Heating and Cooling Loads of a Poultry Shed in Central Coast, NSW, Australia

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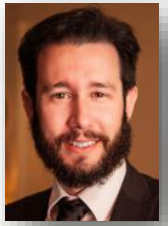


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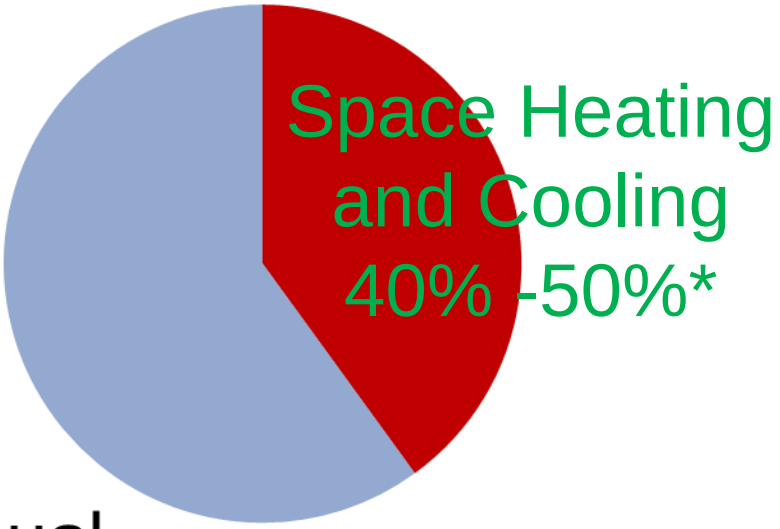
SBE SERIES
International Co-owners: CIB iiSBE UNEP Sustainable Buildings and Climate Initiative FIDIC Global Alliance for Buildings and Construction

Background

Global Annual Energy Consumption
13,000 Mtoe (~544 EJ)

Result In

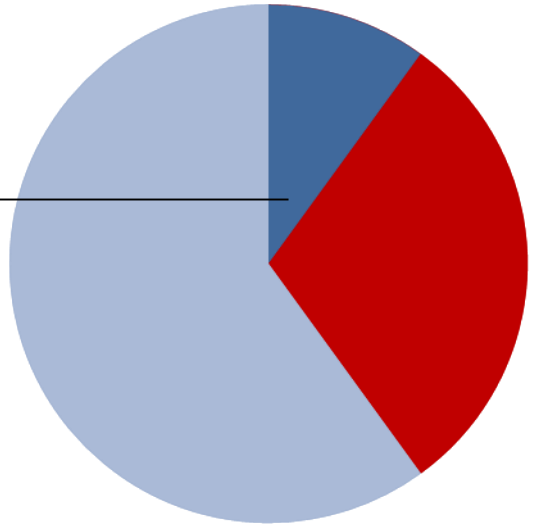


Greenhouse Gas (GHG) Annual Emissions
50 Gt CO2 -e

*International Energy Agency, *Renewables for Heating and Cooling.* 2007

Background

Improving Energy Efficiency for Space Heating and Cooling



Save up to 1509 Mtoe of global annual energy consumption by 2050*

*IEA, *Technology Roadmap Energy-efficient Buildings: Heating and Cooling Equipment.* 2011

Background

Approaches to be adopted

- Improving the thermal performance of building envelope
- Determining the suitable operational schedule
- Increasing the energy efficiency of HVAC system

Aims

Determining the Heating and Cooling Loads of a Poultry Shed in Peats Ridge, NSW, Australia

