

# Sustainable Energy Systems



## Understanding the impacts of Community Renewable Energy in Aotearoa New Zealand

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**CAPITAL THINKING.  
GLOBALLY MINDED.**  
MAI I TE IHO KI TE PAE



<http://www.wgtn.ac.nz/sustainable-energy-systems>



VICTORIA UNIVERSITY OF  
**WELLINGTON**  
TE HERENGA WAKA

# Research Overview

## Step 1: Develop and CRE Impact Framework

This will develop what impacts CRE projects should be achieving in Aotearoa

## Step 2: Conduct Surveys and Interviews

This will help us understand what impacts CRE projects are currently having

## Step 3: System Dynamics Modelling

Develop a model to determine the impacts of CRE projects, and identify suitable support measures to enhance positive impacts and decrease negative one.

# Step 1: Impact Framework for Community Renewable Energy

## Community Resilience

Reduction in power outages.  
% Self-energy provision.  
Improved network capacity for further development.  
GHG gas emissions avoided.

## Community Empowerment

Community Participation.  
Wellbeing and happiness.  
Connection to Māori culture and worldview.  
Energy literacy and engagement.

## Community Energy Hardship

% Household income spent on fuel.  
Ability to pay energy bills.  
Improved health impacts.  
Anxiety levels due to affordability of energy.

## Community Economy

Number of full-time jobs equivalent created.  
Investment in the community.  
Rate of return of projects.  
Industry creation.  
Innovation in energy sector.

# Step 2: Interviews and Surveys

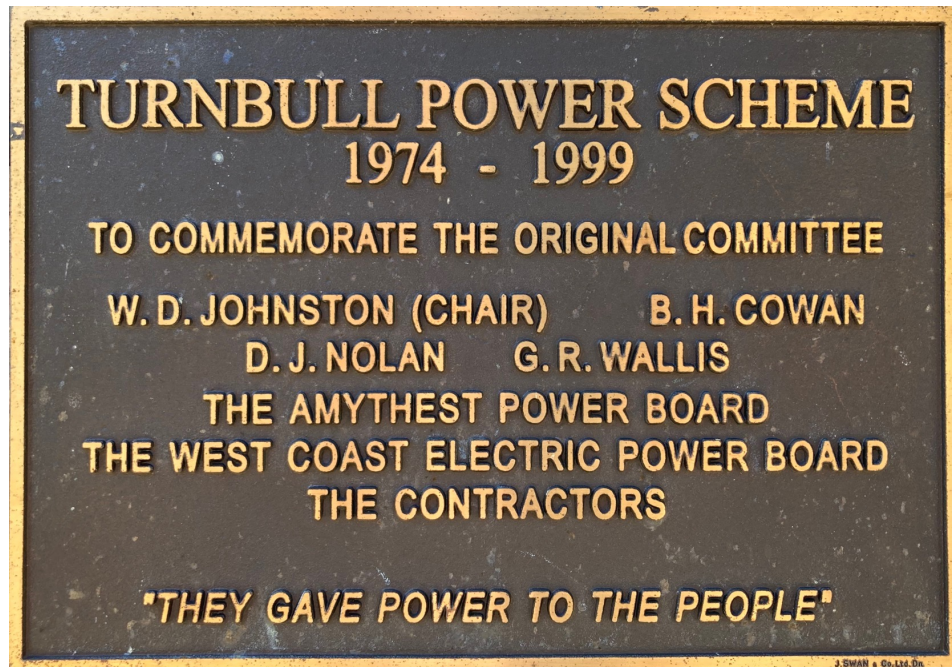


Figure 1: Nameplate for Turnbull Power Station, powering the Haast town.



