customers and translating this value in way to make the homes more desirable.

The ‘cake’ analogy was applied. Customers still need a home which starts with the basics to meet their requirements.

This is the cake: the type of home, number of bedrooms and bathrooms, and its location in the community, for instance. Once that has been determined, the ‘icing’ is added, which relates to the sustainability and energy efficiency features of the home. Positioned well, these are the elements that can surprise and excite a customer.

For NZED homes, the icing on the cake comes in the form of **all year-round comfort, lower bills, and a quality build that will stand the test of time.**

The ‘cherry on top’ is the brag factor. The homes include features not offered in other housing products. The combination of these initiatives enables customers to live in a sustainable way and help the environment.

Fraser's Property also identified that customers believe these elements make for a better life. We therefore focused on communicating to these needs in marketing collateral and on the sales floor. The sales team were able to talk to the sustainability features of the homes in a lifestyle and community sense, as opposed to talking ‘sustainability’ in an overly scientific way.

The broader amenity provided by the Ed.Square masterplan was an advantage:

- ▶ Connection – to all you need, accessible by foot, bike, and train
- ▶ Convenience – shopping, dining, transport just a stroll away
- ▶ Safety – safe, walkable community
- ▶ Comfort – a home you'll love living in all year round
- ▶ Health – fresh air, green spaces, parks and playgrounds, spaces that promote social connection
- ▶ Quality – a home designed to deliver your best life
- ▶ Value for money – a home that you've dreamt of but doesn't cost you the earth
- ▶ Future-focused – latest features that will stand the test of time.

Frasers Property identified the need to explain to customers the sustainability benefits in a very short and simple approach that outlines the customer's needs – the *what's in it for me?* The term 'sustainability' doesn't mean anything to a typical customer. Language and terminology accordingly was adapted to address this.

Once customers understood the benefits, a potentially higher sales price can be justified through an emphasis on value for money, while giving a competitive edge.

Dollar savings from energy efficiency are best expressed as numbers as opposed to percentage savings. It was also effective to **put savings into a lifestyle context**, for example, 'the cost of going out for dinner once a week'. It was important to link the value back to the customers' needs or wants.

Finally, for some customers, Frasers Property identified the need to provide reassurance, and third-party data, websites or ratings schemes helped validate claims.

Implications for future projects and conclusion

Marketing and sales functions should remain focused on identifying benefits to the customer based on the customer's needs. Big picture aspirations are better received by customers when communicated in a lifestyle benefits context.

10 Lessons Learned: Market/Customer response to NZED homes

Category

Commercial / Marketing

Objective

To create specific, targeted marketing material to support the uptake of NZED homes, utilise collateral to increase customer education on the benefits of living in a NZED home, and identify commercial benefits where apparent.

Detail

The full suite of collateral created, and sales training provided had a clear impact on the ability to explain and 'unpack' what a BE.Home was for Frasers Property customers. It also provided the sales team with the confidence to talk about the benefits of NZED homes and the key standout features.

It is important to understand the context of the selling environment when the NZED homes were in market. The launch occurred when market demand was strong, and the \$25,000 Homebuilder Grant¹ was available to take up on these homes. It is therefore difficult to gauge the true influence and impact of the efforts to market and sell these homes.

The sales team identified that customer feedback on the features of NZED homes were 'nice to have' and validated their buying decision to invest in a home that's future-focused, and smarter by design.

All 51 NZED homes at Ed.Square were sold within nine months of launch.

Implications for future projects and conclusion

The direct commercial advantages of the improved specifications of the NZED homes cannot be quantified at this stage. There will be an opportunity to continue to develop marketing material with more direct reference to the energy, cost, and lifestyle advantages of the homes through survey and data collected through energy monitoring and other measures. This will provide improved clarity of the saving representations and benefits.

¹ <https://www.revenue.nsw.gov.au/grants-schemes/homebuilder>

Next Steps

The construction of the NZED homes at Ed.Square commenced in October 2021. Frasers Property anticipate many further lessons will be learned which will influence future projects and highlight new pathways for the potential broader adoption of these homes in the mass market.

The next lessons learned report will be published in April 2023 and will include learnings from the procurement and construction of the NZED homes.

The final knowledge sharing report will be published in 2025 after the monitoring of the homes during operation. The performance of NZED homes will then be compared with other homes within the Ed.Square development to quantify the benefit of the features of the NZED homes.

The final knowledge sharing will include:

- ▶ Technical and commercial analysis of the installed features.
- ▶ Contractor insights into the physical delivery and maintenance of NZED homes, including embedded energy networks.
- ▶ Customer insights on their experience in the homes and satisfaction with the transition to all-electric.
- ▶ Increased insights into effective marketing and sales functions for NZED homes.

Conclusion

The lessons learned through the planning, design, sales and marketing, and early procurement phases of the NZED homes project suggest the broader application of this housing typology in the mass market has significant potential.

However, Frasers Property anticipate there will be many additional lessons and insights apparent through the construction, delivery, and operation of the homes. The two-year study of the benefits of living in the homes compared a standard home, of comparable dimensions and use, will shed new light on this potential, and the pathways to achieving broader take-up.

The early learning learnings from the planning, design, marketing and sales, and early procurement phases can be summarised as follow:

- ▶ Early-stage investigation of the NZED home features during the design phase is critical to facilitate their implementation and cost efficiency.
- ▶ The embedded energy network solution helps to deliver carbon neutral energy including energy generated on-site through solar PV and was made possible with the strata titling structure.
- ▶ The solar hot water system helps the project to transition away from gas and deliver significant energy savings but can present challenges in home design that should be considered at an early stage.
- ▶ Marketing collateral and sales team training does help to communicate the benefits of the home and give confidence to customers in their purchase, however there is a need to clearly articulate customer benefits.
- ▶ Customer acceptance of induction cooking.

Frasers Property's focus for the project now moves to the commencement of construction and continuing to work to maximise the insights across all aspects of the project.

Frasers Property look forward to further contributing to the industry's knowledge and customer education about the energy use and cost-efficiency benefits of NZED homes as Australia, and the world, embraces a net zero future.

Contact Details

Julia Halioua, Sustainability Advisor

Frasers Property Australia

E: Julia.Halioua@frasersproperty.com.au

W: www.frasersproperty.com.au



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