BEFORE A COMMISSIONER APPOINTED BY THE SELWYN DISTRICT COUNCIL

IN THE MATTER OF	the Resource Management Act 1991
AND	
IN THE MATTER OF	applications by KeaX Limited for resource consent to establish a solar array at 150 Buckleys Road, 115 Buckleys Road and 821 Hanmer Road, Brookside, Selwyn Brookside.

STATEMENT OF EVIDENCE OF CAMPBELL MCMATH

ON BEHALF OF THE APPLICANT

(OPERATIONS)

Dated: 09 February 2023

KeaX Limited
Applicant
Campbell McMath
(campbell@keaenergy.nz)

Applicant
PO Box 38
Leeston
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1 INTRODUCTION

1.1 My full name is Campbell John McMath. I am the Managing Director (MD) of KeaX Limited. My wife (Naomi) and I co-founded KeaX Limited on 29th April 2020 to undertake consultancy work, contracting work and R and D projects in the field of solar generation and self-consumption of power.

1.2 I have been installing solar farms for over 10 years, throughout New Zealand and the Pacific Islands. My work involves developing sites, design, engineering, procurement, construction, consultancy, trading energy, trading renewable energy certificate, retailing energy, environmental matters, and customer relations.

1.3 The Kea group venture started on the family dairy farm in Selwyn with some mini-hydro power stations over 10 years ago, from there it grew into a retail company, and moved into solar farms supporting local farms. It is a passion of mine generating power and retailing a product that I have created. Our feather in our cap is in January 2021 we constructed New Zealand's largest solar farm in the Wairau Valley, Marlborough, which was also New Zealand's first utility scale solar farm. We punch well above our weight.

1.4 I am also the MD for Kea Energy part of the Kea group, a separate entity that is our (Generator and Retail) Gentailer arm. My responsibilities are the managing and running of these two companies in all its form.

2 SCOPE OF EVIDENCE

2.1 My evidence is related to operational matters (from an applicant/operator perspective) and :

(a) Describes Kea Group business and how we are local.

(b) Describes the need for renewables, Government Policy, and other operational matters.

(c) Addresses operational and technical matters raised by submitters and in the reporting officer's section 42A report.

3 KEA GROUP

3.1 The Kea group are a local family company(s) and has been for over 10 years. We have been supporting farmers and generally the rural community from our conception. Our staff include Selwyn residents, we have also helped two students from the local college (Ellesmere), and they helped us, we have also helped Selwyn residents when they have been between jobs, or just generally want to try something different. There have been numerous times when working oversees we take Selwyn staff to help build solar farms in the Pacific Islands and give the Selwyn staff experience working oversees which they would not have otherwise had.

3.2 From what we know we are the only Generator/Retailer (Gentailer) which has their head office in Selwyn. We are regionally based, and in relation to this application, as local as you can get.

3.3 We have grown with the community and there are a number of businesses and residential customers in the area using us to supply their power, we support them and they support us. We know all our customers by name and it brings a real family touch to how our business operates. Part of our local community commitment is also supporting the Ellesmere lions golf tournament, we have also done many tours over the years for the like of Lincoln University, Canterbury University, CPIT (Ara) right down to 12 year olds at Cobham intermediate, we believe in investing in our future not just with money but time as well, we also have a gold award from the Selwyn Responsible Business Awards. We are now in a situation where we have Selwyn businesses wanting us to supply them with power as they want to be part of the Kea group and support local, and we often need to turn them down as we simply do not have enough generation (power) to supply them. Our marketing strategy is word of mouth.

4 THE NEED FOR RENEWABLES AND A REDUCTION OF GREENHOUSE GASSES (GHG)

4.1 I understand that the Government has committed to New Zealand transitioning to 100% renewable electricity generation by 2030 and is developing policy packages which aim to accelerate the deployment of renewable electricity generation and reduce carbon emissions. It is

well recognised that there is an urgent need to provide for increased renewable electricity generation.

4.2 Given that climate change is one of the most significant issues facing New Zealand, there is a need to ensure a coordinated policy response to these issues and that includes all regions making provision for renewable electricity generation in a way that contributes to the national outcomes. However, more importantly for us then the policy, is actually implementing projects.

4.3 The passing of the Climate Change Response (Zero Carbon) Amendment Act in 2019 and the establishment of a Climate Change Commission to advise and hold Government to account on its policies may increase the ambition and enforcement of emission reductions in years ahead. The Commission has recently released its draft advice for consultation which includes a target of 60% renewable energy by 2035. The Labour Party's Election "pledge" has also set an aspirational goal of 100% renewable electricity by 2030 (with a review at the end of 2025), but the effect of these policy changes is not yet reflected in energy and emission forecasts for New Zealand.

4.4 Energy needs to be affordable for all parts of society and business to thrive as a nation. Around the world, record energy prices and people struggling to afford power is being reported, so it has become more important for New Zealand to be energy independent. This proposal can form part of the solution, and may assist in reducing reliance on fossil fuels and this associated emissions of greenhouse gases.

4.5 Related to this, I also refer to a Transpower statement (in paragraph 5.11 below) about the reduction of greenhouse gas (GHG) emissions by having generation close to load.

