Path to Innovative & Successful Low-carbon DES Solutions

IDEA 2014

Moving Community Energy Forward
June 9th, 2014 Seattle

INTEGRAL GROUP
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OBJECTIVE
& OVERVIEW

DEFINING A PATH TO INNOVATIVE & SUCCESSFUL LOW-CARBON DES

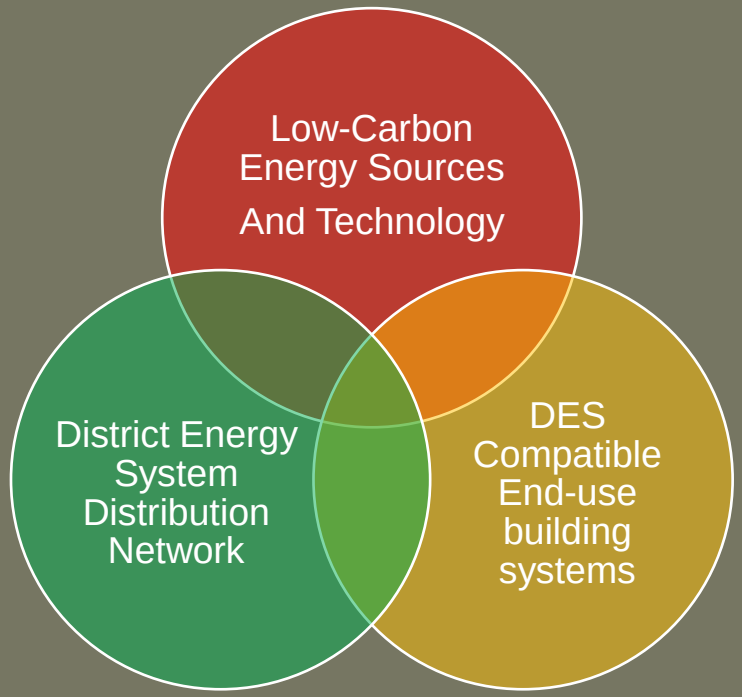
- **KEY REQUIREMENTS:**
  - Technical
  - Economical
  - Social/ Political
- **CONSIDERATION OF ENERGY QUALITY (EXERGY)**
- **IDENTIFYING AN OPTIMAL SITE SPECIFIC DES CONFIGURATION**
  - End-use Energy Demand Side
  - Energy Source and Technology
  - Energy Distribution Network
- **EXAMPLES OF INNOVATIVE DES CONFIGURATIONS**