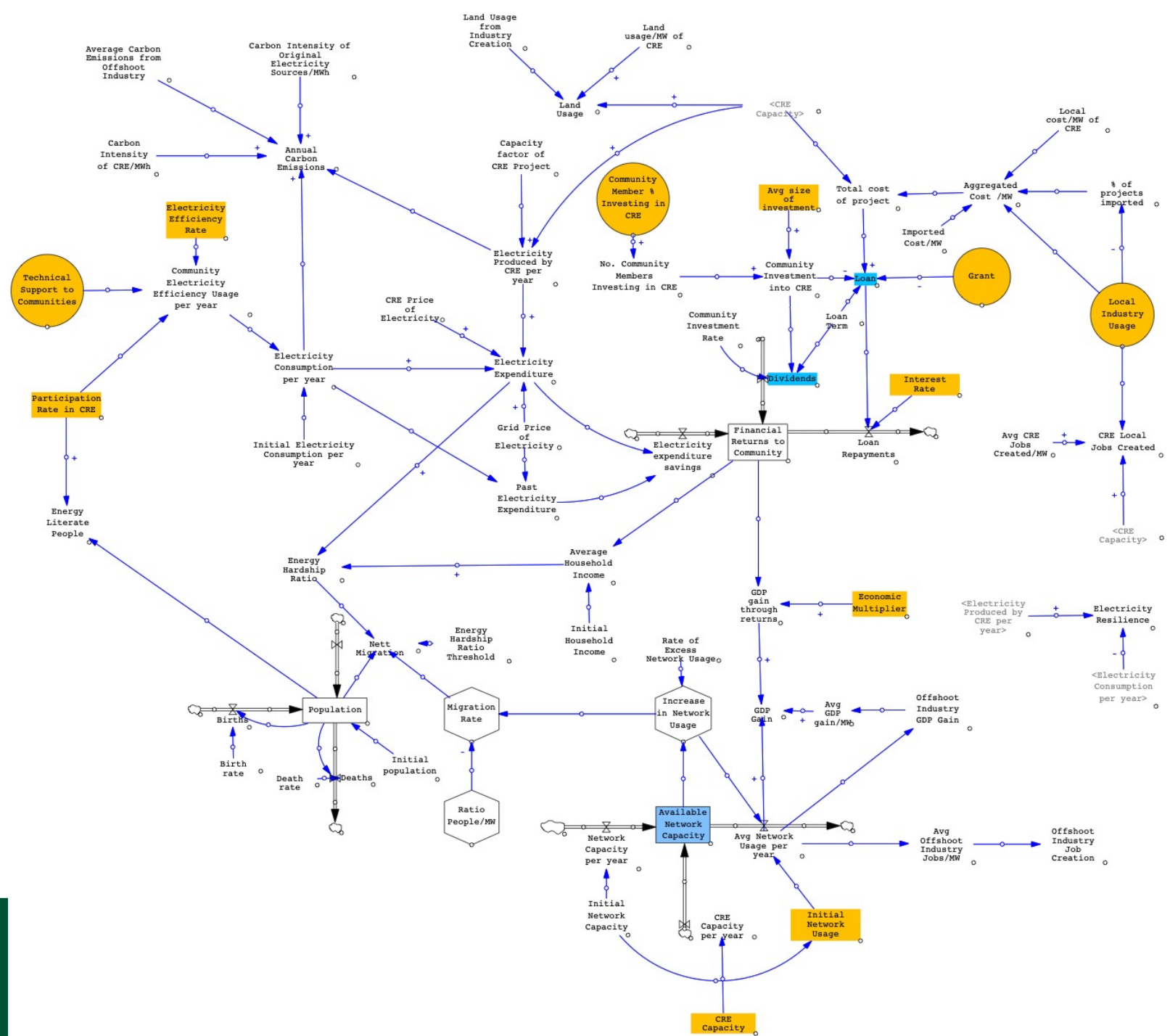
Figure 2: Kawerau Industrial Complex [2]

# Step 3: System Dynamics Modelling

- Can link different systems (and relevant impacts) in one model
- Has the ability to include feedback loops and tipping points
- Very visual and easy-to-identify relationships with variables
- Can identify leverage points in the model and conduct scenario analysis