4.6 With the area as defined by ECAN as having to reduce nitrates to comply with Chapter 11.7.3 of the LWRP (see 8.10) the area could be viewed as "overfarmed" and us reducing the need for nitrates will help with more sustainable farming methods in the area.

5 SITE SELECTION

5.1 When choosing a site, it is not as simple as finding a block of land under a power line. It is necessary to undertake a range of studies

including electricity modelling (this looks at protection for protecting equipment, voltage stability, frequency stability, power factor, Var control, capacity of the line(s), just to name a few parts of a study), feasibility, land type (is it suitable for piles), proximity to ports, roads, other infrastructure such as substations and power lines with capacity available (in short simply less infrastructure to transport the power), for access, sun hours and historic and expected future power prices (an example would be power is cheap next to a hydro power station, but expensive near a load, like a city), as generation is installed near a load it brings down the load price, making power more affordable, a win-win.

5.2 This site was chosen due to its proximity to load, being near existing infrastructure, including a substation and power lines, and generally meeting the requirements in 5.1. The electrical system is also perfect as it offers three directions for the electricity to flow. The transmission lines from Brookside connect to:

(a) Springston then Islington in one direction,

(b) Killinchy then Dunsandel then Hororata in another and;

(c) Norwood (New) in another

Please see attached map 11.2.

5.3 Having multiple directions (as mentioned in 5.2) for power to flow allows for an increase in energy security and resilience. It has other benefits such as finer voltage control in the area, allowing for a more stable grid.

5.4 I understand that the reporting officer has asked for information and confirmation "whether our proposed solar farm has an operational need to locate at this site, given there are other locations within the Selwyn District that are not currently considered highly productive land". In my view, based on my experience in the industry for over 10 years, the factors outlined at 5.1-5.3 above clearly demonstrate an operational need for the proposal to establish at this particular site.

5.5 Acknowledging that the highly productive land policy was not in play when we undertook the site selection process, however living in the district and being aware of the opportunities or constraints at other

possible sites, I do not believe that there were many other opportunities available to us to proceed with a proposal of this scale and nature at a site with a lower (or no) highly productive land classification. Importantly, it is not the intention to take the land out of production altogether, as sheep farming will continue on the site under and around the solar panels (as I discuss in more detail below). The impact of installation of solar infrastructure is also limited in terms of the effect on the quality of the soil.

5.6 I understand that some of the submitters have questioned why the solar farm could not be located in a remote area and a new substation constructed. Substations are expensive to build. To give an idea of the cost of building a new substation (please see below 8.2), Orion's Norwood site is expected to cost $19.9M. it is not economic to have a PV connection of the size we are proposing on equipment dedicated to a solar farm, i.e. if a substation was just for a solar farm, the solar farm would bear that cost, but as it is sharing equipment with load it makes for a more economical connection. A good example is that during the day the lines will be exporting and during the night they will be importing, it is 2-way. It is therefore not economically viable for a new substation to be built for this proposal especially given that energy needs to be affordable for all. On top of the economic cost it would be a gross underutilisation of existing infrastructure.

5.7 When costs of other upgrades in the Orion Selwyn area, are looked at, (shown in the Orion Asset Management Plan 2019), upgrades such as overhead lines to Brookside to be installed to increase resilience and support growth in Selwyn District and western Christchurch, the total forecast is $28.937M. The works are needed to address growth through population, de-carbonising, agriculture use (pumps, irrigators) just to name a few in the Selwyn District. We are helping to supply renewable and affordable energy to this growth area. We may also defer capital cost in the network as the generation is embedded (generated where it is needed, near load).

5.8 Some of the works shown in 5.6 provided us with an opportunity to utilise existing and upgraded assets to construct and operate a solar farm. It is efficient, economic and sustainable to be using assets in both directions, i.e. the power lines and equipment is used for both import and export. It makes energy more affordable for all, as the

asset will work harder and smarter, it also makes this proposal feasible.

5.9 We need to build the solar farm at Brookside as when we investigated other substations in the Selwyn area, all had their own types of issue(s), some of the issues (but not limited to), that we found were:

(a) They did not have the capacity of what we require, the substation is too small.

(b) There were too many limitations and/or restrictions on the line,

(c) They are in a weak part of the network.

(d) They did not have the energy security we need (i.e. between multiple Transpower feeds (GXP))

(e) They were too close to urban areas.

(f) Land prices were too high

(g) Other solar farms were committed to the substations, the capacity was taken.

5.10 Disasters such as earthquakes and wind storms remind us of how important energy is for our lives. Having generation close to the load will help bolster energy security during these disasters. For example, a fault on one or more of the transmission line(s) heading south would put stress on the grid. These lines include:

(a) Islington-Roxburgh

(b) Christchurch – Twizel

(c) Benmore – Islington

In this circumstance, the Christchurch grid would become strained and the need for 'local' power generation and transmission would be essential, and this solar farm offers that.

5.11 Being close to the load reduces network losses and GHG i.e. the power does not need to be transmitted long distances. It also saves on upgrading large transmission lines, contributing to more affordable power for the end user. Not only are there losses of electricity but this

equates to GHG emissions associated with the losses. Transpower's statement on such losses is that: "*Transmission losses are a result of resistance caused by electricity passing through National Grid transmission lines and switchgear. The GHG emissions associated with transmission losses arise from the relative carbon intensity of the electricity generation mix. For FY22, these were estimated at 168,927 tCO_2-e (a decrease of 17% reported in FY21).*" https://www.transpower.co.nz/about-us/sustainability/our-carbon-footprint.