DEFINING
DES STRATEGY

- KEY OBJECTIVES + THEIR HIERARCHY = DES STRATEGY

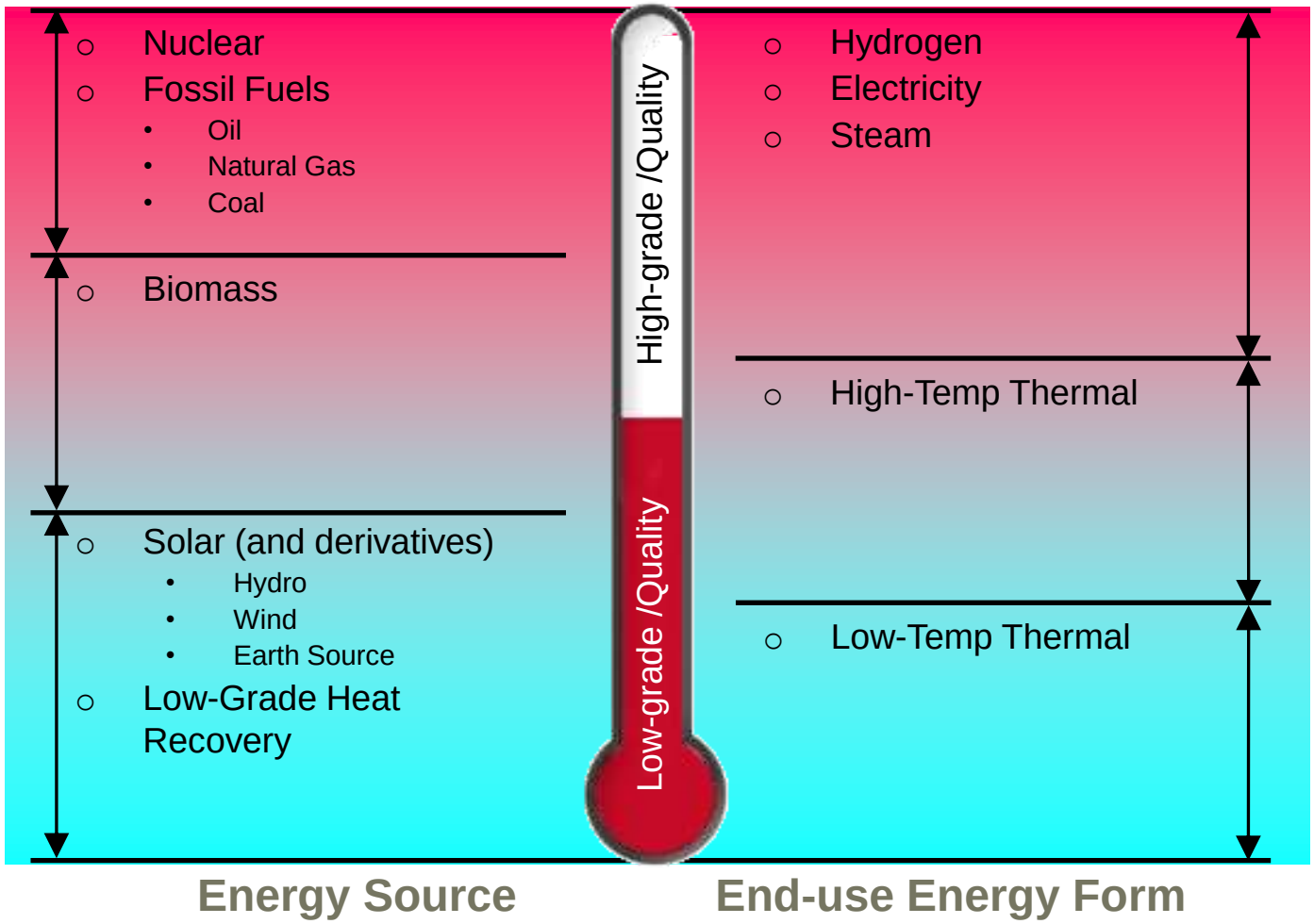
KEY REQUIREMENT #1:
TECHNICAL

- **END-USE ENERGY DEMAND SIDE:**
  - Diverse & Adequate Demand
  - Existing vs. New End-Use
  - Demand use Temperatures!
- **ENERGY SOURCE & TECHNOLOGY SIDE:**
  - Waste Thermal and Low-Carbon Renewable Energy sources available on site
  - Matching and Efficient Energy Conversion Technology
- **DISTRIBUTION NETWORK:**
  - Link between the End-use demand and Energy Source
  - Distribution Network Temperature Level!



KEY REQUIREMENT #1
TECHNICAL

FINDING THE OPTIMAL MATCH: ENERGY QUALITY (EXERGY)



KEY REQUIREMENT #2:
ECONOMICAL

BUSINESS CASE

- Define parameters of a viable business case:
- ROI/ IRR/ Cash flow……"Total Cost of Energy (TCE)"
- "Marginal TCE" over Business as Usual (BAU)
- Cost of conventional energy sources from the grid
- Cost of borrowing capital
- Targeted payback period
- Capital incentives for Low-carbon systems
- ???

KEY REQUIREMENT #3:
SOCIAL/POLITICAL/REGULATORY

MUST ADDRESS PUBLIC PERCEPTION CONCERNS

- Emissions & Air pollution, Odor, Noise, Health…
- “Not in my Backyard!”
- Biomass, WTE, Wind power….