Optimisation to reduce the ongoing cost for Heating and Cooling

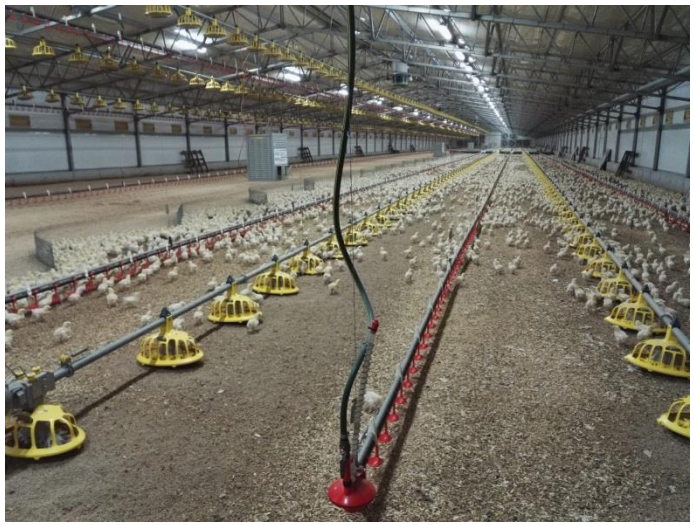
Aims

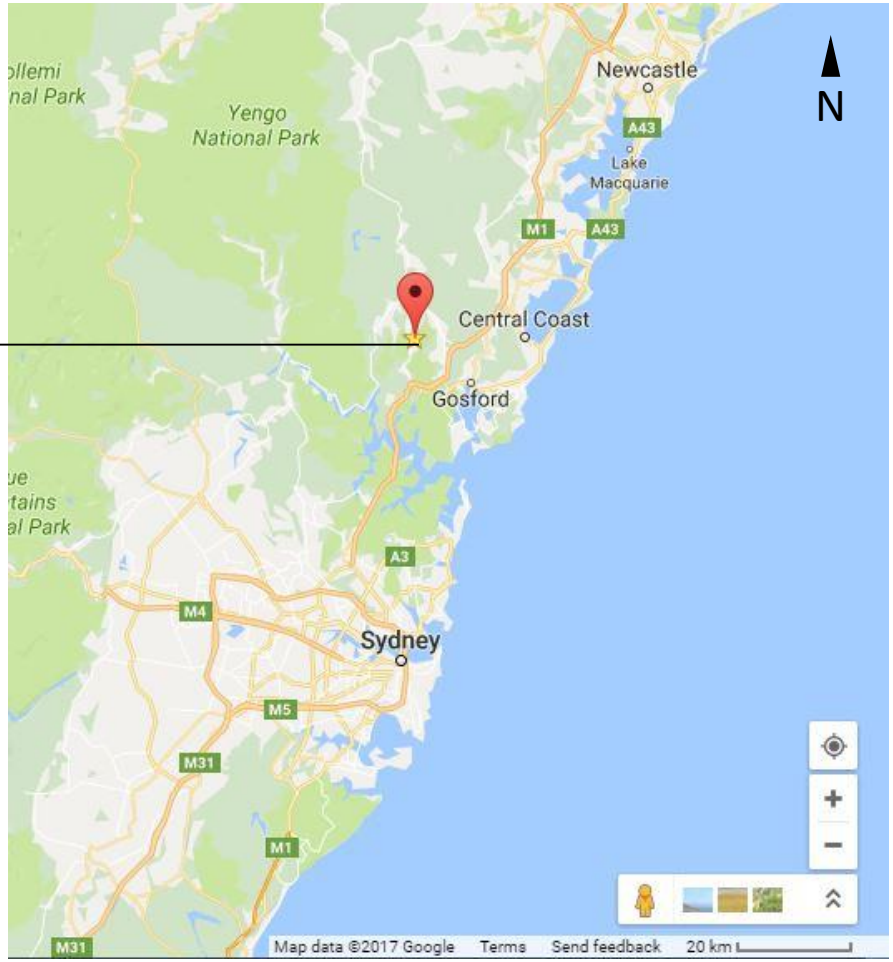
In Australia, agriculture and all the add-on processing industries
contributes to 12% of the GDP

Within the Poultry Industry
600 million chickens p.a.