5.12 I understand that the reporting officer has asked for information about the ability for pasture to survive under the panels throughout the life of the solar farm. We have found that pasture grows very well under the panels (see 8.11), we have seen this on our sites and overseas sites which have been installed for several+ years. This is also reflected in the statement on "*Agri-Voltacis*" (MFAT see 6.3), where we are seeing other countries using the land as Agri-Voltaic. We do have our panels sitting higher which allows for sun and water to get under the panels, we have large gaps between the rows to allow for the sun to get amongst the rows and under the panels in the morning and evenings. With the gaps between the panels it allows for water to reach the ground under them. We have also observed (Grass is greener around and under the panels) that there appears to be a reduction in evapotranspiration, which results in a more sustainable use of water. Other benefits we have noticed, our sheep farming operation on other farms, quite often result on hot days that the sheep choose to rest under the panels. My view on this would be that the sheep would be less stressed (happier, good animal husbandry), this could be part of the reason for higher wool quality.

5.13 It is also good to see FedFarmers are relaxed about the prospect of solar farms. "*Federated Farmers President Andrew Hoggard is relaxed about the prospect of large-scale solar farms*" See article link 8.13 (Oct 2022).

6 ECONOMIC VIABILITY

6.1 Whilst I understand that this is not a matter for consideration under the RMA, I stress that the proposal was subject to a stringent business case and would not be proceeding if it was not economically viable.

6.2 Earnings for property owners are diversified when solar is installed on their land and allows for more innovation to take place and two-tier farming also known as Agri-Voltaic. "*Agrivoltaic farming is the use of land for both agriculture and solar photovoltaic energy generation*"(MFAT, October 2022, link shown in 6.3). Agri-Voltaic farming is increasing around the world and New Zealand needs to stay ahead of the game or at least be part of it and it may contribute to the reduction of GHG. We want to see Selwyn be a leader in Agri-Voltaic's not a follower, being the leader will allow us to develop our Agri-tech sector. The skills we learn from Agri-Voltaics will be sellable throughout the world, and with other farms throughout New Zealand. It allows our children to have more opportunities with job prospects. We are looking for solutions to problems.

6.3 MFAT noted that as other countries take on Agri-Voltaic such as Germany there are implications. "*Potential implications for New Zealand are threefold: German farmers' competitiveness could increase, but equally there will be new opportunities for export of relevant New Zealand technologies and for knowledge transfer.*" Link: https://www.mfat.govt.nz/en/trade/mfat-market-reports/market-reports-europe/germany-agrivoltaics-gets-a-boost-october-2022/

6.4 As an aside, we are in discussions with Lincoln university on research and development for agri-voltaics and the agritech sectors. This is an exciting area and it is helping New Zealand move towards a de-carbonised industry, sustainable farming and also helps reduce GHG.

6.5 From our family farm, I understand the need to reduce fertiliser use, discharge of nitrates to ground and surface water, the need to meet overseas sustainability requirements and the need to diversify farming practice and income. Solar farms alongside sheep farming and potentially other forms of agriculture, provide an opportunity for innovation, and diversification. Perhaps this could lead to a high quality wool maybe we could coin the phrase "Solar Wool" or "Brookside Wool" see reference 8.9.

6.6 Diversification is important as we have seen diseases such as M.Bovis enter New Zealand (most recent RNZ News 20th January 2023 "*Fifth Canterbury farm confirms presence of M bovis*"). This shows how vulnerable the Selwyn area can be, having the solar farm allows for diversification of business in the area. It also provides a strong local electricity supply that will support the local community.

6.7 Our financial models and business models are based on generation starting soon, we need the energy now for our company, the Selwyn area and New Zealand. As I understand it the NPS-REG states we also need renewable generation now, not just for power but to reduce our GHG's. The ever increasing demand from New Zealand de-carbonising also points to the need for the power as a country now. With delays there is also a potential of losing an investor who wants to invest in the Selwyn region. Other delays may also add large costs for network modelling, if the network changes enough during delays, remodelling will be required, this is a finite resource in New Zealand, and takes months to book an engineer. Our existing modelling has taken around a year so far. These are just a few of the reasons on the effects of a delay.

6.8 We are asking for the term to not to have a limitation on the duration, this is for the reasons of economics, commercial, ethical and operational reasons. The project will help New Zealand reach its climate change policies as the solar farm is reducing GHG emissions. Therefore, to remove the solar farm after 35 years would be a backward step on helping New Zealand being self-sufficient. If we also look at the intensity of the farming in the area, as we do not have the need for nitrates, it makes for a more sustainable farming method, and we would want to keep this sustainable farming method beyond 35years. Regarding the economics, given the monetary investment in the project and the Selwyn region, the solar farm needs to return a sufficient amount and certainty of being able to continue the operation. If limited to 35 years the certainty becomes that much more up in the air. Over the 35 years we will be taking on more customers, those Selwyn customers will also want reasonable certainty that we are able to supply power to them beyond the 35 years. With the R and D regarding the Agri-Voltaics happing on the site we might find that the farm will become the highest producer of high quality meat and wool in the region. As mentioned in 6.5 a new industry could begin, for

investment to continue in new Agri-tech areas certainty will be needed. This is how New Zealand will lead the way in agriculture through agri-tech and new ideas, certainty is needed when seeking investment in agriculture and renewable generation.