MEET REGULATORY REQUIREMENTS

- Regional, Municipal…
- Public Utility regulations

STAKEHOLDERS ENGAGEMENT

- Proactive stakeholders communication and engagement plan

DES PLANNING:
END-USE ENERGY DEMAND SIDE

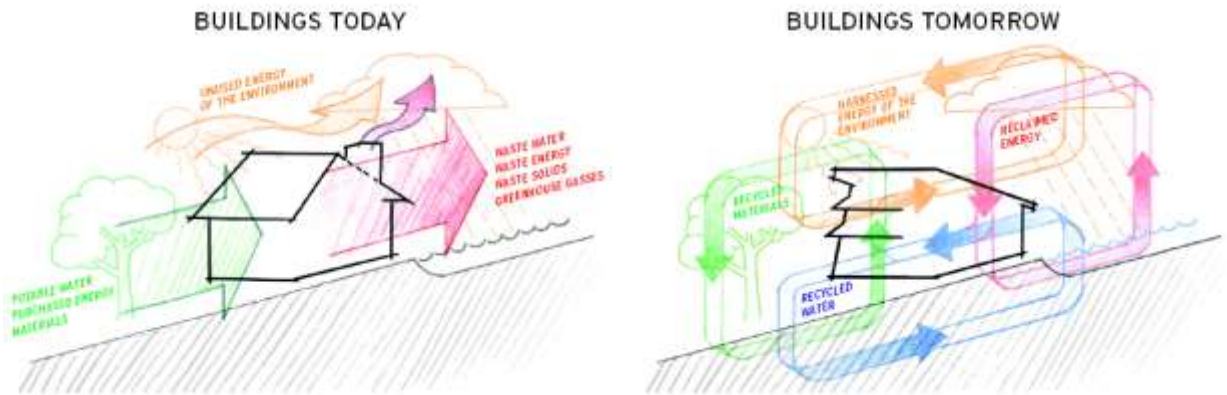
EVALUATE END-USE ENERGY DEMAND SIDE OPPORTUNITIES AND LIMITATIONS

EXISTING BUILDINGS

- Systems requiring high supply temperature level
- Can it be lowered?
- Keep “as is” or upgrade building level systems?
- Can it be reconfigured to achieve ”temperature cascading” and maximum “dT”?

NEW BUILDINGS

- Design with low-temperature systems
- Minimized the energy requirements



DES PLANNING:
ENERGY SOURCE SIDE

EVALUATE LOCAL ENERGY SOURCE OPPORTUNITIES AND LIMITATIONS

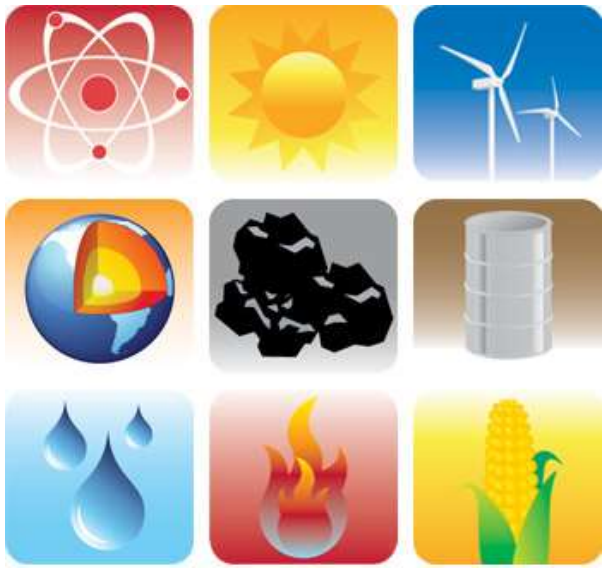
LOW-GRADE:

- On-site waste heat recovery
- Sewer waste heat recovery
- Geo-exchange
- On-site renewables: solar thermal

….

HIGH GRADE:

- Fossil fuels (natural gas, petroleum, coal)
- Grid electricity
- On-site renewables: solar PV, wind power
- Non-traditional combustible fuels (biomass, solid waste, biogas)