Overall costs of heating and cooling for poultry farms is AU$ 80 million (estimated)

Aims





*Location picture from Google Map

Methodology

Simulation Software: EnergyPlus V8.50

Simulation Parameters Considered:

- Location and climate conditions
- Building envelope
- Chicken growth and heat generation
- Operational schedules

Table 1: Poultry Shed Simulation Parameters

Time/Days	Weight/kg	Metabolic Weight/w	Power/W	Population of Chicken	Size of Shed	Required Temperatue/°C
1	0.04	0.09	0.68	40,000	Small	33.0
7	0.16	0.25	1.82	40,000	Small	30.7
14	0.42	0.52	3.82	40,000	Small	27.5
21	0.84	0.88	6.43	40,000	Large	24.8
28	1.39	1.28	9.36	40,000	Large	22.0
35	1.97	1.66	12.13	40,000	Large	21.0
42	2.43	1.95	14.21	30,000	Large	21.0
49	2.74	2.13	15.55	20,000	Large	21.0
56	2.90	2.22	16.23	10,000	Large	21.0

Thermal Loads for One Summer Batch

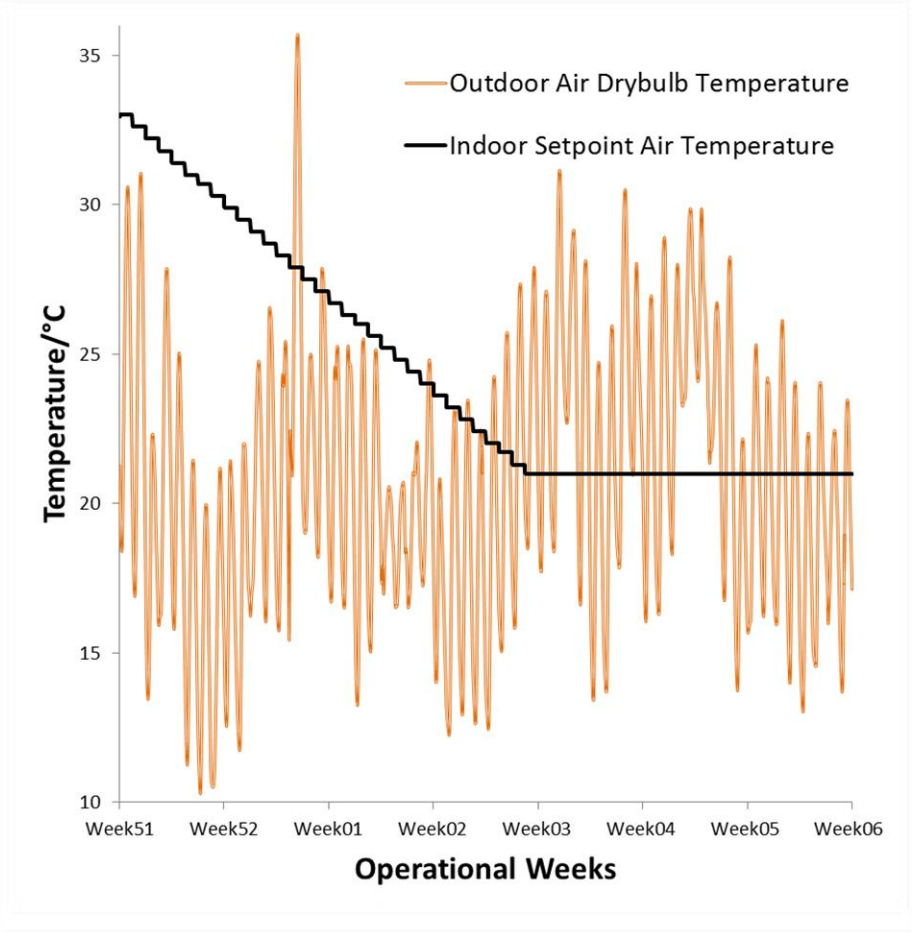


Figure 1:Indoor and Outdoor Air Temperature

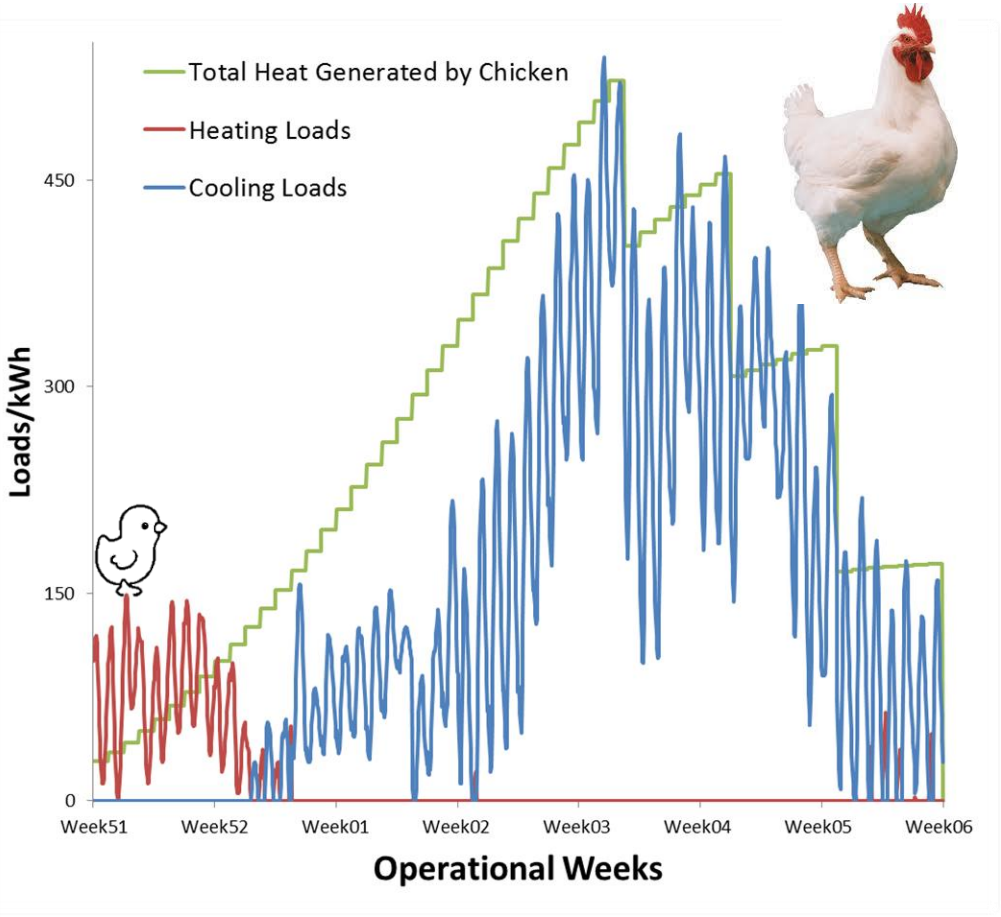


Figure 2: Hourly Heating and Cooling Loads

*Chicken pictures from Google image

Loads Estimation

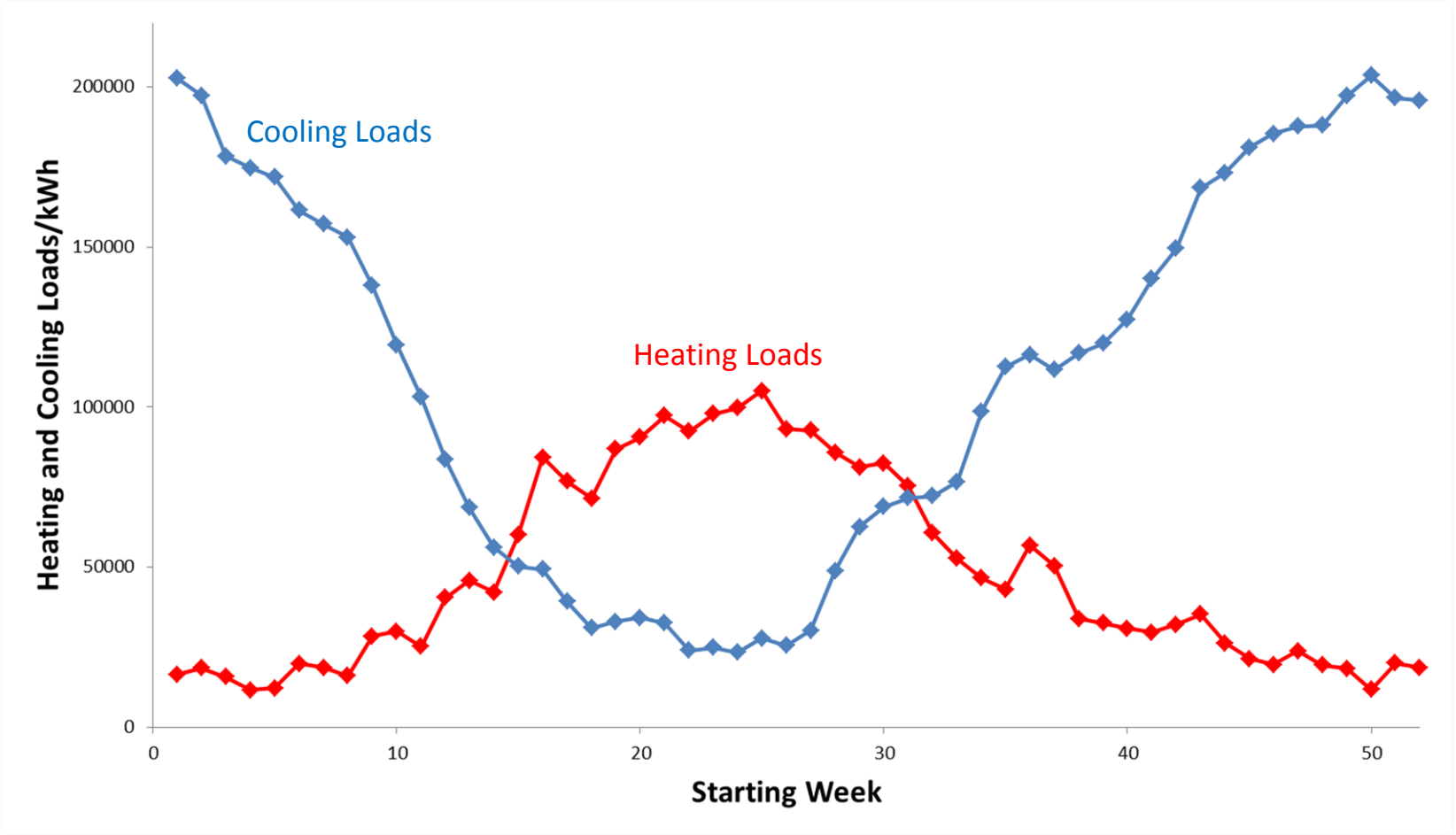


Figure 3: Overall Loads for Different Starting Week

Cost Estimation(Current System)