CONSULTATION WITH THE COMMUNITY

6.9 I spoke with the Wards at the conception of the project and they were keen to be part of it. Matthew Ward went around and spoke to his neighbours. Some of these neighbours including the Kewishs and the Caseys wanted to know more, and asked to meet me.

6.10 My first meeting with the Casey's in July 2021 was with myself and Angela Ward. There were a couple more meetings through the next few months (years), Clarke Casey appeared enthusiastic and proposed an option of being part of it by farming his sheep under the panels, and he asked if the existing trees on the boundary with the Prices could be removed. I agreed to this and it forms part of the proposal. It is also proposed to grow plantings around the outside of the solar farm, which links in with the community wanting indigenous planting around the boundaries and our intent to increase bio-diversity in the area.

6.11 I also met with the Kewishs at the start of March 2022, when we explained about the project and answered their questions.

6.12 Since the proposal was limited notified, I have had meetings with members of the community and groups when they called, including people who were not identified as potentially adversely affected. I addressed the matters which they were concerned about, and since have given further evidence to help them understand their concerns.

EMPLOYMENT OPPORTUNITIES

6.13 The submitters also raised concerns about the solar farm reducing employment opportunities. After construction and during operation, other than the employee from Kea who would visit the site on a monthly basis, there will be contracting jobs on site. These include but certainly are not limited to:

(a) The shepherds 1-2 FTE.

(b) The plant/ground maintenance team 2 FTE.

(c) The New Zealand inverter supplier service contract (26 days a year)

(d) Fault team 1 FTE

6.14 Other jobs which may be created and require people to be employed by KeaX as a direct result of the solar farm, include jobs like but not limited to:

(a) Energy sales officers 3 FTE's

(b) Sales/Account Manager 1 FTE

(c) SCADA/NMS Control room 1 FTE

(d) Call centre 2 FTE's

(e) Call centre Manager 1 FTE

(f) Energy trader 1 FTE

(g) General Manager 1 FTE

6.15 I also understand that the Wards farm will still be operating as a smaller scale dairy farm (across the road) and that the Prices will continue farming at another location. The farming of sheep beneath and around the panels is a farming method known as "Agri-Voltaic". It is new and exciting to New Zealand. However, we are seeing on white papers, so are also expecting a higher quality product (see 8.9). Less-intense and higher quality a win-win for the area.

6.16 It is also noted that there is a shortage of dairy farm workers in New Zealand, DairyNZ quote "*The dairy sector is estimated to have a shortage of 4000 workers*" please see below for link (8.3), so there are opportunities right throughout the dairy industry. Consequently, for any person there are options generated with the solar farm as well.

7 **CONCLUSION**

7.1 In conclusion, I consider that the proposal will contribute both local and national benefits including:

(a) supporting local employment and the local economy.

(b) assisting with the diversification of land use and farming.

(c) the efficient use of existing infrastructure by locating the proposal on a site that has existing access to existing transmission infrastructure.

(d) contributing to the generation of affordable renewable energy and this is supported by the NPS-RG.

(e) assisting with New Zealand de-carbonising its economy.

Campbell McMath

February 2023

8 Appendix 1:

8.1 Press release from the beehive

https://www.beehive.govt.nz/release/nz-embracing-renewable-electricity-future

A future where New Zealand's electricity generation is entirely renewable is within our reach, says Energy and Resources Minister Megan Woods.

The Minister today welcomed the recommendations of the Interim Climate Change Committee's (ICCC) report on Accelerated Electrification.

"New Zealanders are calling for a clean, green and carbon neutral economy. Increasing our renewable electricity will play a big part in helping us get there," Minister Woods says.

Our government's goal is to decarbonise our economy while keeping electricity costs low for consumers and creating new jobs in renewable energy.

The Minister says the challenge of reaching 100% renewable electricity by 2035 has been well signalled.

"We can have an ambitious goal while also being pragmatic. We will be conducting five-yearly assessments to ensure the energy trilemma of affordability, sustainability and security is well managed.

"A simplistic trade-off won't be needed. We will move our country towards a zero-carbon future while keeping power prices in check for households.

"An investigation into customer electricity pricing is underway with decisions on that to be released imminently.

"We also know reaching our aspirational goal of 100% renewable electricity by 2035 will mean a sharper focus on lowering process heat and transport emissions. This work is already being prioritised.

"My renewable energy strategy work programme will also assist New Zealand's transition to a low emissions economy.