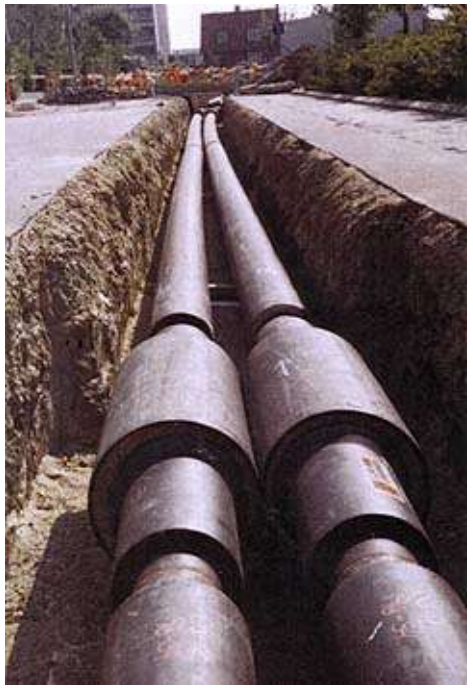


DES PLANNING:
TECHNOLOGIES & NETWORKS

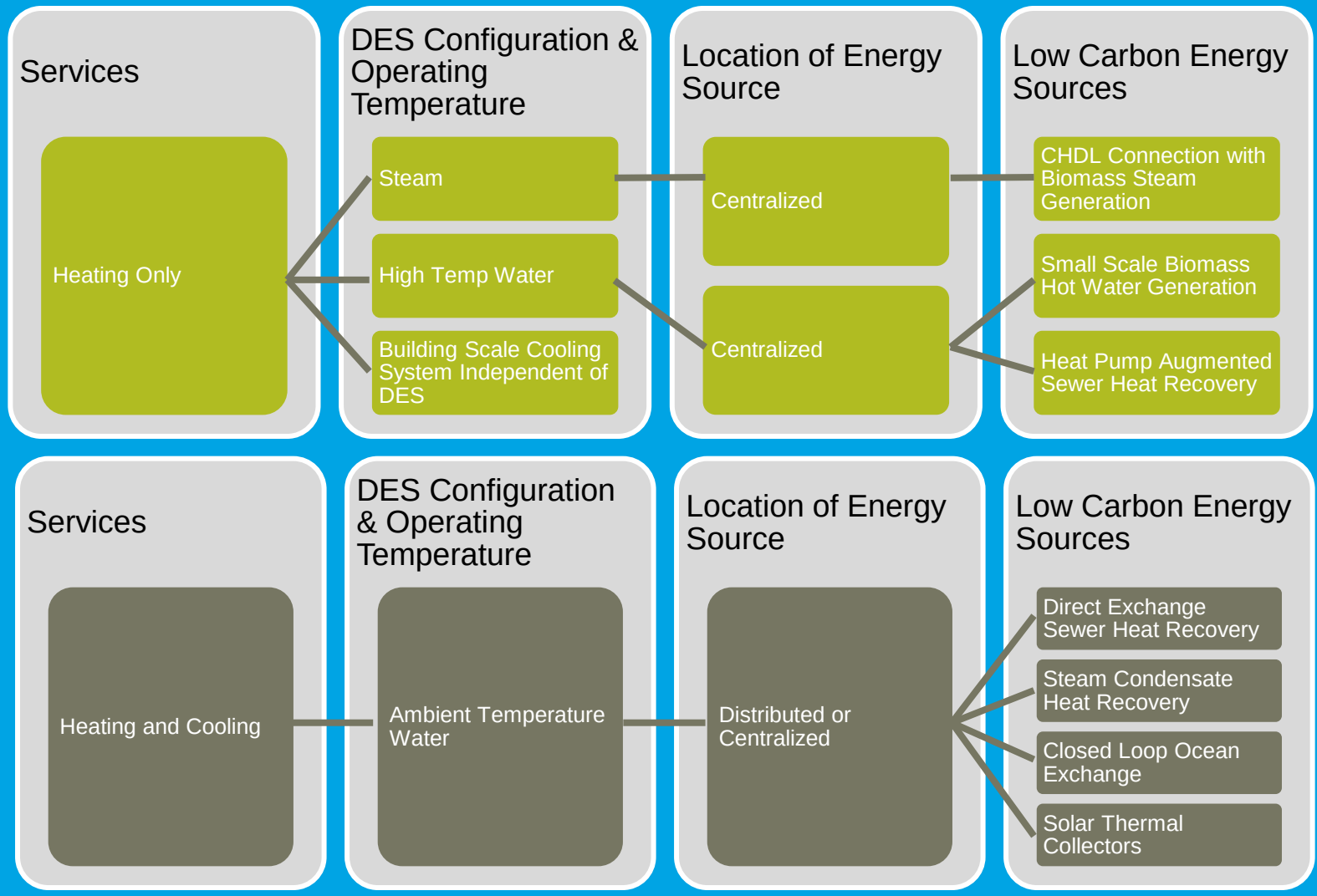
DEVELOP OPTIMAL DES TYPE AND NETWORK CONFIGURATION, ENERGY SOURCES AND TECHNOLOGIES