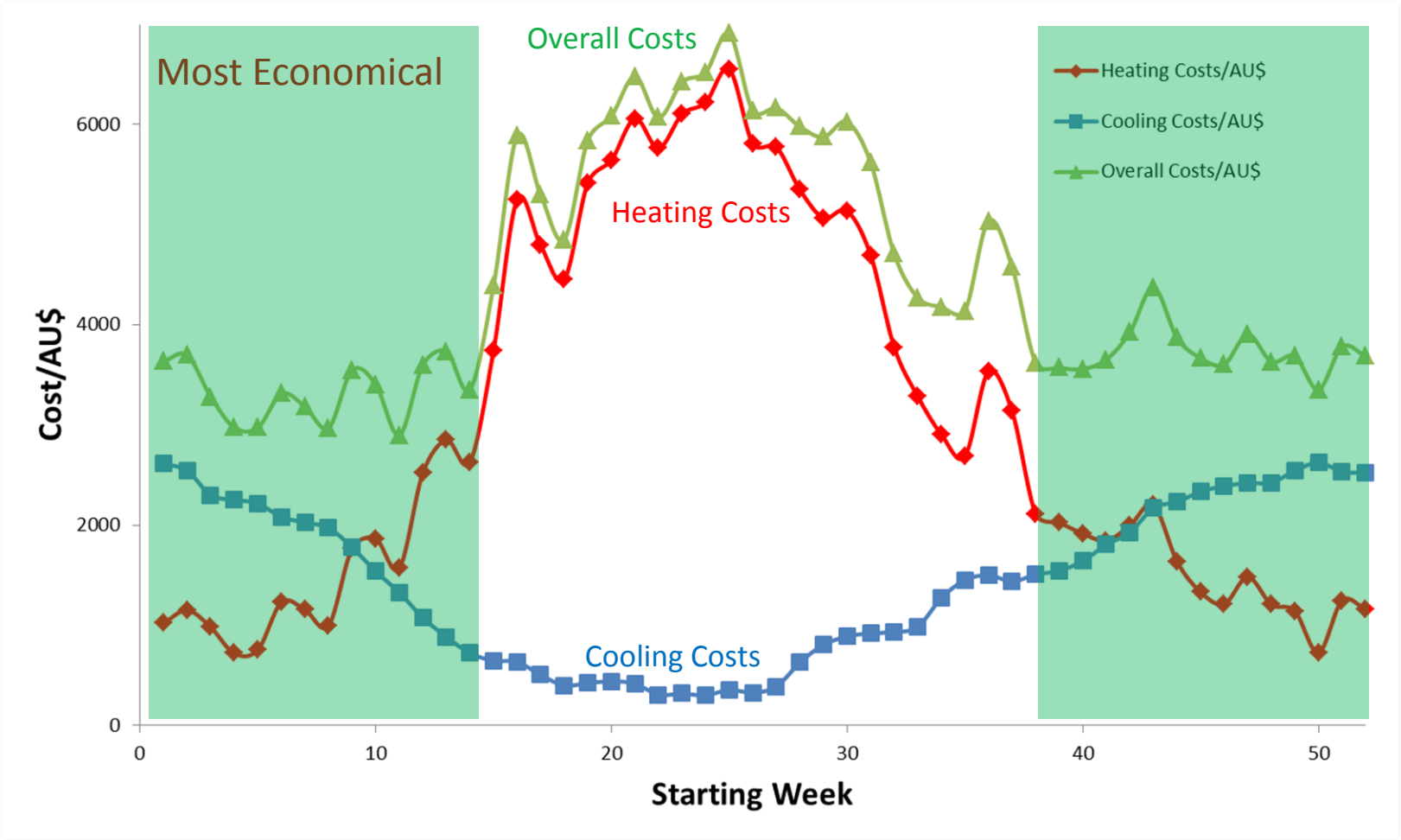


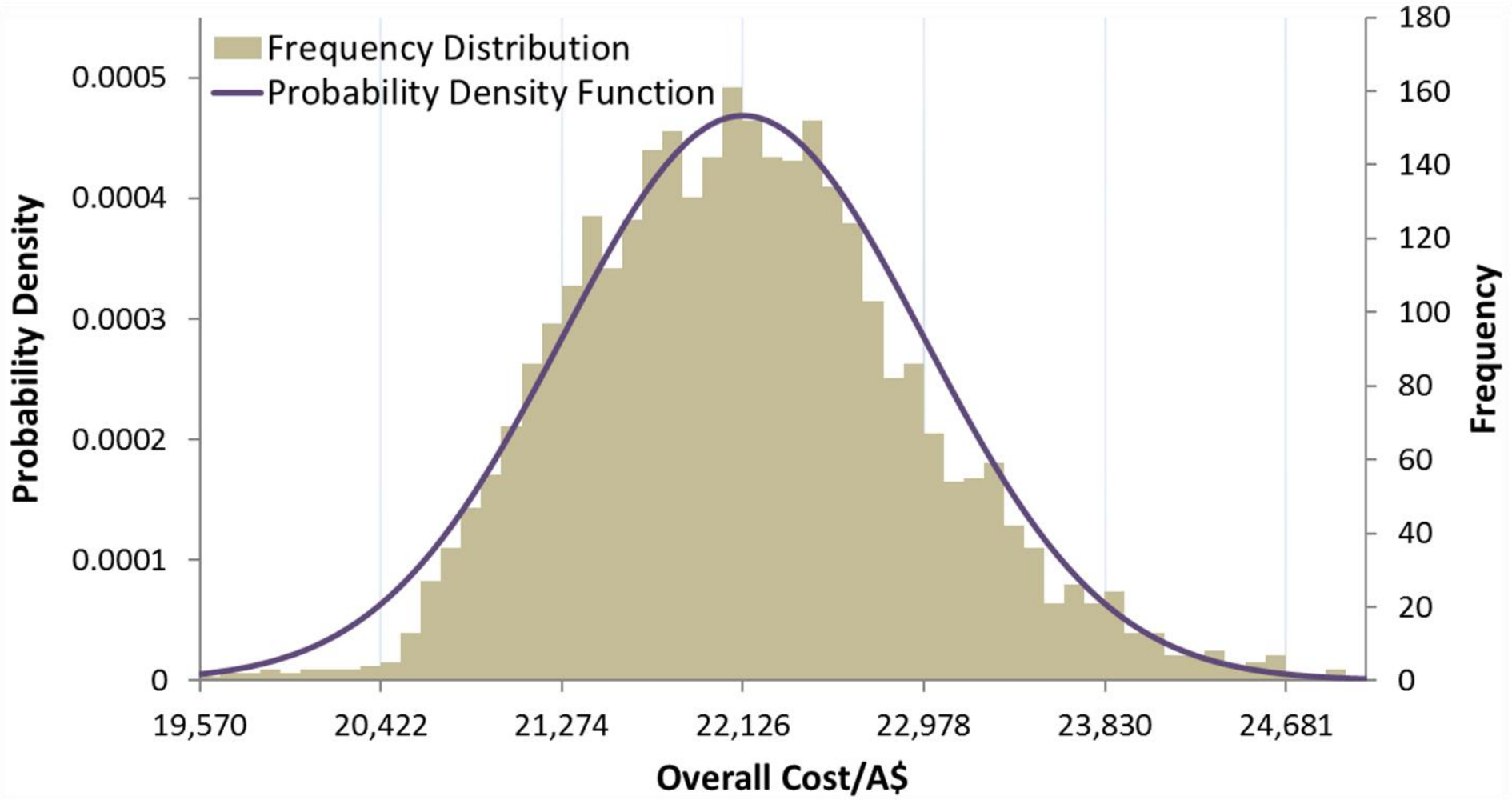
Figure 4: Costs for Different Starting Week

Batch Schedule Optimisation

Time for a typical batch: 8 weeks
Batches per year: 5
Possible interval time: 1 to 6 weeks
Possible schedules: 3248

Average cost: AU$ 22,126

Batch Schedule Optimisation



Batch Schedule Optimisation

Minimum cost: AU$ 19,514

Cost saving on average : 12% (20% on heating)
GHG emission reducing:
Equivalent of planting more than 600 trees

