Case Study: Cohaus in Grey Lynn

A consumer owned network supporting a community housing project

Cohaus is an integrated housing project created, designed and financed by the people who call it home. The project incorporates five key elements of community, housing, transportation, water and energy. Cohaus started with a clear intention and a set of requirements to provide reasonably affordable, high-quality housing for 10 to 20 families within easy biking and public transportation distance from the Auckland CBD, and, to be ecologically minded within commercially sensible constraints.

The incorporation of these five elements enabled capital savings in one area be used to invest in long term savings in other areas so that, as a whole, the project was cost effective for residents of the community.

Governance

The governance structure enabled effective decision making, collective consultation and individual ownership. Each of the families who would become owners set up a trust with shares in a development company that was managed by two directors, each of whom were community members and future residents. Once the project was constructed, the trusts converted to unit title with a body corporate and the development company would be dissolved. This allowed people the flexibility to participate from the start all the way through to being occupants or to swap out during the process. Ultimately most of the families that started became owner occupants and residents.

People and skills

The project started from a series of meetings of the founding families. The two directors of the development company, one of whom is the architect, had the power to make decisions quicky. Cohaus would hire consultants for specialized areas such as Revolve Energy for the energy systems design and enablement.

Project steps

Land acquisition: First, they set about finding and purchasing a suitable site, which turned out to be in the suburb of Grey Lynn close to the CBD, bike friendly and well served by public transportation. The site had a single building which was no longer to be used for its intended purpose, making the property prime for redevelopment into co-housing.

The design: The design was intended to maximize community green space and shelter it from wind and street noise with the buildings. The buildings would anchor the perimeter. Car parking was minimized to maximize green space.

The buildings were designed for living functionality rather than features that would might look good on a brochure but have minimal practical value. Where possible, amenities were shared. Reducing complexity reduced the capital cost.

Sound financial decision making

Features and technologies that enhanced sustainable living needed to stack up economically. Financial models were used to evaluate options and make trade-offs.

One clear example was the decision to go with a central heat-pump hot water system. Heat pump hot water systems are higher capital cost but, being three times more energy efficient, deliver a much higher net present value. One central hot water system is more cost efficient to purchase, install and maintain than 20 smaller hot water cylinders. In combination, this decision had a payback of three years which is very quick given the life of the project. In addition, eliminating the hot water cylinder from each unit, freed up space equivalent to a large closet per unit.

Photo by Adam Luxton

Since the solar PV system was of clear economic benefit but had a longer payback, it was financed separately with a loan from one of the families. This removed the capital cost burden from the project and the loan could be serviced from savings realized on energy over time. Once the loan is repaid, this additional fee can be put toward other uses or removed from the monthly bill for each unit.

Six shared vehicles offer a number of economic benefits. They reduce the amount of parking needed allowing for more green space and a shared garden or extra units. There are the savings from shared cost of maintenance, WOF, insurance and other fixed operational costs and well as the upfront capital cost. Currently two of the shared vehicles are EVs and four are hybrids with the goal to go to all EVs in order to maximize the use of day time solar production and sustainability.

The energy system

Consumer owned network

Cohaus operates a consumer owned electricity network with a single grid connection to supply electricity to the 20 units and all shared loads such as laundry, communal lighting, hot water and EV charging. Cold water is similarly distributed to apartments from a single Watercare connection. Hot water is completely internal to the site with a central on-site hot water plant delivering hot water via a ring main.

The property has a single gate meter at the grid interconnection point. This means that Vector, the local lines company, only has one connection and one customer, and, Ecotricity, the energy retailer, only has one customer, rather than 20. This gives Cohaus buying power to get a cost-effective energy rate and allowed them to reduce the collective interconnection capital cost and operating cost.

Within the property there are check meters for each unit and for most of the key loads such as the central hot water system and the EV chargers which enables Cohaus to monitor and allocate the cost of services to each unit.