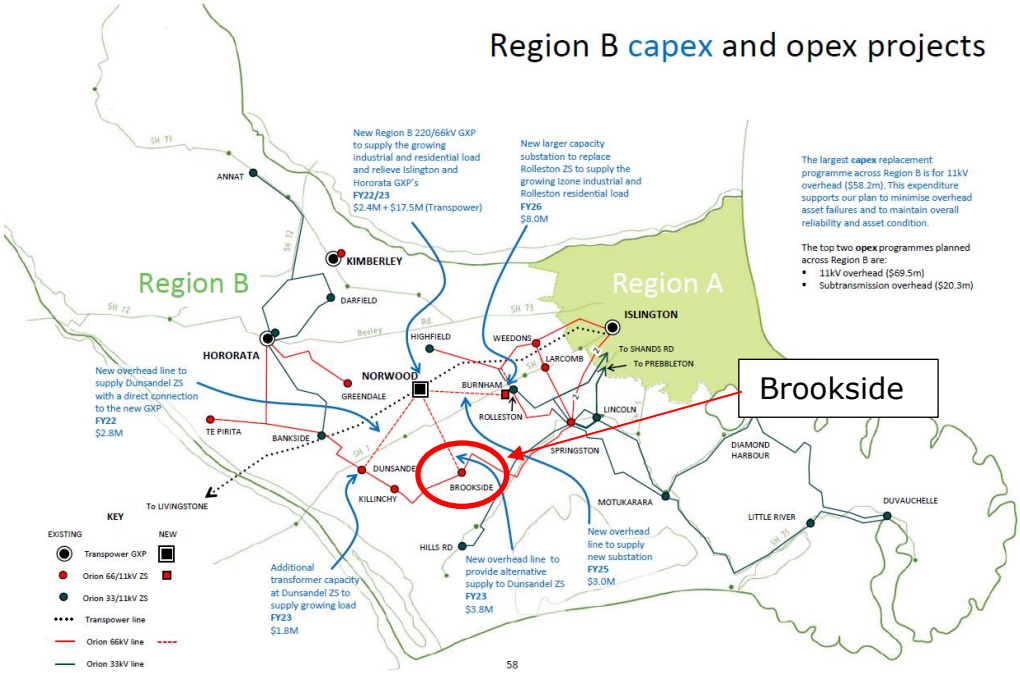
"We are confident we can get to our 100% renewable ambition, and are confident new technologies will be developed to help us get their affordably, but we also want to signal we will be pragmatic about this goal and we won't die in a ditch over the last couple of percent if it places unreasonable costs on households and puts security of supply at risk.

"That is why we are putting 5 year reviews in place and have given ourselves a 16 year lead in to achieve the this ambition that is so important to achieving our emission reduction goals," Megan Woods said.

Minister Woods accepted the recommendations, and stated that further work, such as further storage solutions, exploring a transport emissions

reduction target and revising the National Policy Statement for Renewable Electricity Generation would also be investigated.

8.2 **Orion AMP Maps of anticipated expenditure and network constraints.**



https://www.oriongroup.co.nz/assets/Uploads/FY19-maps-of-anticipated-expenditure-and-network.pdf

8.3 **Dairy NZ link to staff shortages.**
https://www.dairynz.co.nz/news/international-workers-will-help-address-dairy-staff-shortage/

Sustained advocacy from the dairy sector has helped secure 500 more international workers to help on dairy farms, however, the Government's border class exceptions still fall short of the sector's 4,000 worker shortage.

DairyNZ is relieved the Government is allowing an extra 500 international dairy workers into the country through a border class exception. This means 800 international staff will be able to enter New Zealand to work on dairy farms.

DairyNZ chief executive Dr Tim Mackle says DairyNZ has been working hard to make sure the Government understands the huge pressure farmers are under, due to workforce shortages.

The organisation has pushed for 1500 international dairy workers into the country in time for the 2022 dairy season on 1 June.

"We made it clear to Government that the 300 dairy border class exception workers previously approved was nowhere near enough to meet the demands on-farm and reduce the current high levels of farmer stress," says Dr Mackle.

"The Government's decision to increase the number of international workers by 500 is a step in the right direction to reduce the pressure on farm teams. We will continue to advocate for more to be allowed into New Zealand, to help address the significant staff shortage."

The dairy sector is estimated to have a shortage of 4000 workers. Record low unemployment, combined with a prolonged border closure, have contributed to the shortage of workers.

DairyNZ has also launched a 'Join Us' campaign aiming to connect dairy farmers and New Zealanders and inviting Kiwis to join a dairy job – see www.godairy.co.nz for more detail.

"We continue to encourage Kiwis to join our sector and farmers have been taking a range of steps to make dairy farming more attractive to staff, however in such a tight labour market the contribution international staff make to keep farms running is critical," says Dr Mackle.

"From here, we strongly encourage farmers who want international workers on board for calving to apply through the border exception process.

"It's now simpler for farmers to use the class exception process, so we hope to see farmers take up the opportunity. People no longer need to stay in MIQ or isolate. There is also no limit on the number of farm assistants who can apply."

Workers on a class exception visa need to be paid at least $28 per hour.

(a) *Background*

The recent changes announced by the Government will increase the number of international workers allowed into New Zealand under the 2022 dairy class exception from 300 to 800.

This is in addition to the 2021 dairy class exception visa which allowed 200 international workers to enter the country.

Employers must apply to DairyNZ for nomination and have a class exception visa granted by Immigration New Zealand.

A limited number of dairy workers may be eligible to enter New Zealand under other criteria – for more details see www.dairynz.co.nz/border. Information on the changes to the border class exception will also soon be available at this web address.