# Step 3: System Dynamics Modelling (Conceptual Stock and Flow Diagram)



# Case Study: Energise Ōtaki Solar PV System



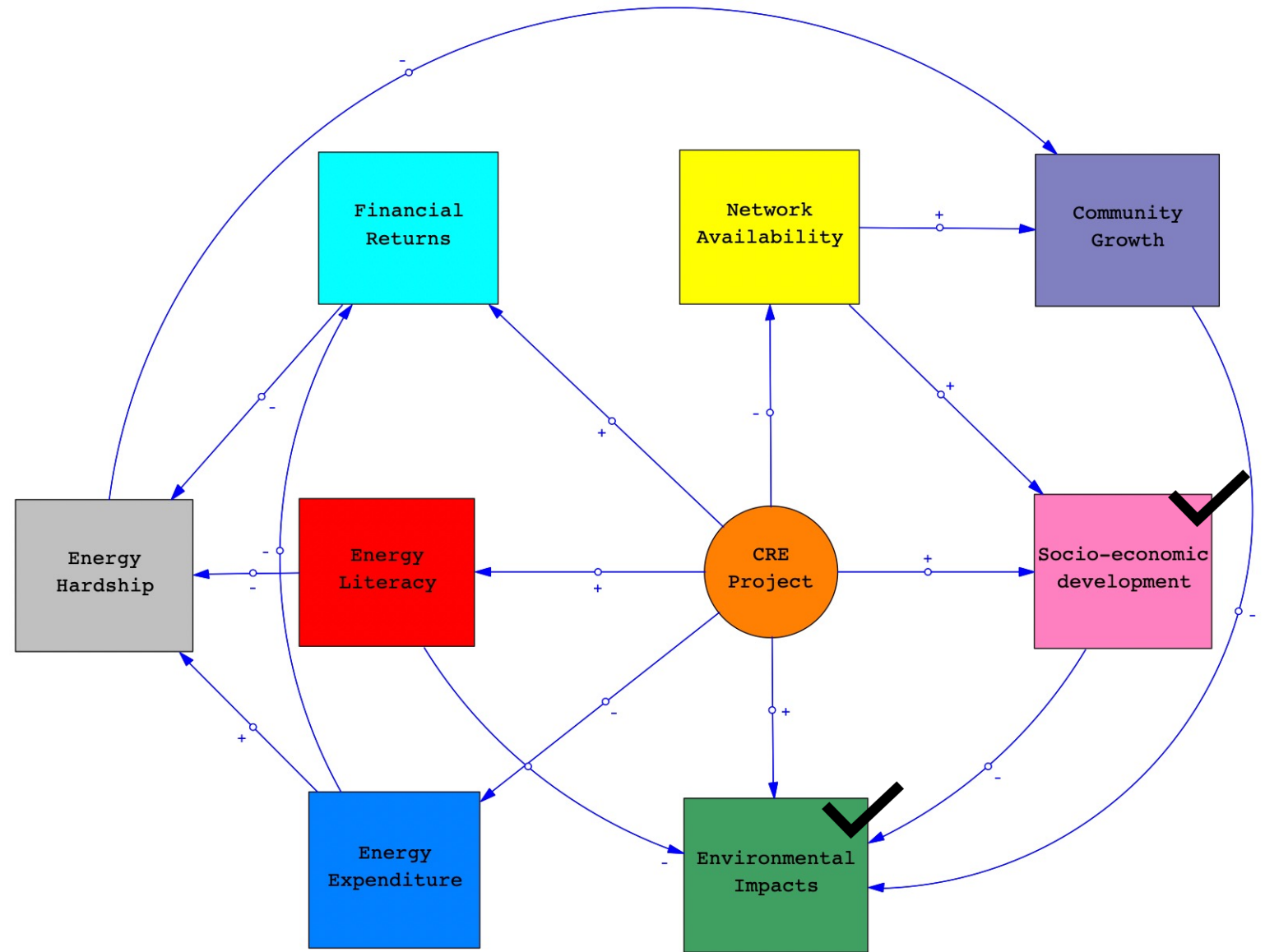


# Interviews

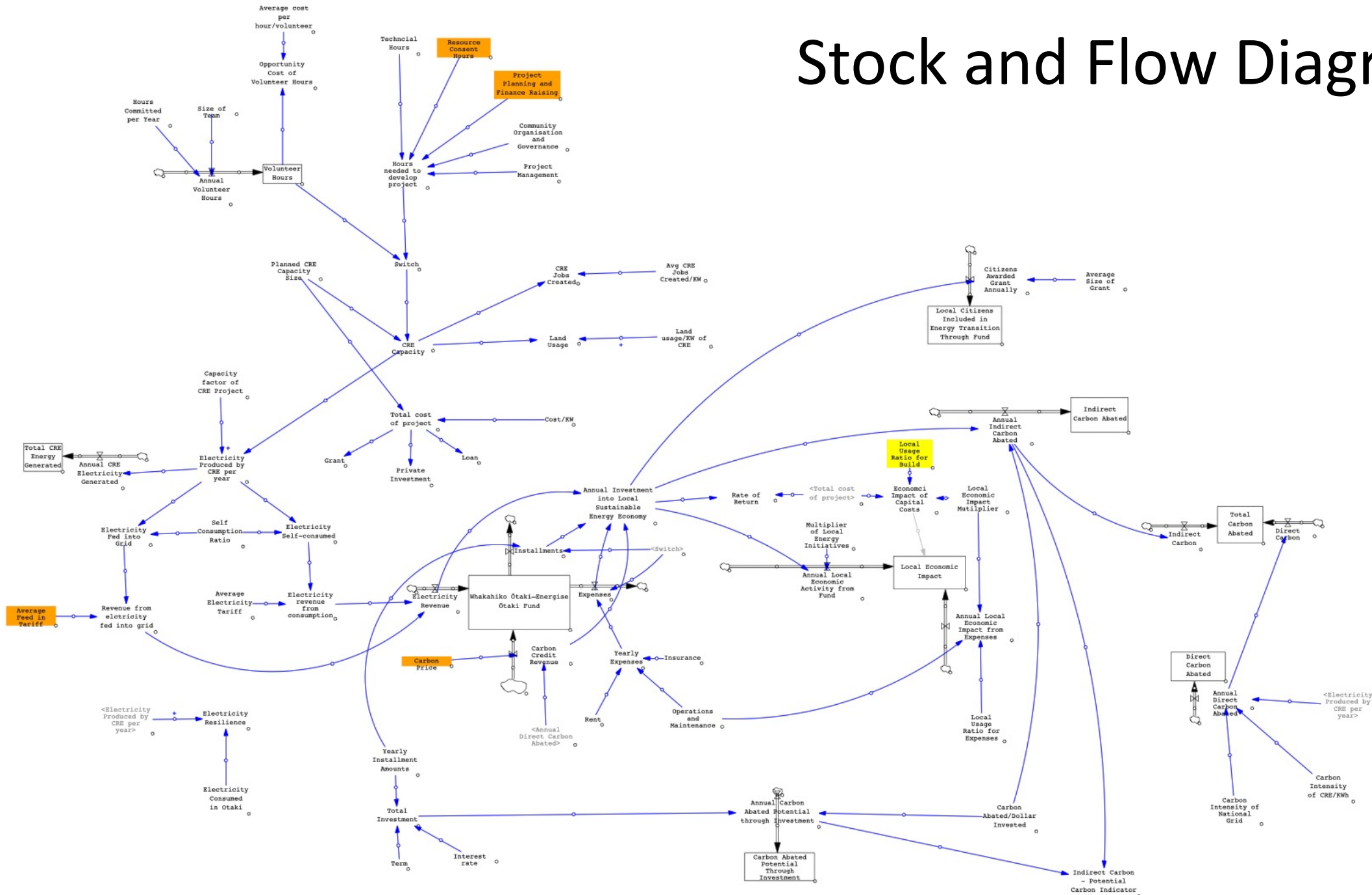
In 2020, Energise Ōtaki, with funding from the Wellington Community Trust, set up two solar systems to generate power to go straight to users within the community. **A 23kWp system is now installed at Ōtaki College and a 107 kWp system**, named Rau Kūmara, adjacent to the Ōtaki Wastewater Treatment Plant

There is an **estimated minimum \$25,000 annual revenue** from the two installations that will start going into the **Whakahiko Ōtaki–Energise Ōtaki Fund**. This is then dispersed to the community for **reinvestment, in energy-related projects such as insulation improvements for households, education and local employment.**