Internal billing is managed using a software billing system designed by Revolve Energy for consumer owned networks. One of the residents manages the internal billing and the relationship with the retailer Ecotricity including analysis for future energy strategies. Their renumeration for this part time work is modest compared to the energy savings. The rest of the residents enjoy the benefits of low cost and self-generated energy without having to spend time managing it.

Energy control system

Having a single gate meter and operating a consumer owned network enables Cohaus to take full advantage of their on-site generation and controllable and flexible loads to generate savings without compromising comfort and convenience.

The control system manages the demand so that the limits set by the lines company are not breached and the demand charges are kept to a minimum. In the event that the property is nearing peak demand, there are three controllable loads that can be turned off or delayed; EV chargers, hot water heater and the outlets on a dedicated circuit for each unit's space heaters. The residents are aware that these services are subject to curtailment and understand the economic benefits. The control system also seeks to utilize as much of the solar energy generated on site by heating the hot water and charging the EVs during the day.

Load control operates to reduce operational cost by maximising the use of onsite generation. If Cohaus moves to time-of-use rates in the future, load control can be used to take advantage of lower (off-peak) tariffs.

Demand control has allowed the site to reduce the grid connection capacity allocation by 30%, down from 250 A to 180 A. This eliminated the need to upgrade the distribution transformer which saved at least $40,000. In addition, since the lines charge is proportional to the capacity (Amps) allocated the 70 Amp reduction (250-180) saves about $750 per annum in lines charges.

Photovoltaics

The 40kWp (peak) roof mounted system feeds the consumer network and therefore all loads on the property. In New Zealand, the cost of a kWh of energy from the grid is significantly higher than the price paid to the owner for a kWh of solar exported to the grid. The value of solar energy is maximized by the control system to ensure that, to the extent possible, the energy generated is used on site particularly by controllable loads such as the hot water heater and EV chargers.

Photo by Adam Luxton

Central hot water

The central heat pump hot water heating system cost about $100,000 which was about $50,000 more than having conventional individual hot water heaters. However, the additional capital cost of the heat pump system will be paid back through energy savings in less than 3 years ($15,000 of operational savings per year, increasing over time). In addition, over 20m² of floor area was saved in the apartments by avoiding the installation of individual hot water cylinders, with a built floor space value of $100,000. Thus, the payback was instant from a space savings perspective and delivers an additional $15,000 of operational savings per year, increasing over time. The hot water heating set point can be increased when there is excess on-site solar electricity available.

Space heating

Since the units are well insulated, the space heating requirements are relatively modest. Therefore, it was decided to use a dedicated, controllable circuit for the outlets (plugs) for the space heaters, but leave the decision on size and number of space heaters up to the owners. In a peak capacity event, the space heater circuit can be curtailed if needed.

EV chargers

The shared electric vehicles are charged with smart fast chargers that integrate into the demand control system. This allows EV charging to be reduced or curtailed during times of peak demand and for charging costs to be reduced by maximising charging at times of excess PV generation and in the future low electricity pricing.

Allocating costs fairly

The data acquisition, metering & billing solution ensures that the operational and capital costs of the system are recovered fairly from the residents. The system:

1. Records and stores the metered electricity, hot water and cold water use of each apartment.
2. Allocates the costs of the shared vehicles by distance travelled.
3. Optimizes energy cost by storing and managing tariffs for the service centrally, including time of use tariffs for any service.
4. Allows onsite solar PV generation to be determined on a half hourly basis and billed to each unit at a separate rate to grid electricity to incentivise residents to change their usage patterns.
5. Automatically generates monthly invoices for the services which are pushed into Xero to be managed and communicated.

To start, billing has been kept simple. Over time, as residents become more comfortable, and ways to save or shift energy use become evident, the billing system might become more intricate to create incentives for residents.

Monitoring and visualisation

The same data that has been captured for billing, plus data from additional check meters which measure central loads (e.g. heat pumps, PV & EVs) can be visualised centrally. A fully customisable dashboard allows the managers of the site to keep track of consumption, and generation of electricity, heat and cold water.

A simplified dashboard will be shared with residents to allow them to understand the best time to use electricity & hot water.