8.4 **Vertical Farming an up and coming area.** https://puregreensaz.com/25-interesting-facts-on-indoor-farming/

8.5 **25 Interesting Facts on Indoor/Vertical Farming (link in 8.4)**

1. *Food innovation could become a $700 billion market by 2030; that's 5x jump from the $135 billion market today.*
2. *There were 2.3 million square feet of indoor farms worldwide as of 2016. That number is expected to grow to between 8.5 million and 16.5 million square feet by 2021.*
3. *The global vertical farming market was worth $1.5 billion dollars in 2016 and is projected to grow to $6.4 billion dollars in 2023.*
4. *Indoor farming has been around for quite a long time – the earliest example is the Hanging Gardens of Babylon built more than 2,500 years ago.*
5. *Five main crops that are grown indoors are leafy greens, microgreens, herbs, flowers, and tomatoes.*
6. *Indoor farming is 170x more productive than outdoor fields.*
7. *There is faster growth and more harvest cycles with indoor farming; for example, indoor lettuce farming has 4x as many crop turns as outdoor growers in a given year.*
8. *Indoor growers yield 10-15x more than outdoor farms.*
9. *The term vertical farming was coined by Gilbert Ellis Baily, an American geologist in a book about the subject.*
10. *Hydroponics, a system often used in indoor farming, uses 90% less water.*
11. *Nutrient Film Technique (NFT) is the most common hydroponic system that's used today.*
12. *Indoor farming allows for plants and crops to grow all year-round.*
13. *NASA, along with other international space agencies, have experimented with hydroponic systems in space.*
14. *Hydroponics have been around for thousands of years, however the term originated in 1937 by Science magazine.*
15. *Food born illness costs nearly $15.6 billion per year in the US alone.*
16. *AeroFarms invested $42 million in order to build the world's largest indoor farm.*
17. *In terms of new technology, indoor growers are mostly excited about the use of automation.*
18. *The vertical farming sector has grown more than 24% and continues to grow between 2018 and 2024.*
19. *Japan has shown the most success with indoor farming, with 200 large scale factories, known as 'farming as manufacturing'*
20. *Modern LED systems are optimally suited to vertical farming.*
21. *Schools, including colleges and universities, are adapting and teaching about indoor farming.*
22. *Indoor farming is opening up new locations to farm – like this underground vertical farm and an upcoming agricultural city.*
23. *Vertical farming saves as much 90% of your space.*
24. *Aeroponic and aquaponic are just two subsets of hydroponic systems.*
25. *Aquaponics, which raises both fish and vegetables, has been practiced since 1000 AD.*

8.6 **Link to Orion AMP's, this shows where network growth and spend is going.** https://www.oriongroup.co.nz/corporate/corporate-publications/asset-management-plans/

8.7 **MFAT reference for Agri-Voltaic.** https://www.mfat.govt.nz/en/trade/mfat-market-reports/market-reports-europe/germany-agrivoltaics-gets-a-boost-october-2022/

Summary

- *Agrivoltaic farming is the use of land for both agriculture and solar photovoltaic energy generation.*
- *Following the example of Japan, China, France and the United States, Germany has now also taken steps to promote agrivoltaics, through regulatory and financial incentives.*
- *Whilst these changes are not expected to give agrivoltaic farming an immediate boost, uptake should increase, especially by German horticulture.*
- *Potential implications for New Zealand are threefold: German farmers' competitiveness could increase, but equally there will be new opportunities for export of relevant New Zealand technologies and for knowledge transfer.*

Relevance for New Zealand

Agrivoltaic farming could over time increase the competitiveness of Germany's horticulture sector, in particular. At the same time, Germany could become a major market for relevant technologies, including from New Zealand. An increased uptake of agrivoltaics in Germany could create knowledge and establish good practice around this still relatively new technology, offering opportunities for New Zealand to learn from this experience.

8.8 **CRC Plan LWRP – PC1**

https://www.ecan.govt.nz/your-region/plans-strategies-and-bylaws/canterbury-land-and-water-regional-plan/change-1-selwyn-waihora

8.9 **Solar farm trial shows improved fleece on merino sheep farmed under panels**