# Systems map: Energise Otaki Case



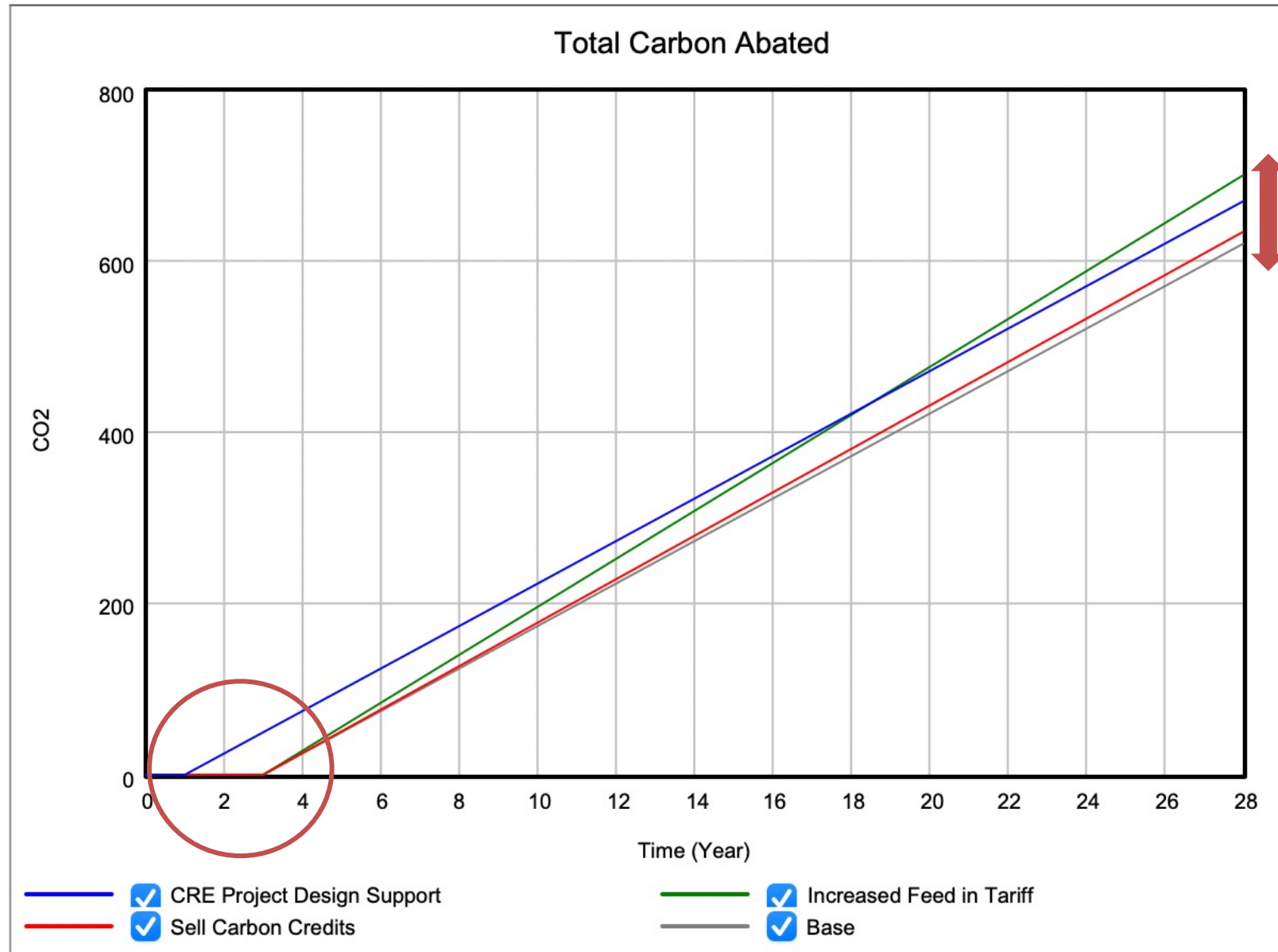
# Stock and Flow Diagram



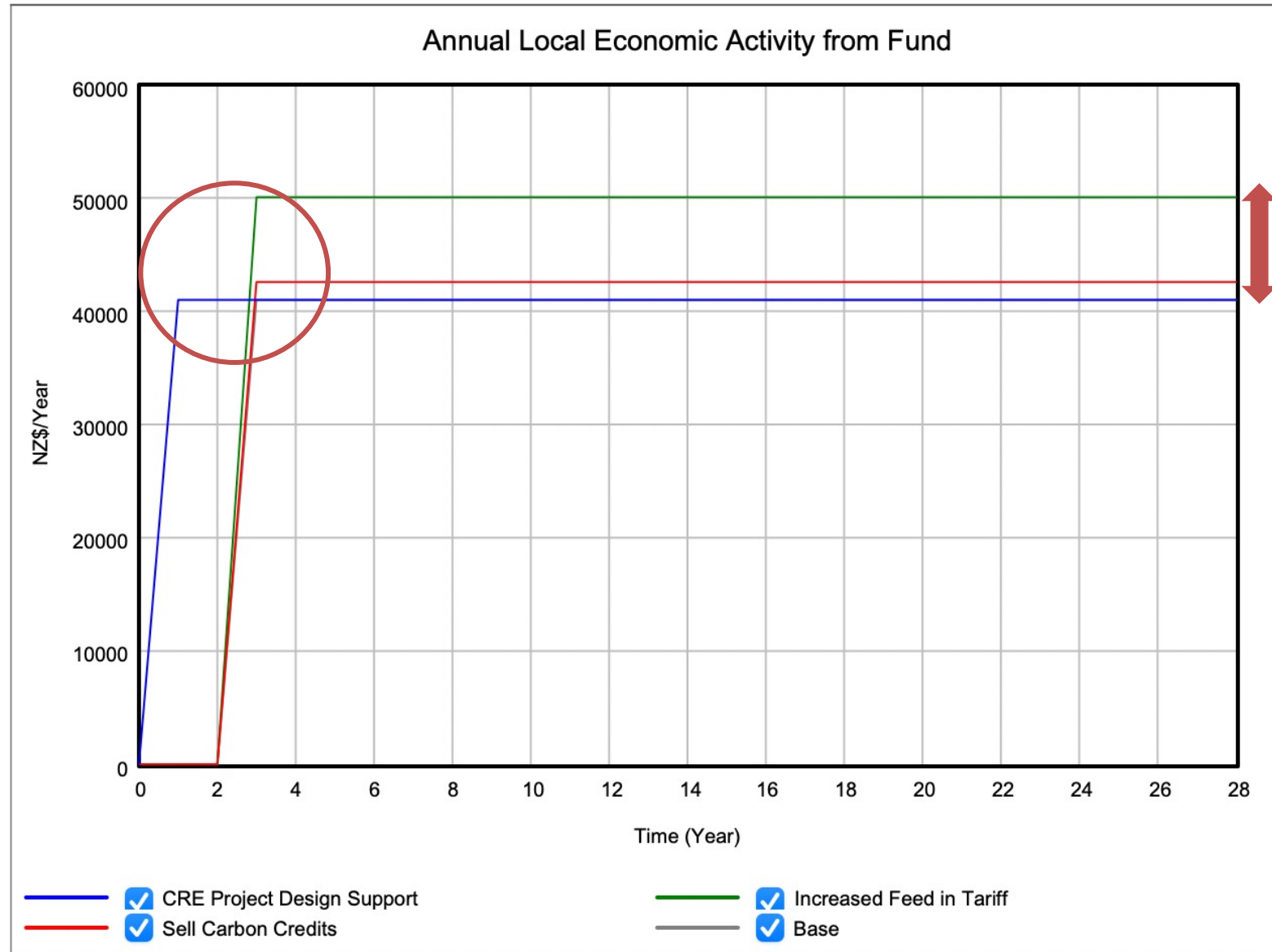
# Test Policy/Support Initiatives

	<b>Feed In Tariff</b>	<b>Carbon Credit Price</b>	<b>Design Hours needed</b>
<b>-Base</b>	NZD 0.1	NZD 0	150
<b>An increased feed-in tariff</b>	NZD 0.201	NZD 0	150
<b>Sell Carbon Credits</b>	NZD 0.1	NZD 85	150
<b>CRE Project Design Support</b>	NZD 0.1	NZD 0	50

