homestar

DRAFT UNITARY PLAN

Homestar Cost-Scoring Appraisal for Auckland Council

05 February 2013 - Revision 1.0

Jasmax

1.0 Executive Summary

1.1 About

This study explores potential cost and specification implications associated with recognising the “Homestar” rating tool in the forthcoming Auckland Unitary Plan.

1.2 Results

This study suggests that Homestar ratings for a sample 3 bedroom / 180sqm new house in Auckland, which may at the time of undertaking this study (June 2012) sell for around $550,000, could be achieved for the following construction cost increases over typical practice:

- 5 star rating: +$ 3,237.50
- 6 star rating: +$ 6,437.50
- 7 star rating: +$16,241.50

1.3 Implications

This study indicates that:

- Changes in design and specification can be achieved using widely available products, without major change to construction methods.
- Homestar prioritises a passive solar approach which is desirable and highly appropriate to the Auckland climate, and which offers direct health and comfort benefits to the population.
- Homestar incentivises smaller dwellings, which could also align with other measures to increase housing affordability.
- Reduced demand pressure for water and energy resulting from specification changes could reduce pressure on infrastructure.
- Potential benefits to consumers in the form of resulting energy and water bill savings are anticipated, to be assessed separately.
- Issues of policy operation should be considered in detail to ensure the crossover of information between Resource Consent and Building Consent documentation is well managed.

2.0 Background

2.1 Authorship

Auckland Council requested Jasmax Ltd to undertake this study.

Tim Robinson and Jerome Partington of Jasmax provided architectural specification and design input – both have experience of applying a range of sustainability ratings tools to design, specification and building. Jerome is a Greenstar Accredited professional.

Jasmax were assisted in appraising cost implications by Eoin Darby, a Greenstar Accredited Professional, of Rawlinsons Quantity Surveyors.

Matthew Cutler-Welsh of the New Zealand Green Building Council provided expertise around Homestar's intentions and technical framework.

2.2 Purpose

This study supports preparation of the draft Unitary Plan for Auckland, and in particular the potential for using the "Homestar" rating tool in the Unitary Plan. Homestar is a tool which can rate both existing and new dwellings – see section 3 for more information about the Homestar tool.

The over-arching Auckland Plan adopted in 2012 directed that the Unitary Plan consider this type of approach – specifically, to

> *"Improve energy efficiency and conservation (in both supply and use) through ... energy efficient development and design, by (i) ensuring development is assessed using an appropriate ratings tool along with provision in Auckland's Unitary Plan and (ii) supporting the retrofitting and redevelopment of residential, commercial and industrial buildings."*
> *(The Auckland Plan, Directive 8.3, page 212).*

The purpose of this study is to identify the potential issues associated with adopting the Homestar tool with respect to:

- Specification changes required to achieve 5/6/7 Star ratings.
- Anticipated costs associated with revised building specifications.
- Alignment with the interests of owners and occupiers.

2.3 Scope

This work has been undertaken as a desktop study, replicating the preliminary stages in the planning of a development using standard industry methods and expertise.

This desktop approach has been necessary due to the relatively recent introduction of the Homestar tool, which means that there is only limited project-based evidence available. However, it is worth noting that some of the earliest adopters of Homestar are beginning to complete building projects, and in many cases are actively sharing cost and specification information, and providing valuable observations of how the resulting homes are received by the market.

The study only considers application of the tool to new-build homes, and was limited to investigation of parts of the 10-step Homestar scale:

- 3 stars will be achieved through new-builds that comply with the current Building Code. 4 Stars is likely to be achieved, although not guaranteed, through many commonly adopted building practices where developers seek to differentiate their product from a product that is driven by basic compliance. 4 stars and below were not investigated as they represent close to current practice or statutory minimum specifications.
- 8 Stars and above represents advanced low-energy or zero-energy dwelling design and is anticipated to incorporate technology such as solar electric panels and significant water recycling systems. This level of performance is not felt to be an appropriate target for mass adoption at an early stage, and therefore was not investigated.
- The intervening 5 to 7 Stars represent an opportunity for advancing the performance of buildings using relatively small adjustments to design and specification, while delivering potentially significant benefits to owners and occupiers. The implications of achieving the required performance for these levels has been the main focus of this study.

This study does not attempt to explain in depth the very extensive issues around why sustainability is important, what constitutes sustainability, and the very complex issues around building performance and materials science. It takes the Homestar framework (which incorporates a developed understanding of these issues) as a given and seeks to work with the targets and assumptions set by this tool. Further investigation of the wider and more technical details is possible, and recommended, starting with some of the reference notes included in the Homestar framework.

2.4 About Homestar

The Homestar tool was developed by and is operated through a joint venture between the New Zealand Green Building Council (NZGBC) and BRANZ. The tool is designed specifically for New Zealand application, and can be used to assess both existing and new dwellings. At present the tool does not apply beyond houses, but the authors are in the process of preparing for alternative versions which will target apartments and other dwelling forms.

Homestar is readily accessible through an online tool which provides an indicative rating and individualised advice for the public. In addition, qualified Assessors trained by Homestar are able to undertake certification of buildings

This study has been undertaken using the Homestar tool as published and available during June 2012, as subsequently amended under a draft revision in preparation for 2013 (version 2), and adopting the scoring methodology used by the certification method rather than the online tool (the latter reflects a speculative approach rather than the evidence-based assessment).

2.5 Baseline comparison

The study also adopted use of a 'baseline' dwelling design against which to assess quantity-based costs. This design was identified as representing a typical mid-market product in Auckland, with the following attributes:

- A two-storey 180m^2, three bedroom, two bathroom house with double garage on a relatively flat site. Homestar assesses this plan as 149m^2 of internal space plus the garaging. Refer to section 3.5 for a commentary on how home size affects the Homestar rating.
- Timber frame construction with 90mm external walls, on a reinforced concrete ground floor slab.
- A mix of brick and weatherboard external walls, solid aluminium frame double-glazed windows with no gas fill or special coatings, and long-run corrugated roofing.
- Electrical, mechanical and plumbing required to meet the Building Code, including entry level instantaneous gas water heater.
- Mid-market specification for bathrooms, kitchens and other fittings.

2.6 Relevant research

The study also drew upon a range of relevant research relating to design, energy performance, health implications, and material specifications published in recent years by a variety of organisations. These included documents from BRANZ, Beacon Pathway, Otago, Canterbury, Victoria, UNITEC and Auckland Universities. These research documents are generally available through the websites of these organisations, and this study owes a significant debt to this pre-existing research for enabling specification decisions to be taken rapidly in the context of a wider understanding of how more sustainable and healthy homes can be delivered in New Zealand.

2.7 Methodology

The target for the methodology is a simple one – in effect it is:

"What specification/design scores most points for the least cost?"

This basic question drives the methodology, firstly looking to understand the points available and then researching the cost of suitable specifications. The word "suitable" is important here – a set of criteria were developed to guide what specifications were considered.

The study was therefore undertaken in key stages:

1. Appraisal of the Homestar framework itself, to understand what performance is required and how the distinct Star ratings can be achieved.
2. Identification of criteria for developing specifications.
3. Identifying current specification and cost benchmarks based on common industry practice. This resulted in the 'baseline' package referred to in the "Reference information" section above.
4. Assembling preliminary building specification elements together with packages of elements to meet 5, 6 and 7 Star ratings in the Homestar tool.
5. Cost appraisal of discrete specification elements.
6. Cost-benefit analysis and resulting adjustment of the packages required to provide out-turn costs for achieving 5, 6, and 7 Star ratings. Initial specification assumptions were also revisited to consider whether early exclusions were valid.
7. Review of outcomes; identifying conclusions and recommendations.