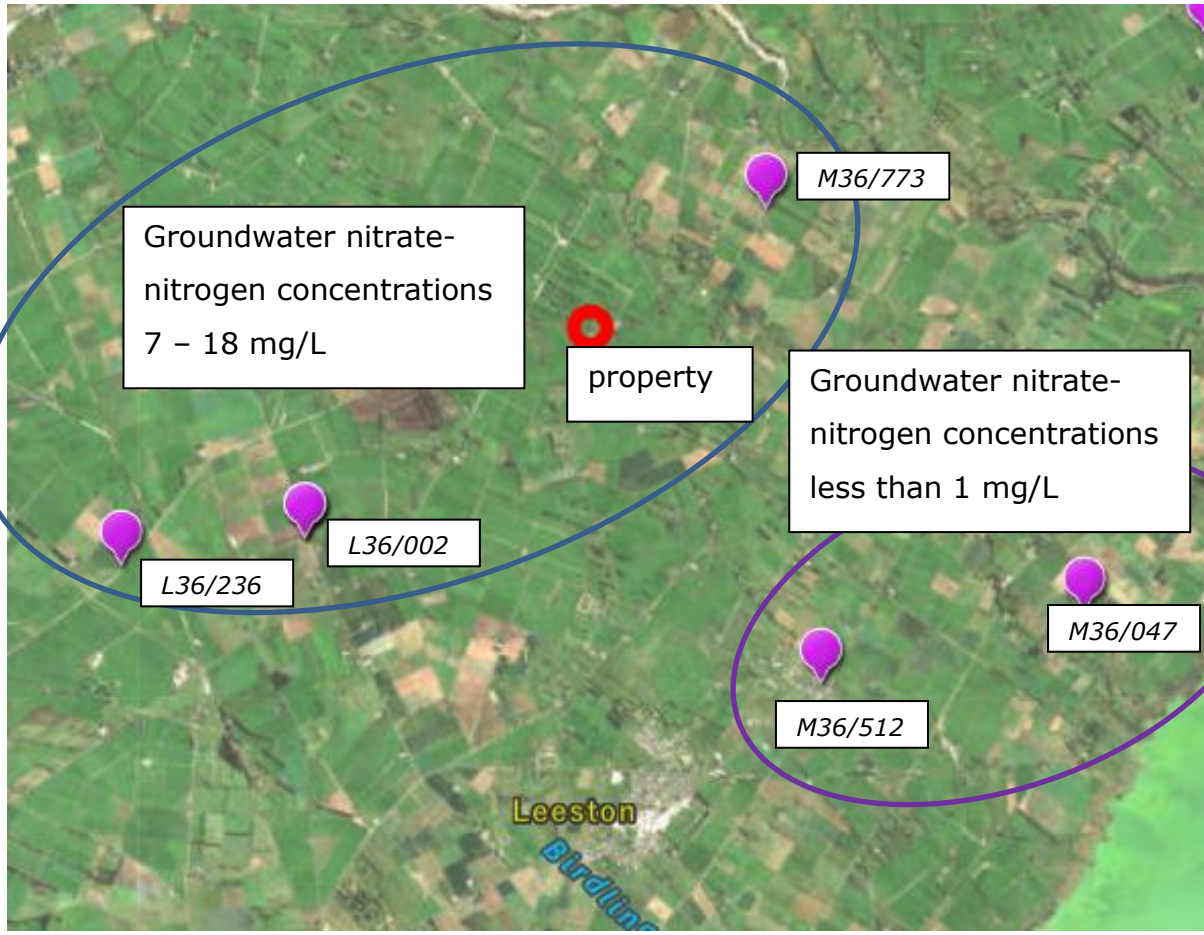
https://www.abc.net.au/news/rural/2022-05-30/solar-farm-grazing-sheep-agriculture-renewable-energy-review/101097364

https://interestingengineering.com/innovation/grazing-sheep-solar-panels-wool-quality

8.10 **Ecan nitrate report.**

Enquiry nitrate-nitrogen concentrations in groundwater in area around 115 Buckleys Road Leeston

Current nitrate nitrogen concentrations (see map)



More info on groundwater quality currently and over time (graphs) for these bores can be found by entering the bore numbers in this form: https://www.ecan.govt.nz/data/water-quality-data/

Nitrate-nitrogen trends (from Annual Groundwater Quality Survey 2021)

L36/0224: Likely increasing nitrate concentrations over last decade

M36/7734: Very likely increasing nitrate concentrations over last decade

M36/0473: Very likely increasing nitrate concentrations over last decade

Interpretation

Nitrate-nitrogen concentrations near the farm on 115 Buckleys Road are relatively high and (very) likely increasing based on groundwater quality in our wells database. Chapter 11.7.3 of the LWRP sets out water quality limits and targets for the Selwyn Region. The target for nitrate-nitrogen in groundwater is 8.5 mg/L (5 year annual average). Our data shows concentrations are higher than this in the area of the property. Groundwater in the Selwyn Region feeds into streams and springs that eventually enter Te Waihora/Lake Ellesmere. In Plan Change 1 of the LWRP it was recognised that actions were required to prevent further degradation of the water quality and quantity in the Region by ***stricter management of water takes and nitrate leaching from farms***. The supporting documents that clarify these ambitions can be found here: https://www.ecan.govt.nz/your-region/plans-strategies-and-bylaws/canterbury-land-and-water-regional-plan/change-1-selwyn-waihora/ , under Public Notification and Supporting Documents. A summary can be found in this information sheet (page 2).

8.11 **Grass growth under panels**

Can you put where the photographs were taken please?

Buckleys Road, Brookside.

Hanmer Road, Brookside

Wairau Valley, Marlborough

North Rakaia Road, Rakaia

8.12 Sheep under panels

New Scientist article on benefits of sheep and farming.

https://www.newscientist.com/article/2357545-putting-solar-panels-in-grazing-fields-is-good-for-sheep/

Sheep living among rows of solar panels spend more time grazing, benefit from more nutritious food, rest more and appear to experience less heat stress, compared with nearby sheep in empty fields.

Earlier research suggested that agrivoltaic farms – which combine grazing animals with solar panels – offer more efficient renewable energy at lower overhead costs, as well as reducing wildfire risks. The latest findings show that the practice is also good for animal welfare, providing further evidence …

8.13 Federated Farmers

Article in FedsNews

https://www.fedsnews.co.nz/prospects-looking-bright-for-solar-farming/

October 3, 2022 by Simon Edwards

Simon Edwards

Sun is an essential ingredient for farmers' crops and grass, and it's also the resource critical to a new land use tipped to spread across thousands of hectares of New Zealand pasture – solar farms.