Optimised Schedule

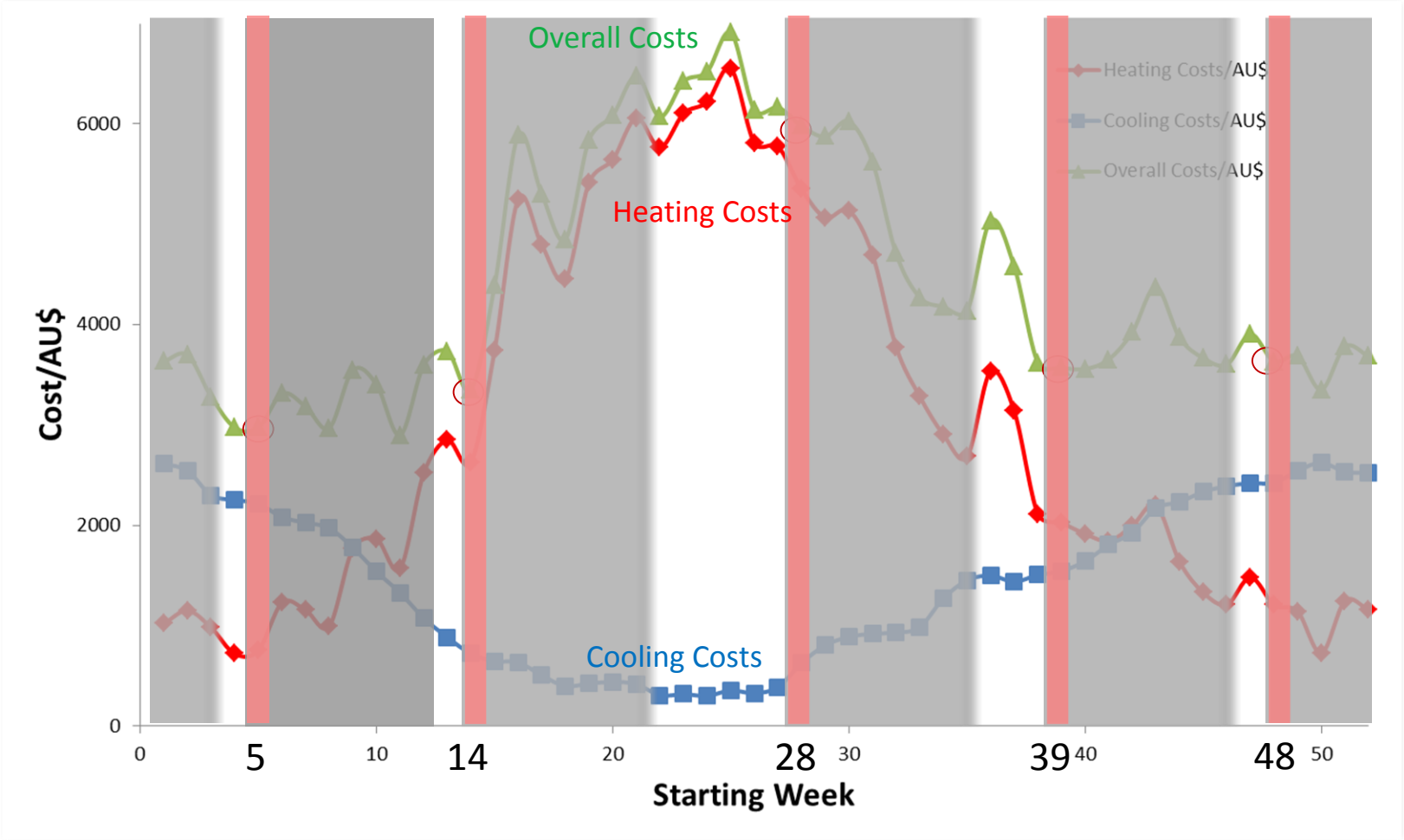


Figure 4: Costs for Different Starting Week

Geothermal Energy for Heating

Current System
Energy Efficiency for
Gas Burner: 85%
LPG Price: 7c/kWh*

Geothermal System
COP for Geothermal
System: 3.8(~380%)
Electricity Price* :
Peak: 12.3c/kWh
Shoulder: 9.6c/kWh
Off Peak:6.5c/kWh

Operational Cost Saving Up to 80%

The maximum cost saving is estimated based on operating during the off peak time for a full scale geothermal system.

Average Operational Cost Saving: 60-70%

The cost saving is estimated based on a full scale geothermal system and subject to the energy price.

Conclusions

1. The two vital factors that influence energy expenditure
   - The climate conditions
   - Internal heat gains from metabolic heat of chickens

2. Most economical time for starting a batch
   - From late September to early April

3. Operational optimization
   - 20% of the heating cost and 12% in total cost could be saved on average

Thank you