3.0 The Homestar framework

3.1 Overview

Homestar version 2 includes ten Star-rating performance levels, based on combinations of specificiation 'points' available for elements in six categories.

Few requirements are prescribed as to where points must be scored (see section 3.4 below). This allows designers, developers and homeowners to follow their own priorities, avoiding a prescriptive imposition, and enables people to take 'easy wins' before needing to address more challenging elements.

On the basis that a development may be seeking to achieve a target Star rating, there are two key steps in identifying a Homestar score:

1. Identify points scored under each element and category, including any minimum requirements for the target rating. See 3.3 and 3.4 below.
2. Add any bonus points for "Innovation" - this will not be a common score as it explicitly incentivises unusual, ground-breaking practices.
3. Multiply the total score based on Dwelling Size. This is a significant factor designed to incentivise smaller dwellings, see 3.5 below.

3.2 Star rating levels

This points framework translates into the following thresholds, with the Star ratings that this study is most interested in highlighted in green:

Rating	Required score
1 Star	0
2 Star	20
3 Star	30
4 Star	40
5 Star	50
6 Star	60
7 Star	70
8 Star	80
9 Star	90
10 Star	95

3.3 Categories

Homestar version 2 allocates requirements into thematic categories, with a total score of 100 available across all categories; these are shown on the chart opposite. An additional 5 points is available for innovation.

The Energy, Health and Comfort category provides the largest group of points (48), followed by Water (15) and Materials (12). This hierarchy aligns with the widely recognised logic of designing homes with reduced environmental impacts:

- Building "Envelopes" – the enclosing form of walls, floors and roofs – that create comfortable and health internal spaces by managing heat, moisture and air flows to work with local climate
- Reducing imported energy and water demand with efficient appliances
- Using materials that are safer for humans and use less energy and water in their manufacture

3.4 Minimum requirements

Minimum points are required under Homestar version 2 for priority elements. These reflect key New Zealand opportunities and issues of passive solar design, insulation and moisture, directly addressing problems found in many homes:

1. 5 Star rating requires:
   - 7.6 points under Whole House Thermal Performance
   - 3 points under Moisture Control
2. 6 Star rating includes the requirements of Level 5, plus:
   - 10 points under Whole House Thermal Performance
   - 1.8 points under Internal Potable Water Use
3. 7 Star rating increases requirements to include:
   - 11.5 points under Whole House Thermal Performance

These minimum thresholds are indicated on the chart opposite.

3.5 Dwelling size

The intention of this is to recognise that smaller dwellings consume less resources (materials, energy and water used in construction, land, energy and other resources in use) and are therefore inherently more sustainable compared to a larger house with the same specification.

The multiplier identifies a benchmark size, at which the score remains unchanged – this benchmark size varies by the number of bedrooms.

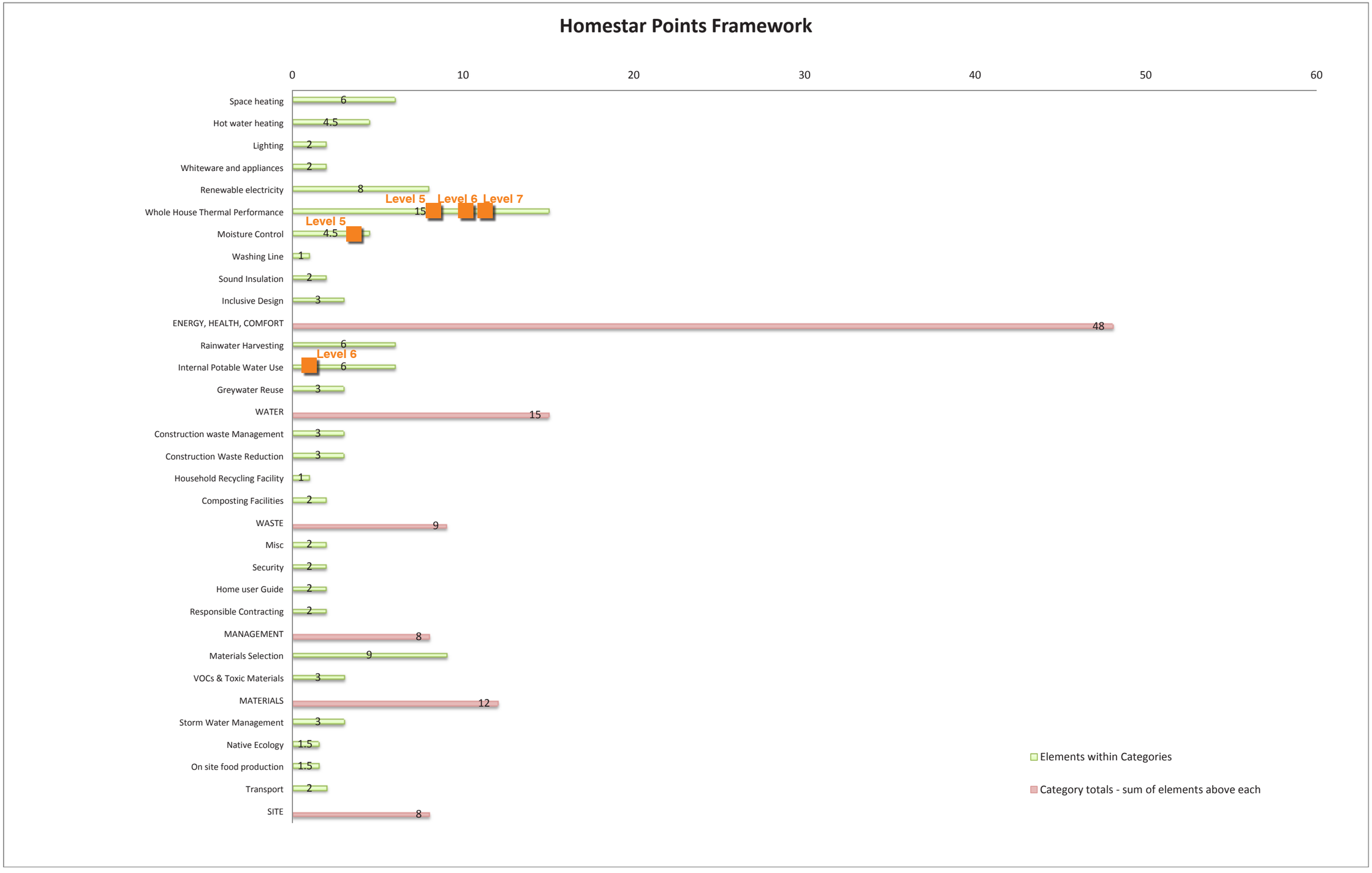
1. Smaller houses are rewarded by increasing their score.
   - Smaller houses need not be as highly specified to achieve ratings.
2. Larger houses are penalised by decreasing their score.
   - Larger houses need to be more highly specified to achieve ratings.