Late last month news broke that the Todd Corporation is well advanced with plans to cover a 1022ha dairy farm southeast of Taupō with 900,000 solar panels, shipping container-sized inverters and a huge switchyard. The panel arrays will track the sun from east to west each day and Stuff reported that while about 20 staff will be employed in the operation and maintenance of the facility, once fully operational control of the solar farm will be automated, with remote monitoring of the plant from a control room.

Assuming Taupō District Council and the Bay of Plenty Regional Council grant the resource consents lodged in April, the first panels will go in later this year. All going to plan the solar farm will be fully operational by 2027, generating 400MW of electricity – enough power for around 100,000 homes.

It may sound impressive, but it is by no means unusual.

Lodestone Energy is proposing more than half a million solar panels spread across five locations in Northland, the Coromandel and the Bay of Plenty.

Adding enough electricity to the national grid to power 50,000 homes – that's a city the size of Wanganui – Lodestone says on its website that each solar farm will incorporate world-leading bi-facial modules and single axis tracking technology. This will see the panels rotate and track the sun as it travels across the sky. Electricity will be produced from both sides of the panel, allowing the capture of energy from reflected sunlight from the ground.

The company's first solar farm, Lodestone Two near Kaitaia, is expected to be operational in the third quarter of next year.

Two solar farms are being discussed in the Wairarapa, and a $150 million-plus farm covering the equivalent on 262 rugby fields at Christchurch airport is scheduled to be generating 150MW – enough for 20 per cent of Christchurch homes – within 5-7 years. Ultimately, planes will be able to pull up and recharge from adjacent storage batteries.

New Zealand's largest solar farm to date – a much more modest 5,800 panel facility generating enough electricity for 520 homes – is at Kapuni in Taranaki. It came on-line in May last year.

Andrew Harvey-Green, electricity and energy sector research analyst at Federated Farmers' strategic partner Forsyth Barr, says several of our largest electricity generators and at least 10 independent developers are at various stages of capital raising, planning and/or consenting for solar farms.

He says the cost of building solar generation has come down significantly in recent years to the point that "it's not too far away from the cost of building a wind farm.

"On top of that, look at where electricity prices have moved in New Zealand – the cost of gas, the cost of carbon, the cost of coal has pushed those prices much higher so it's becoming more attractive to build renewable energy," Harvey-Green said.

While at the beginning of last year hardly anything had been announced by way of large-scale solar, "here we are 18 months later and the numbers being talked about are quite phenomenal".

Even so, we're chasing a trend that is already well-advanced overseas. Governments in many other jurisdictions offer subsidies for developers of renewable generation. Secondly, the closer you are to the equator, the more generation you get from solar.

"Even without subsidies, the economics [of solar farms] work better offshore than in New Zealand so they got that head start on us."

Plenty of those offshore solar farms in Australia and the UNA are on arid or otherwise relatively unproductive land, where there isn't the same competition for space as exists here, Harvey-Green said.

But pasture converted to solar panel use here doesn't necessarily mean the land is lost to grazing.

Lodestone says for its solar developments, the panels will be high enough, and spaced sufficiently, to allow farming and cropping to continue underneath. The panels would even provide nifty summer shelter for cattle and sheep.

Back to the company's website: "This agrivoltaic approach allows the land to continue to be productive, with over 85% of baseline farming yield expected when the solar farm is operational."

Those planning the solar farm to the west of Christchurch airport's runaways say they will be making sites available for data centres and vertical farming operators.

Federated Farmers President Andrew Hoggard is relaxed about the prospect of large-scale solar farms.

"So long as the hosting land owner is paid a fair amount for the encumbrance, nearby farms aren't unfairly impacted by construction, and increased investment in local lines to handle the load doesn't drive up power prices in the area, there shouldn't be any problems," he said.

"They seem to be focusing their interest around areas that border existing substations or other keys bits of infrastructure to minimise costs of transmission, so it's likely they'll be fairly targeted, not a blanket approach."

Unlike wind turbines, which can generate a fair bit of opposition around noise and the threat to bird life and visual impact, solar farms only have that latter downside. Forsyth Barr's Harvey-Green says that probably means they're easier to gain resource consent for, and they're certainly easier to build.

The prospects of these huge solar farms have been put in the shade of late by rising costs of solar panels, shipping and other supply chain disruption, so while Harvey-Green understands consents have been gained, or are in the process of being gained, for several of them, he's not aware of a start on actual construction.

"Things have slowed down a wee bit.

"But it's highly, highly likely we're going to be seeing a lot more activity in the renewable energy space. For solar, it will be fairly site specific initially. I'd be surprised if we get all the ones that have been talked about built within the next 10 years but for certain, solar prospects look good going forward."

8.14 Sheep numbers

Reference to sheep numbers from beef and lamb

https://beeflambnz.com/data-tools/farm-classes

South Island finishing-breeding farms

Farms which breed or trade finishing stock, and may do some cash cropping. A proportion of stock may be sold store, especially from dryland farms. Carrying capacity ranges from 6 to 11 stock units per hectare on dryland farms and over 12

stock units per hectare on wetter or irrigated farms. Mainly in Canterbury and Otago, this is the dominant farm class in the South Island.