The system also tracks costs and savings in real time to allow live reporting of cost and carbon savings.

Interactions with contractors

Supported by Revolve Energy, Cohaus, put together a clear set of system specifications that could be bid out in an RFP (request for proposal) process that enabled direct comparison of offers from contractors. This ensured that best quality, price and service level was achieved for each system. Revolve Energy continues to act in an advisory capacity to Cohaus.

Interactions with the lines company

Lines companies are transitioning in their attitude toward innovation in the distribution grid and this was reflected in the Cohaus experience. In general, the lines company will supply whatever capacity is needed. Vector was prepared to supply the 250 A (three phase) suggested by the electrical building services engineer. However, Vector was initially not prepared to tell Cohaus what capacity threshold was available to the site without the need for a distribution transformer upgrade. This information was vital to the economic decision to invest in a load control system to reduce the capacity needed or to simple go with a higher capacity connection.   This required navigating to someone at Vector who was prepared to provide the information. Once it was established that the threshold to avoid a transform upgrade was 180 A (three phase), the decision was made to go with load control and save the cost of the transformer upgrade of at least $40,000.

However, even the 180A capacity allocation is higher than needed and Cohaus will seek to demonstrate this with data over time and seek further reductions in lines charges. The peak load to date has been 85A (one half of the capacity allocated.)

Further, while Cohaus has achieved internal cost savings, they have not been able to engage with Vector to provide ancillary or flexibility services such as load shedding, load shifting, voltage support or reactive power support. Perhaps these opportunities will arise in the future as Vector seeks to procure these services and puts in place the grid management technology to be able to provide a demand signal and API feed of current tariffs.

There is also a future opportunity to be able to operate in island mode in the event of a grid outage but this would require batteries to be installed to balance the generation and load.

Interactions with the retailer

Ecotricity is considered to be an innovative retailer supportive of community initiatives for self-generation and load management even though it means they sell less electricity. They provided two options for energy. One based on time-of-use and the other a flat rate. Because of the volume purchase, both were considerably lower than they would have been for a single household. After analysis of anticipated usage, Cohaus opted to go with the flat rate for energy at just over 11 cents per kWh locked for a two-year period. Lines charges are separate and a pass through. This, in combination with solar, makes the middle of sunny days the best time to use electricity

Cohaus will analyse its usage patterns in advance of negotiating the new energy rate toward the end of the 2-year period to determine which rate it should be on. Cohaus might also adjust the internal billing to reflect time of use pricing to encourage residents to shift energy use toward low-cost times. Having control of the billing system and customer network allows flexibility in how they allocate costs and incentivize behaviour of their community.

Storage

A common question is whether energy storage was considered and why it is not included. There are three answers to this. Firstly, energy is stored in the form of super heating the hot water system and through charging EVs. This is just a valid a method of energy storage as stationary batteries and more cost effective. Second, since Cohaus is grid-tied in a relatively resilient part of the grid, the grid effectively acts as storage and Cohaus is part of a broader community of energy users. Third, the financial case for batteries which would include energy arbitrage, ancillary services and resiliency did not stack up because, at the time of construction, these where not a sufficiently important problem to solve or were not available. If this changes, then stationary onsite battery storage can be added in the future.

Final words for those who follow

Cohaus sought to balance economics, ecological stewardship and comfort with each design decision. This required careful consideration of upfront costs and future needs and lifestyle choices.

One example was the decision to only have the required storm water storage buffer rather than oversize the system to perhaps double the requirement. The council requires a certain size in order to buffer storm water runoff, but additional tanks could store water for reuse in the garden and other non-potable uses. These subterranean tanks are most economically installed at the start of construction. At the time, the economic cost did not seem justifiable, but in retrospect some residents would have liked to have additional water for the garden or other uses.

There are check meters at each unit and most of the common loads. However, the shared laundry could also benefit from having a check meter to better allocate costs. At present this is all bundled with general lighting and so usage cannot be incentivized or allocated.

When you can amortize costs across a community of 20 units it is easier to make long term infrastructure decisions that require upfront capital cost for longer term payback.

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