An excerpt of the Homestar table is set out here, showing factors in relation to sample Auckland build sizes - currently these often exceed the benchmark. The study plan aligns closely with the Benchmark at 3 bedrooms / 149m² internal.

Bedrooms / GFA						Factor	Percentage against Benchmark					
1	2	3	4	5	6		1	2	3	4	5	6
44	72	100	119	135	148	1.126	64%	65%	67%	65%	67%	71%
46	76	104	123	143	150	1.111	67%	69%	69%	68%	71%	72%
48	79	110	132	149	156	1.095	70%	72%	73%	73%	74%	75%
51	83	115	139	155	162	1.079	74%	75%	77%	76%	77%	78%
54	88	119	146	162	169	1.063	78%	80%	79%	80%	80%	81%
57	91	126	152	169	176	1.047	83%	83%	84%	84%	84%	84%
59	96	131	160	178	185	1.032	86%	87%	87%	88%	88%	89%
62	101	137	166	185	192	1.016	90%	92%	91%	91%	92%	92%
65	105	144	174	193	200	1.009	94%	95%	96%	96%	96%	96%
69	110	150	182	202	209	1	100%	100%	100%	100%	100%	100%
72	115	157	191	211	218	0.984	104%	105%	105%	105%	104%	104%
75	120	163	198	220	227	0.968	109%	109%	109%	109%	109%	109%
79	126	170	207	230	237	0.953	114%	115%	113%	114%	114%	113%
83	131	178	217	240	247	0.937	120%	119%	119%	119%	119%	118%
86	138	186	226	250	257	0.921	125%	125%	124%	124%	124%	123%
90	144	194	236	261	268	0.905	130%	131%	129%	130%	129%	128%
95	150	202	246	272	279	0.889	138%	136%	135%	135%	135%	133%

Sample Auckland Build Sizes (approximate) in each Bedroom category

Note: 2 Bedrooms includes both Apartment and House sizes


Homestar Points Framework
0
10
20
30
40
50
60
Space heating
6
Hot water heating
4.5
Lighting
2
Whiteware and appliances
2
Renewable electricity
8
Level 5
Level 6
Level 7
Whole House Thermal Performance
15
Level 5
Moisture Control
4.5
Washing Line
1
Sound Insulation
2
Inclusive Design
3
ENERGY, HEALTH, COMFORT
48
Rainwater Harvesting
6
Level 6
Internal Potable Water Use
6
Greywater Reuse
3
WATER
15
Construction waste Management
3
Construction Waste Reduction
3
Household Recycling Facility
1
Composting Facilities
2
WASTE
9
Misc
2
Security
2
Home user Guide
2
Responsible Contracting
2
MANAGEMENT
8
Materials Selection
9
VOCs & Toxic Materials
3
MATERIALS
12
Storm Water Management
3
Native Ecology
1.5
On site food production
1.5
Transport
2
SITE
8
Elements within Categories
Category totals - sum of elements above each

4.0 Specification criteria

Specifications is a skill relevant to all building projects, but one which is practiced in many ways.

The most common practice is the re-use of standard specifications, or the carrying forward of the set of specifications last used by a builder or designer on a project. This practice offers the benefit of, hopefully, carrying forward lessons learnt as to what specification works well and is available at a cost effective price. Supporting this, many projects do look for new products to enhance their appeal to the consumer or to reduce costs. Some companies pursue new products and building methods; others tend to regard the safety of tried and tested methods as being more beneficial. As a very broad generalisation, much of the house building industry tends to adopt the latter method, in line with the relatively conservative and risk sensitive attitude shown by a large proportion of the home buying market.

Specifying for sustainability will by necessity challenge common specification practices in order to secure outcomes such as energy / water efficiency and human health. All building elements from foundations to superstructure and exterior cladding to systems, kitchens and bathrooms are called into question in terms of how they perform for these outcomes. Change in any of these specifications can result in resistance from designers, builders, consenting authorities and (not least) householders. One of the major reasons that more sustainable buildings are not being delivered as a widespread market response is that all of the above parties tend to regard change, and the potential cost of change, as being unwelcome from the points of view of the process involved, and the perceptions of the homes that may result.

A wide range of considerations were therefore taken into account when researching specifications to put forward for cost appraisal. These reflect the basic desire to make the proposed specification attractive, or at least acceptable, to householders and builders, and to minimise cost and procurement barriers in promoting these specifications.

The following broad criteria were kept in mind when researching and finalising specifications:

- Market acceptance and benefit to householders.
- Market availability and ease of substitution for existing specifications.
- Cost – effectiveness and magnitude.
- Opportunities for multiple benefits – products that ‘solve’ several performance aspects, for example insulation that improves energy performance and improves health outcomes for installers and occupiers.
- Local manufacture opportunities – this reflects concerns to both limit excessive transportation of materials and products, in itself a negative environmental impact, and to strengthen the national economy.
- Diverse manufacturing impacts associated with different competing products – for example, energy consumed and waste produced in manufacture can vary enormously between products that appear to be identical at the point of installation and use.

In considering issues such as ‘market acceptance’, it is recognised that awareness of specification issues varies widely – to some home buyers the ‘specification’ of their homes is interpreted as purely the square metre size of the house, the colour of the kitchen benchtop, or the number of garage spaces.

Market research undertaken by Homestar and the Real Estate Institute of New Zealand and published while this work was in hand does however identify that home buyers do actively seek the following:

- How well a home is orientated for the sun.
- What insulation a home has.
- What heating a home has.
- Whether a home has internal moisture issues.

5.0 Preliminary specifications

It is worth noting that because Homestar applies to both new and existing properties, many specification items are effectively included already in new homes in order to meet the Building Code or market expectations.

Often environmentally certified / high performance / low-impact products are competitively priced and in widespread use as 'standard' products, in which case designers, builders and home buyers need only ensure that a particular manufacturer's product is used.

Similarly, this study also assumes inclusion of key specification items that incur negligible expense (for example, ensuring extract fans in bathrooms are wired to lighting circuits) and are therefore accounted for at nil cost, but which contribute to creating an energy efficient and healthy home. In these instances, it is again up to designers, builders and home buyers to ensure good practice is adopted.

Initial scoping of the Homestar framework and potential products considered against the specification criteria suggested the following broad directions, set against the Homestar groupings.

The list below specifically identifies items which are over and above Building Code requirements, or which may normally be included but not thought of as 'sustainable' elements.