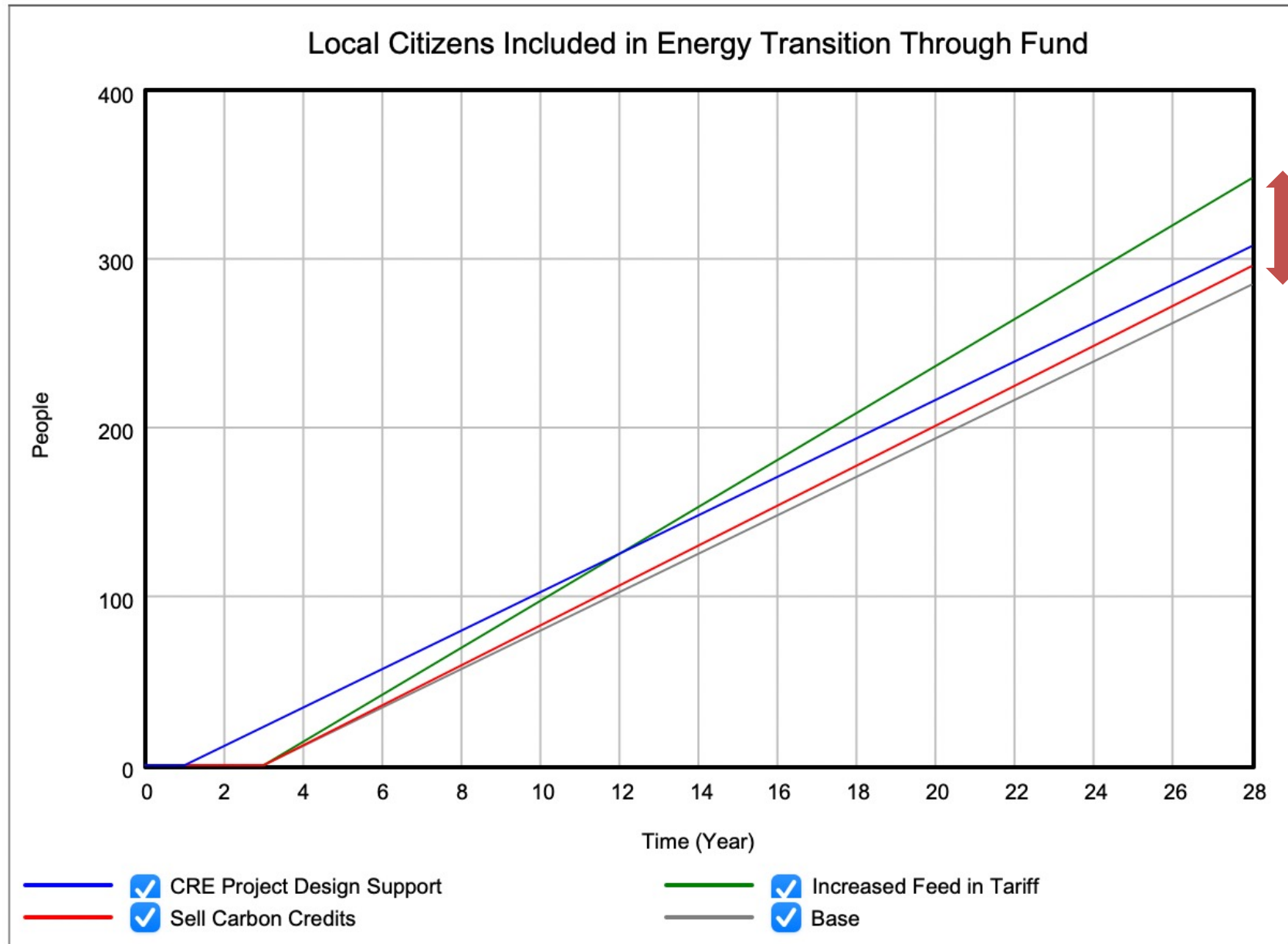
# Carbon Emissions Saved



# Local Economic Impact



# Social Inclusion in Energy Transition



# Conclusion

- Systems thinking and modelling can provide a holistic picture of CRE impacts.
- System dynamics modelling can provide indicative results of impacts when inflexion points/policy scenarios are applied, in a range of different sectors
- Each CRE project is very diverse and there is a lot of value in small models
- Data in the initial stages of the project is crucial to validate results
- Modelling needs to be complimented by case studies/qualitative data to provide a complete picture of the impacts



# References

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<https://www.mbie.govt.nz/dmsdocument/10349-discussion-document-accelerating-renewable-energy-and-energy-efficiency>

W. Clements, J. Quinao, Recent Geothermal Well Work-Over Experiences at the Kawerau Geothermal Field , New Zealand, 2018 (2019) 1–8.

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