1. Energy, Health, Comfort
    - Passive solar design – orientation of rooms, sizing of windows and doors, inclusion of concrete floors or other 'thermal mass'; double-glazing; above-Code insulation in walls, floors and roofs; Energy-rated whiteware; extract ventilation fans; efficient space heating – electric heat pumps; hot water storage tank with heat pump or solar hot water sources; LED lighting (Compact fluorescent as an alternative, but these types have greater toxicity and market perception issues); covered exterior area for washing lines.
2. Water
    - Rainwater storage tank plumbed into WC's; WELS-rated showers, taps, WC's and whiteware.
3. Waste
    - Construction waste management; waste sorting bins in kitchen; compost bin in garden.
4. Management
    - Security ventilation catches to windows; compiling a home user manual;
5. Materials
    - Environmentally certified concrete/timber/insulation/paints and coatings; low-formaldehyde MDF / Ply / particleboard; low VOC-paint and adhesives
6. Site
    - Provision of a vegetable garden and fruit trees; provision of native species within garden plantings

Further explanation should be given to some of the specifications excluded in the initial specifications:

- Gas space and water heating can be beneficial to achieving points under Energy, Health and Comfort; however unflued gas space heaters and 'standard' instantaneous gas water heaters (low-efficiency, non-condensing models) should be avoided for health, internal air quality or efficiency reasons.
- Renewable energy (eg solar electric panels or wind turbines) were excluded due to their site-specific considerations and potential price.
- Double-layer plasterboards and laminated window glazing for sound insulation were excluded for anticipated cost reasons.
- The provisions for "Inclusive Design", which are based on the Lifemark standard, were generally excluded due to anticipated cost and complexity. Only the lowest level of scoring (Level 3) was pursued as the implications of the items required changed little in terms of specification, and would be relatively easy to achieve within the plan of many current houses.
- Greywater re-use was excluded due to the regulatory prohibition on using this type of equipment within the urban limits of Auckland.
- Stormwater management installations were excluded due to the highly site-specific nature of these systems, the potentially high cost involved, and the interaction with regulatory requirements that are more likely to drive uptake of this type of system rather than householder preference.
- Transport access (ie public transport) was excluded due to the location-specific variability of this element, and the lack of control (other than selecting more central development sites) that is generally able to be exerted over this issue.

IMPORTANT NOTE:

Where specific products are identified by name in this document this does not preclude other products from being suitable, subject to their performance or achievement of a particular standard. Homeowners and professionals should satisfy themselves that any equivalent product is acceptable to the Homestar performance requirements.

References to specific products are included primarily to provide evidence that suitable products are available on the market. Secondary reasons for referencing products included identifying products which might satisfy multiple performance aspects - for example, human health benefits as well as environmental impact benefits.

6.0 Elemental specification costs

The table below itemises specifications and costs for incremental upgrades above the baseline model. In many cases there are several upgrade steps against a Homestar category.

Category	Points Available	Points Claimed	Cost	Cost / Point	Specification	Notes
EHC-1a	6	4.4	$-	$-	Electric panel heater in all rooms. Assumes plugin heater supplier separately by occupier.	Relies on envelope insulation and passive solar design elements to achieve score. Additional points can result from further envelope upgrades.
EHC-1b		0.9	$3,000.00	$3,333.33	Upgrade to Hi-wall heat pump in living / dining / kitchen	"
EHC-2a	4.5	2.7	$50.00	$18.52	180L (2-3 people) electric storage tank, one element, mains pressure, 50mm rigid insulation	Relies on low flow showers for score
EHC-2b		2.7	$300.00	$111.11	250L (5 people) electric storage tank, one element, mains pressure, 50mm rigid insulation	"
EHC-2c		1.4	$3,000.00	$2,142.86	Upgrade to HW Heat pump - Econergy HP4000 LT compressor head; storage tank as above (no element)	"
EHC-3a	2	1.5	$22.50	$15.00	CFL bulbs in 75% of internal fittings. All external lights have integrated daylight & movement sensor	
EHC-3b		0.5	$140.00	$280.00	As above, plus 25% of internal fittings are integral LED bulbs, and all external bulbs are CFL	
EHC-4a	2	1.7	$350.00	$205.88	2.5 star fridge freezer, bottom freezer, frost free	
EHC-4b		0.3	$1,200.00	$4,000	Add 4 star (energy) dishwasher	
EHC-5	8	4	$10,000.00	$2,500.00	2.2kW output Solar PV panels, inverter, panels installed on north-facing roof - meets 50% of house annual demand	
EHC-6a	15	12	$2,200.00	$183.33	R3.5 ceiling insulation (2 x R1.8 / 100mm blankets Autex Greenstuf). Passive solar design of windows.	Assumes 90mm external stud with R2.2 wall insulation, Windows aluminium clear 4-12-4 IGU.
EHC-6b		0.8	$6,074.00	$7,592.50	Upgrades from above: 140mm external studs filled with R2.6 wall insulation, R4.2 ceiling insulation (2 x R2.2 / 140mm blankets Autex Greenstuf). Exposed concrete slab 2m width at northern windows/doors. No downlighters set into insulation envelope. Low-e coating to glazing.	Argon fill not included - approximately $850. Thermally broken frames would be $6000-7000 dependent upon complexity of glazing patterns
EHC-7a	4.5	0.3		$-	All washbasins/sinks and baths have overflows	
EHC-7b		0.4		$-	Concrete ground floor	Requires polythene ground sheet where ground floors are suspended timber
EHC-7c		0.1	$300.00	$3,000.00	Showerdome	
EHC-7d		0.5	$218.00	$436.00	Upgrade underfloor insulation from R1.3 to R1.5	Code achieves required wall and ceiling insul. Assumes Autex Greenstuf 90mm wall pads (R2.0)
EHC-7e		0.5	$218.00	$436.00	Upgrade underfloor insulation from R1.5 to R1.8.	
EHC-7f		0.6	$109.00	$181.67	Upgrade underfloor insulation from R1.8 to R2.0.	
EHC-8a	1	0.3	$300.00	$1,000.00	Wall mounted fold out washing line frame, mounted externally in general garden area.	
EHC-8b		0.3		$-	4sqm of external space dedicated to drying washing.	
EHC-8c		0.4	$1,250.00	$3,125.00	4sqm of polycarbonate roof on timber framing to cover washing drying area.	
EHC-9a	2	1	$-	$-	Habitable rooms include areas of carpet; mechanical extraction included; concrete floors. Solid core internal doors where ground floor is not concrete.	
EHC-9b		1	$-	$-	Walls enclosing noisy rooms (entertainment rooms, music rooms, or childrens play rooms) have double layer of 13mm plasterboad on one side, and studs filled with acoustic insulation - eg Novahush 580 (60mm) or 900 (90mm) - and solid core doors with acoustic seals. All plumbing tied back to frame with vibration isolators, eg rubber washers to each screwed fixture point.	Design assessed is all open plan and does not include any noisy function rooms of the type indicated. Cost of plumbing isolation negligible in overall installation costs.
EHC-10	3	0.9		$-	Lifemark Level 3. Reallocate 2m^2 of internal space to allow 1.5m wheelchair turning circle in shower / wc room.	Assumes bedroom on ground floor, lever handles to all doors, all access doors 860 leaves (not stores/wardrobes etc), and relatively level access from parking to entrance door.
WAT-1	6	5.5	$3,000.00	$545.45	4000L above ground tank, pump and feeds to laundry and WC	
WAT-2a	6	1.5		$-	Shower head with 9L maximum flow rate	
WAT-2b		0.3		$-	6/3L dual flush WC	
WAT-2c		0.7		$-	Upgrade WC to WELS 4 star - 4.5L/3L dual flush - eg Robertson Heron Close Coupled WC or equivalent	
WAT-2d		0.3	$800.00	$2,666.67	Provide new washing machine	
WAT-2e		0.3	$300.00	$1,000.00	Upgrade to WELS 4 star washing machine - eg Simpson SWT605SA or Samsung SW70SPWIP	

Category	Points Available	Points Claimed	Cost	Cost / Point	Specification	Notes
WAT-2f		0.9	$250.00	$277.78	Upgrade to WELS 5 star washing machine - eg Panasonic NA-148VG3 or Bosch WAS32742AU	
WAT-2g		0.3		$-	Upgrade Kitchen and basin taps to WELS 4 star (7.5L/minute) - eg Caroma / Dorf “Balance V” mixers	
WAT-2h		0.3		$-	Upgrade Kitchen and basin taps to WELS 5 star (6L/minute) - eg VCBC Crystal range mixers or Euroware TAP-CP-F0037 and TAP-CP-F0041	
WAT-2i		0.4		$-	Upgrade Kitchen and basin taps to WELS 6 star (4.5L/minute) - eg Pacific Tapware 2000 series mixers	
WAT-2j		0.2	$1,000.00	$5,000.00	Provide new dishwasher	
WAT-2k		0.8	$700.00	$875.00	Upgrade dishwasher to WELS 5 star - eg F&P OneTouch DW60DOX1 (more cost effective than 4-star models)	
WAT-3	3	3	$10,000.00	$3,333.33	Ecoplus three-toilet system plus garden irrigation addition, in-ground tank	
WST-1	3	3	$200.00	$66.67	Implement a site waste management plan in accordance with REBRI guidelines	
WST-2	3	3	-$200.00	-$66.67	90% of waste diverted for recycling, or less than 10kg/sqm sent to landfill	
WST-3	1	1		$-	10L, 2 compartments sorting bin within kitchen - eg Hideaway KC30H, or Easy Recycling Double Bins HH2	
WST-4	2	2	$50.00	$25.00	2L storage in kitchen, 240L compost bin in garden - eg, internal: Easy Recycling Triple Bins HH1 (deduct cost of bin to meet WST-3 to offset); external: Warehouse Round Compost Bin with Lid 240L	
MAN-1	2	2		$-	No specifications to achieve. All new houses should comply.	
MAN-2	2	2	$20.00	$10.00	Window security restraints / stays to all windows. Fire extinguisher (x1).	Assumes “secure locks” are standard to all doors, sensor lighting provided under EHC3, modern hot water tank installed properly to limit outflow temperature, smoke alarms fitted as standard code compliance.
MAN-3	2	2	$200.00	$100.00	Time to compile owners manual, based on template document, designers drawings and installers manuals. Assume 2 hours of professional time at $100 / hr	
MAN-4	2	2		$-	Contractor Environmark Gold, with Environmental Management Plan, or EcoPlumber, IAONZ, EcoSmart Electrician	
MAT-1a	9	3	$-	$-	Resene/Dulux paint, Polyester ceiling insulation (Autex Greenstuf).	
MAT-1b		2		$-	Concrete supply chain to ISO 14001 Chain 1 and 2	
MAT-1c		2		$-	Floor coverings to ISO 14001 Chain 1 and 3. Eg Godfrey Hirst, Feltex, Cavalier Bremworth,	
MAT-2a	3	0.75		$-	Low VOC coatings - eg Resene / Dulux range	
MAT-2b		0.75		$-	Low VOC adhesives - eg Bostik range	
MAT-2c		0.75		$-	Low VOC carpet - eg Cavalier Bremworth, Heritage carpets ECNZ range, Feltex,	
MAT-2d		0.75		$-	Any particle board, MDF, LVL, plywood and other engineered timber is low-formaldehyde to relevant AS/NZ standards. Eg Laminex Lakepine MDF, Nelson Pine Super E0 MDF, Laminex Superfine particleboard,CHH Kopine particleboards, CHH Ecoply, all CHH LVL products manufactured in NZ,	
STE-1	3	1.5	$-	$-	75% permeable site beyond roof footprint. No additional cost assumed for grass.	
STE-2a	1.5	0.5	$960.00	$1,920.00	40% of site area (excluding under roof) planted with native species mix suitable for domestic garden. 4 plants per sqm, pb5 and pb8 mix. Offset cost against saving in seeded lawn. Auckland species.	
STE-2b		1	$720.00	$720.00	Additional 30% of site area (excluding under roof) planted with native species mix suitable for domestic garden. 4 plants per sqm, pb5 and pb8 mix. Offset cost against saving in seeded lawn. Auckland species.	
STE-3a	1.5	1	-$100.00	-$100.00	4sqm exposed topsoil in garden. Offset cost against saving in seeded lawn.	
STE-3b		0.5	$200.00	$400.00	Four fruit-producing trees, pb8.	
STE-4	2	0	$-		Transport - not sought - depends on site location, costs for sites vary enormously	

7.0 Cost-scoring appraisal

The graph opposite maps cost incurred against points achieved, to help identify what the most effective upgrade elements may be.

Extracting the most highly contrasted lines from the graph suggests the ‘easy wins’ that can be pursued in assembling specification packages. The list below proposes upgrades that are relatively low cost per point, and also relatively low in total cost terms. Whether these items were actually used in the final specification packages depended in part on the practicality or likelihood of their inclusion by homebuilders in the current market.

	Cost over ‘standard’	Points
Electric hot water cylinder - 0.7 points more than an instantaneous gas heater (low-efficiency model) EHC2	$350	2.7
75% of lighting to be CFL or LED – 25% of this to be integral LED luminaires, with all external lights CFL including sensors. EHC3	$162.50	2
Provide 2.5 star fridge-freezer. EHC4	$350	1.7
Additional ceiling insulation (R3.5 rather than Code minimum R2.9). Ensure passive solar design of orientation and window proportions; use concrete floor as thermal mass. EHC6	$2,200	12
Upgrade underfloor insulation to R2.0. EHC6, EHC7	$545	2.1
Concrete rather than timber ground floor. EHC6, EHC7, EHC9	NIL	0.4
All basins, sinks, baths to have overflows. EHC7	NIL	0.3
Provide external drying rack for washing, in dedicated space. EHC7	$300	0.6
Re-plan ground floor to allow wheelchair turning circle within WC / Shower space as part of Lifemark Level 3. EHC10	NIL	0.9
9L/min shower head, 4.5/3L dual flush WC, 4.5L/min basin and kitchen taps. WAT2	NIL	3.5
Produce site waste management plan; implement site waste management plan. WST1, WST2	NIL or negative	6
Recycling storage bins within kitchen area. Compost storage tub within kitchen area, and 240L compost bin in garden. WST3, WST4.	$50	4
Fire extinguisher and security restraint stays on windows. Assumes “secure locks” are standard to all doors, sensor lighting provided under EHC3, modern hot water tank installed properly to limit outflow temperature, smoke alarms fitted as standard code compliance MAN2	$20	3
Concrete from ECNZ, Enviromark or ISO14001 certified suppliers. MAT1	NIL	2
Resene, Dulux paints, Autex insulation, Bostik adhesives and sealants, carpets and floor coverings from selected Feltex / Cavalier Bremworth / Heritage ranges. Alternative suppliers acceptable subject to ECNZ, Enviromark or ISO14001 certification. MAT1, MAT2	NIL	7.25
MDF, LVL, Plywood, any other engineered timber in superstructure or kitchen units to be low-formaldehyde. MAT2	NIL	0.75
4m2 of garden for vegetables; 4 fruit trees. STE3	$100	1.5
75% permeable site beyond roof footprint. No additional cost assumed for grass, soft planting. STE1	NIL	1.5
	$4077.50	52.2

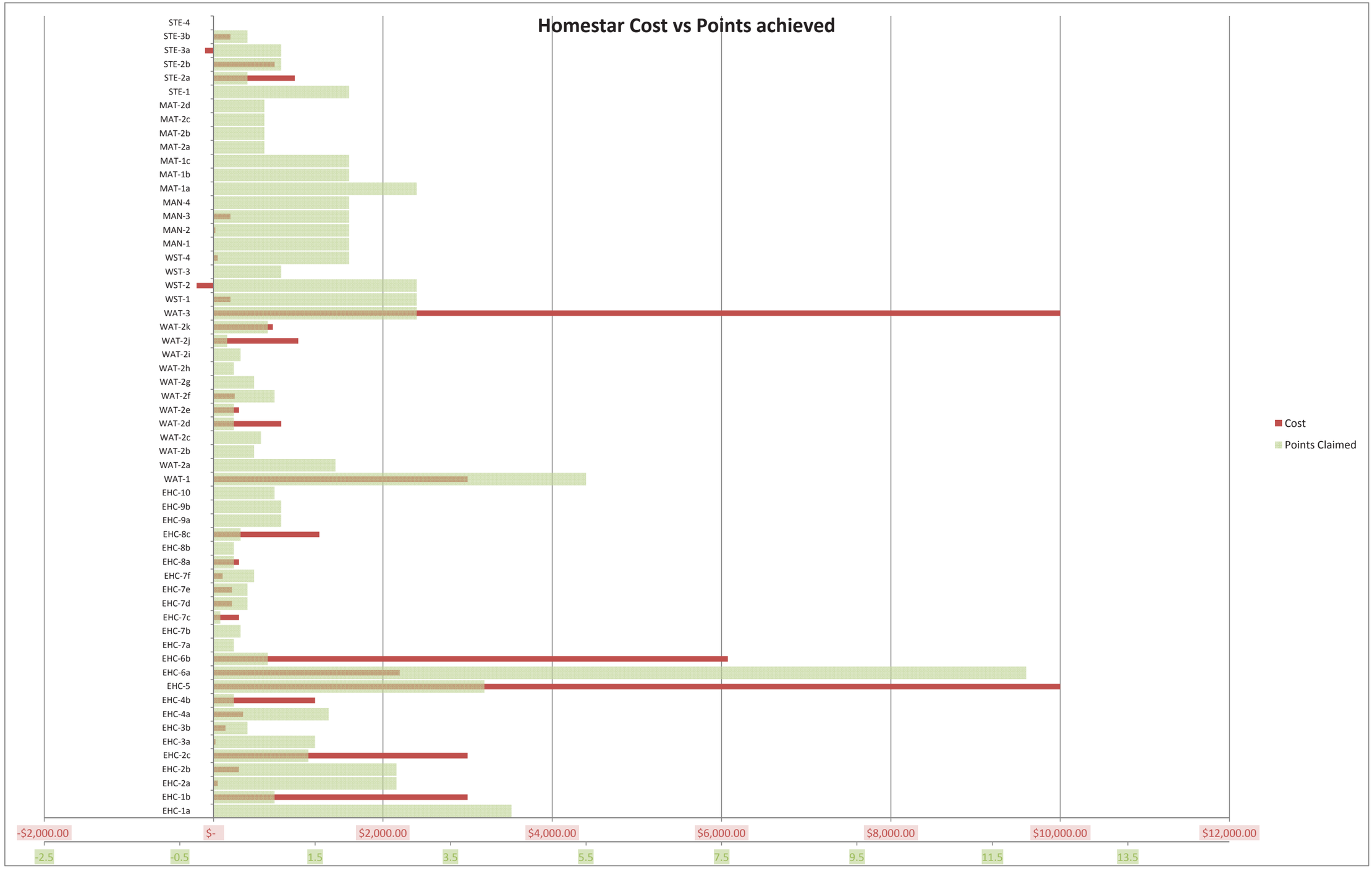
It is worth discussing the relatively low cost attributed here to the highly scored element (12 points out of a possible 15) for whole house performance. The approach here suggests that achieving a good passive solar design and efficient thermal envelope is primarily attributable to good design, rather than construction expense.

While good arguments may be made that there is more complexity to this issue – which to an extent is difficult to understand and cost on an explicit basis in an abstract study such as this – that may increase this cost, the unfortunate fact is that many houses are still built without adequate consideration of how rooms are arranged in relation to the sun. The position taken in this assessment is that it is also common that rooms can easily be positioned in a good solar arrangement with relatively limited effort (and cost) by designers and builders, and that few homebuyers or occupiers are likely to object to the benefit that can ensue from this effort.

Drawing attention to passive solar design is not new – the principles of this are well established and easy to quantify using engineering assessment tools. However, achieving good solar design basics has not been realised in the market. It is suggested that if Homestar were to achieve only one improvement to Auckland homes, in the form of mandating improved passive solar design rather than simply ‘encouraging’ it, then a significant improvement to new housing stock will have been achieved.

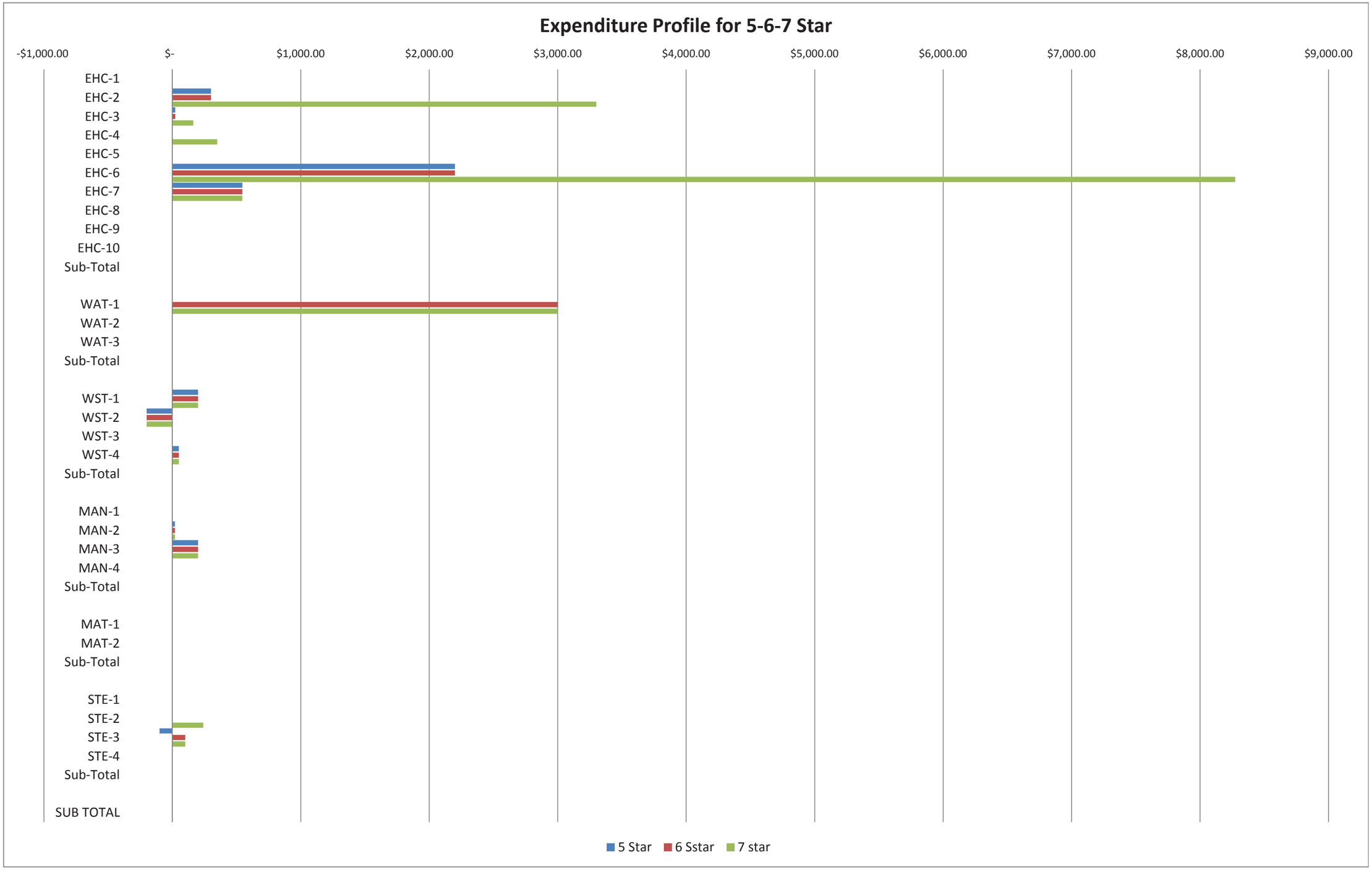
Achieving an improvement to solar design is an issue that requires attention from both Council and subdivision developers. This is due to limitations on the potential for solar design created by the layout of streets and lot subdivision. In many cases it is impossible for building designers to achieve an optimal solar layout if a site is poorly configured with little thought as to how passive solar design is affected.

It is therefore important that Auckland Council does more than just endorse the use of Homestar - it must ensure that both District Plan rules and development proposals are formulated or assessed with passive solar outcomes in mind, if the use of Homestar is to be effective in this respect.


Homestar Cost vs Points achieved
STE-4
STE-3b
STE-3a
STE-2b
STE-2a
STE-1
MAT-2d
MAT-2c
MAT-2b
MAT-2a
MAT-1c
MAT-1b
MAT-1a
MAN-4
MAN-3
MAN-2
MAN-1
WST-4
WST-3
WST-2
WST-1
WAT-3
WAT-2k
WAT-2j
WAT-2i
WAT-2h
WAT-2g
WAT-2f
WAT-2e
WAT-2d
WAT-2c
WAT-2b
WAT-2a
WAT-1
EHC-10
EHC-9b
EHC-9a
EHC-8c
EHC-8b
EHC-8a
EHC-7f
EHC-7e
EHC-7d
EHC-7c
EHC-7b
EHC-7a
EHC-6b
EHC-6a
EHC-5
EHC-4b
EHC-4a
EHC-3b
EHC-3a
EHC-2c
EHC-2b
EHC-2a
EHC-1b
EHC-1a
-$2,000.00
$-
$2,000.00
$4,000.00
$6,000.00
$8,000.00
$10,000.00
$12,000.00
-2.5
-0.5
1.5
3.5
5.5
7.5
9.5
11.5
13.5
Cost
Points Claimed

8.0 Specification and cost packages

	5 Star			6 Star			7 Star			
Ref No.	Specifications	Points	Cost	Specifications	Points	Cost	Specifications	Points	Cost	Comments
EHC-1	no heating provided - assume occupants' portable electric	4.2		no heating provided - assume occupants' portable electric	4.2		no heating provided - assume occupants' portable electric. Increase from EHC-6 upgrades	4.7		Scores rely on building envelope specification
EHC-2	Electric cylinder	2.7	$300.00	Electric cylinder	2.7	$300.00	Heat Pump Hot Water Heater	4.1	$3,300.00	Cylinder cost is an upgrade over gas 'baseline'
EHC-3	CLF lamps 75% of internal (normal luminaires), sensors on extl lights	1.5	$22.50	CLF lamps 75% of internal (normal luminaires), sensors on extl lights	1.5	$22.50	CFL or LED to 90% of internal, exclusive fittings to 25% and all living room, sensors on extl	2	$162.50	
EHC-4							2.5 star fridge/freezer (bottom freezer, frost free).	1.5	$350.00	
EHC-6	R3.5 ceiling insulation (2 x R1.8 / 100mm blankets Autex Greenstuf). Full or edge insulation under slab, R2.0 batts in walls.	12.8	2,200.00	R3.5 ceiling insulation (2 x R1.8 / 100mm blankets Autex Greenstuf), Full or edge insulation under slab, R2.0 batts in walls.	12.8	$2,200.00	140mm stud external wall; R3.6 insul. R4.2 ceiling insul, no downlights. Low-e glazing. Full or edge insulation under slab. 2m exposed slab at north facing ground floor windows.	12.8	$8,274.00	Low-e coating but not Argon fill required for 7 star rating. No argon fill included here to reduce cost of glazing upgrade.
EHC-7	Extract for kitchen, laundry and shower; bathroom extracts hardwire to lights. Extl grille flaps. Polythene ground sheet under timber floors. Underfloor insulation to R2.0.	2.8	$545.00	Extract for kitchen, laundry and shower; bathroom extracts hardwire to lights. Extl grille flaps. Polythene ground sheet under timber floors. Underfloor insulation to R2.0.	2.8	$545.00	Extract for kitchen, laundry and shower; bathroom extracts hardwire to lights. Extl grille flaps. Polythene ground sheet under timber floors. Increase from windows (low-e) under EHC-6	3.9	$545.00	Assumes - Openable, stay-secured windows. No unflued heaters.Contained overflows to all fittings. Clothes dryer ducted, condensing or no dryer.
EHC-9	All plumbing through frame with vibration proof seals	0.86	$-	All plumbing through frame with vibration proof seals	0.86		All plumbing through frame with vibration proof seals	0.86		
EHC-10	3 star Lifemark	1	$-	3 star Lifemark	1	$-	3 star Lifemark	1	$-	
WAT-1				4000L above ground tank, pump and feeds to laundry and WC	5	$3,000.00	4000L above ground tank, pump and feeds to laundry and WC	5	$3,000.00	
WAT-2	9L/min shower, 6/3L WC, 4.5L taps,	4.6	$-	9L/min shower, 4.5/3L WC, 4.5L taps	4.6	$-	9L/min shower, 4.5/3L WC, 4.5L taps,	4.6	$-	No non-composting WC currently available to achieve maximum score.
WST-1	Site waste plan, REBRI guideline	3	$200.00	Site waste plan, REBRI guideline	3	$200.00	Site waste plan, REBRI guideline	3	$200.00	
WST-2	90% of waste recycled, or <10kg/sqm to landfill	3	-$200.00	90% of waste recycled, or <10kg/sqm to landfill	3	-$200.00	90% of waste recycled, or <10kg/sqm to landfill	3	-$200.00	Likely to rely on WST-1
WST-3	10L, 2 compartment bin in kitch.	1	$-	10L, 2 compartment bin in kitch.	1	$-	10L, 2 compartment bin in kitch.	1	$-	
WST-4	2L storage in kitchen, 240L compost bin in garden	2	$50.00	2L storage in kitchen, 240L compost bin in garden	2	$50.00	2L storage in kitchen, 240L compost bin in garden	2	$50.00	
MAN-1	New house should not have any problems.	2		New house should not have any problems.	2		New house should not have any problems.	2		
MAN-2	Window restraints, fire extinguisher.	2	$20.00	Window restraints, fire extinguisher.	2	$20.00	Window restraints, fire extinguisher.	2	$20.00	
MAN-3	Produce Home User Guide	2	$200.00	Produce Home User Guide	2	$200.00	Produce Home User Guide	2	$200.00	
MAN-4						$-	Contractor Environmark Gold, or EcoPlumber, IAONZ, EcoSmart Electrician	1	$-	No cost, but only included under 7-star as potentially harder to source.
MAT-1	Resene/Dulux paint, Polyester ceiling insulation, concrete supply chain for floor to ISO 14001 Chain 1 and 2	5	$-	Resene/Dulux paint, Polyester ceiling insulation, concrete and floor covering supply chain for floor to ISO 14001 Chain 1 and 2	7	$-	Resene/Dulux paint, Polyester ceiling insulation, concrete and floor covering supply chain for floor to ISO 14001 Chain 1 and 2	7	$-	
MAT-2	TVOC (coatings), VOC (floor coverings) within limits	1.5	$-	TVOC (coatings) and VOC (adhesives & sealants, floor coverings) within limits, low formaldehyde engineered timber	3	$-	TVOC (coatings) and VOC (adhesives & sealants, floor coverings) within limits, low formaldehyde engineered timber	3		
STE-1	75% permeable site beyond roof footprint. No additional cost assumed for grass, soft planting.	1.5	$-	75% permeable site beyond roof footprint. No additional cost assumed for grass, soft planting.	1.5	$-	75% permeable site beyond roof footprint. No additional cost assumed for grass, soft planting.	1.5	$-	Allows for approx 50sqm impermeable parking and patio on a 300sqm section
STE-2							10% covereage	0.5	$240.00	
STE-3	3 m2 vegetable garden	1	-$100.00	Dependent on bedrooms: 3-4sqm vegetable garden, 2-4 fruit trees	1.5	$100.00	Dependent on bedrooms: 3-4sqm vegetable garden, 2-4 fruit trees	1.5	$100.00	
TOTAL (for benchmark sized dwelling)		54.5	$3,237.50		63.5	$6,437.50		70.0	$16,241.50	
Reduced score possible for smaller houses		-6.9			-8.0			-8.8		
Additional score required for typical current Auckland 3 / 4 / 5 bedroom houses (20% larger than benchmark)		+3.4			+4.0			+4.4		


Expenditure Profile for 5-6-7 Star
-$1,000.00
$-
$1,000.00
$2,000.00
$3,000.00
$4,000.00
$5,000.00
$6,000.00
$7,000.00
$8,000.00
$9,000.00
EHC-1
EHC-2
EHC-3
EHC-4
EHC-5
EHC-6
EHC-7
EHC-8
EHC-9
EHC-10
Sub-Total
WAT-1
WAT-2
WAT-3
Sub-Total
WST-1
WST-2
WST-3
WST-4
Sub-Total
MAN-1
MAN-2
MAN-3
MAN-4
Sub-Total
MAT-1
MAT-2
Sub-Total
STE-1
STE-2
STE-3
STE-4
Sub-Total
SUB TOTAL
5 Star
6 Sstar
7 star

9.0 Conclusions

9.1 Key results

This study suggests that Homestar ratings for a sample 3 bedroom / 180sqm new house in Auckland can be achieved for the following additional construction costs.

- 5 star rating: $ 3,237.50
- 6 star rating: $ 6,437.50
- 7 star rating: $16,241.50

These costs should be taken in the context of the overall baseline construction cost, and the nominal baseline selling price of the chosen sample house:

- Baseline construction cost: $ 297,000 (180m^2 2-level @ $1,650/m^2)
- Baseline selling price: $ 550,000

- 5 star increase: +1.09% of build cost
- 6 star increase: +2.16% of build cost
- 7 star increase: +5.46% of build cost

9.2 Observations

This study also suggests that:

- Changes in design and specification needed to achieve 5 to 7 Star ratings can be achieved in many cases using widely available market products and without major changes to construction methods.
- That Homestar prioritises a passive solar approach which is strongly recognised in the home buying market as desirable and highly appropriate to the Auckland climate.
- Homestar also incentivises smaller dwellings; while based on environmental outcomes, this could also support other measures to increase housing affordability.
- Many of the 'easy win' specification items include water saving items. While issues around water (cost, infrastructure demands) have relatively low priority in the home-buying market, the potential to reduce infrastructure demands could be a high value consideration for Council.

Additional observations:

- Any cost increases will be most noticeable in the lower value market segments, where additional costs represent a higher proportion of the construction and selling values.
- Based on experience of increasing building performance requirements through building codes and planning requirements, both locally and internationally, the cost of more expensive upgrade items can be expected to fall over time as supply increases and specifications become standard practice.

9.3 Qualifications

The study does not directly address the following:

- The cost of undertaking the Homestar assessment - including direct fees and indirect overheads for designers, developers and builders. Costs will undoubtedly apply under these headings, but these can be hard to quantify at present. Assessment fees are being examined by Homestar at present with the intention of achieving a low, cost-effective price point. It is also fair to expect that indirect overhead costs may initially be high while those involved in developing homes become familiar with a new approach and adjust their practices, but once practices change this can reasonably be expected to be absorbed within current cost margins. Homestar assessments can be undertaken quickly and with a high degree of certainty, potentially posing relatively low risk for developers compared to other elements of compliance.
- Costs have not been directly identified in relation to achieving a passive solar design layout. This approach was taken due to the variability of site-based factors (eg orientation, shading, site proportions) and the difficulty of identifying a baseline of how well typical market housing is currently performing. It is suggested that this is primarily a design agenda rather than a direct cost agenda - that is, good design will be able to create a good passive solar layout on many sites by using the same floor area and cost budget, notwithstanding site issues such as shading from neighbouring trees.
- Escalation of costs. The figures and specifications provided apply to market data as at June 2012.
- Extrapolation of construction costs to end sales costs as presented to the consumer, which would require taking account of varying development costs and profit margins, and GST.
- Analysis of the impacts of these costs for different dwelling sizes and market price points. This would be a worthwhile investigation to understand how any policy provisions may affect important issues such as affordability in lower market segments.
- Full cost-benefit analysis taking account of potential savings that householders can reasonably expect to realise through reduced energy and water consumption.
- Apartments. Homestar was developing capacity for apartment asessment, which is likely to recognise the different attributes and opportunities associated with different building and land use forms, at the time of undertaking this study.

9.4 Policy implications

Operative issues:

- Potential endorsement of Homestar in the Unitary Plan would create a crossover between Resource and Building Consent information. This is due to the need to identify detailed building specifications earlier than normally documented in the development process, and the potential need to monitor detailed construction compliance beyond normal planning data. Potential impacts of this on the design, consenting and development processes may be significant. Management of this would need careful consideration; achieving a simple, workable system should be addressed as early as possible. Provision should be made for flexible evolution of detailed designs and specification between Resource Consent and Building Consent.
- Provision for correlation of revisions between the independently controlled Unitary Plan and Homestar mechanisms would be necessary. Consideration should be given to creating a transparent 'roadmap' for how policy will recognise any changes in the Homestar tool, what the timescale for adopting any changes would be, and what timescale would be associated with any incremental increase in requirements over time.