KEY CONSIDERATIONS:

- Thermal/ Electric/ Co-generation/ Tri-generation
- Heating Only vs. Heating & Cooling
- High-Temperature vs. Ambient Temperature
- Cascading Temperature Levels
- Centralized vs. Distributed Energy Source
- Energy Sources and their combinations
- Energy Conversion technologies and their combinations

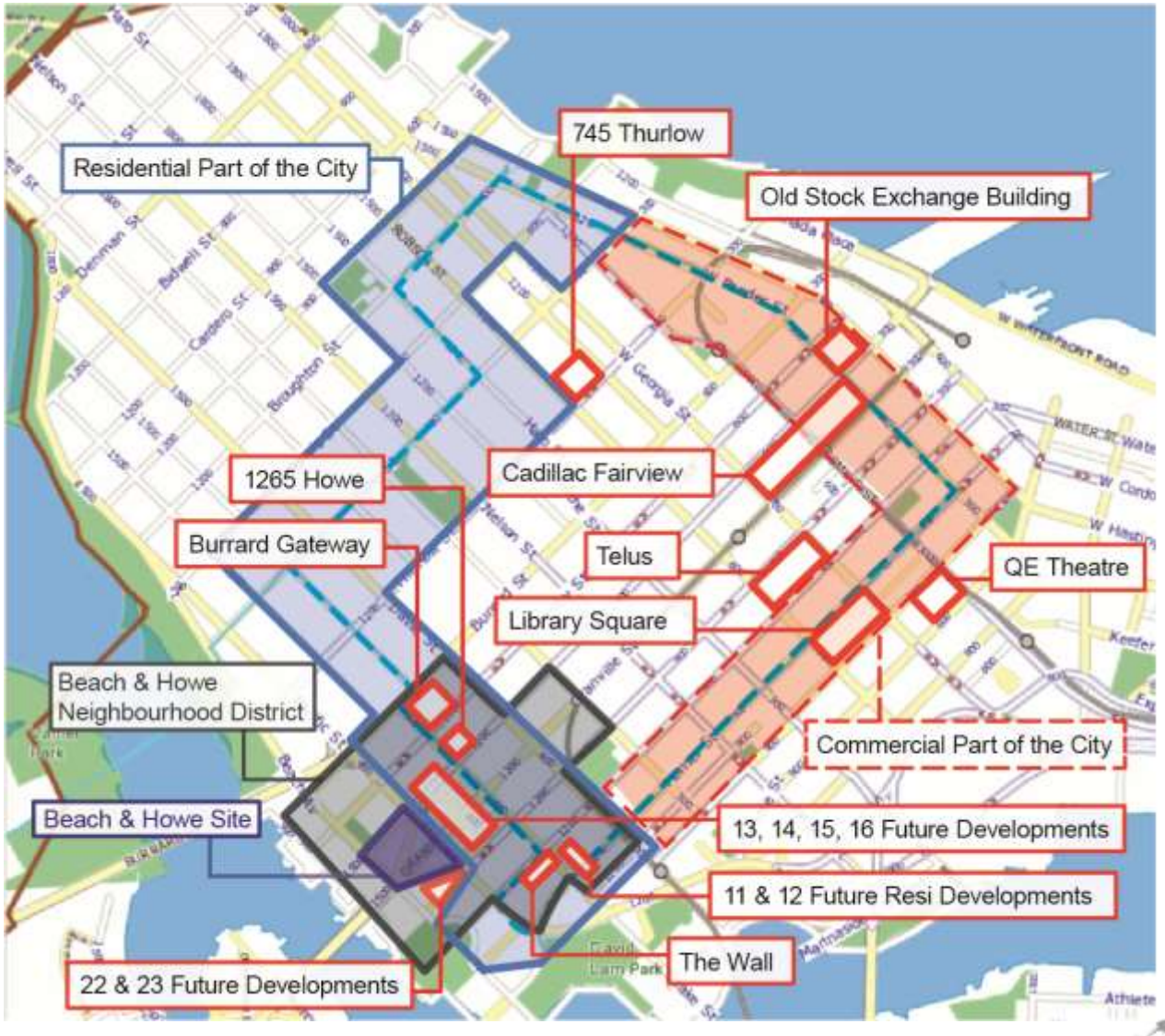


DES PLANNING:
DOWNTOWN VANCOUVER EXAMPLE

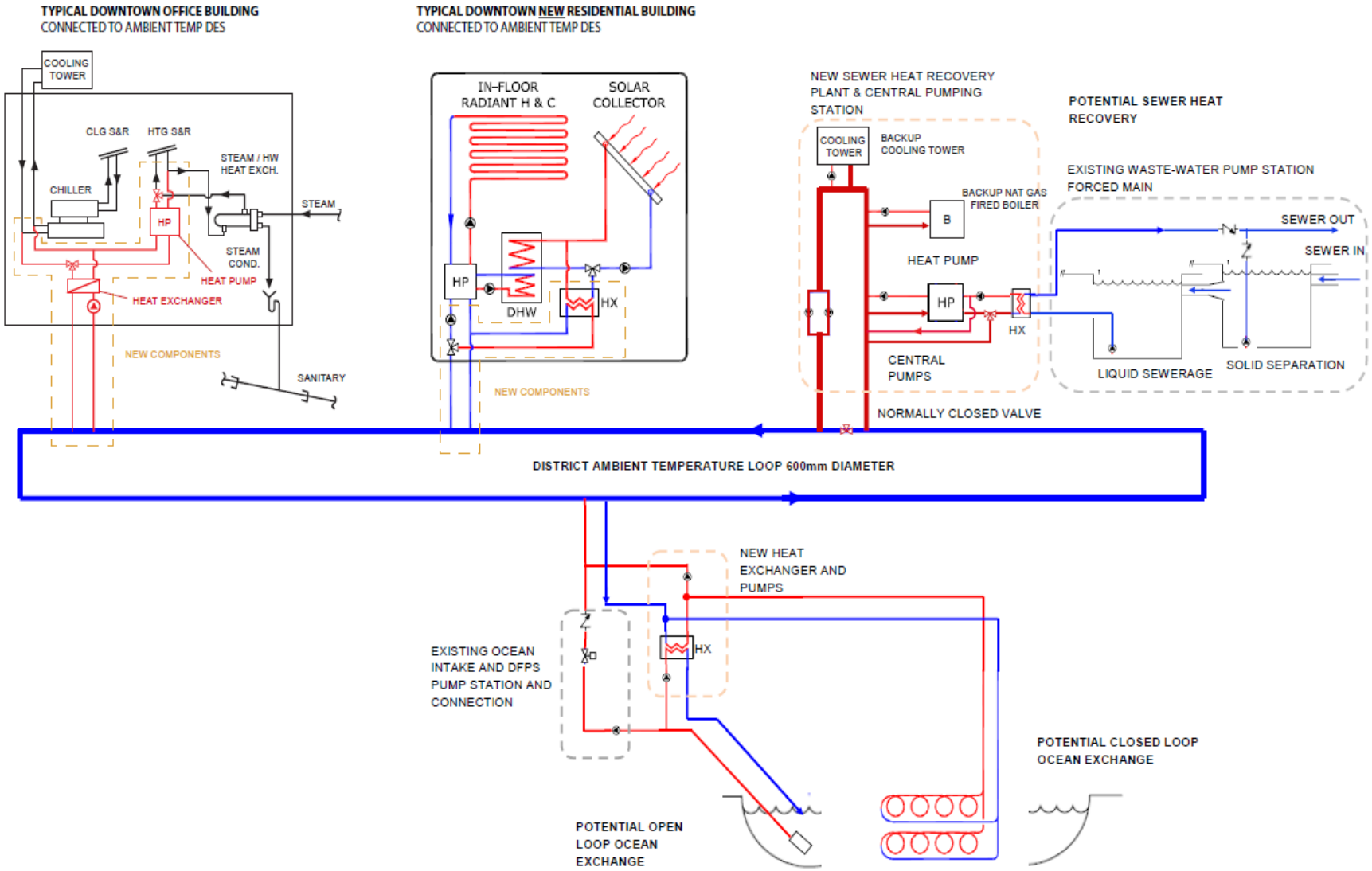


VANCOUVER DOWNTOWN
"AMBIENT LOOP"

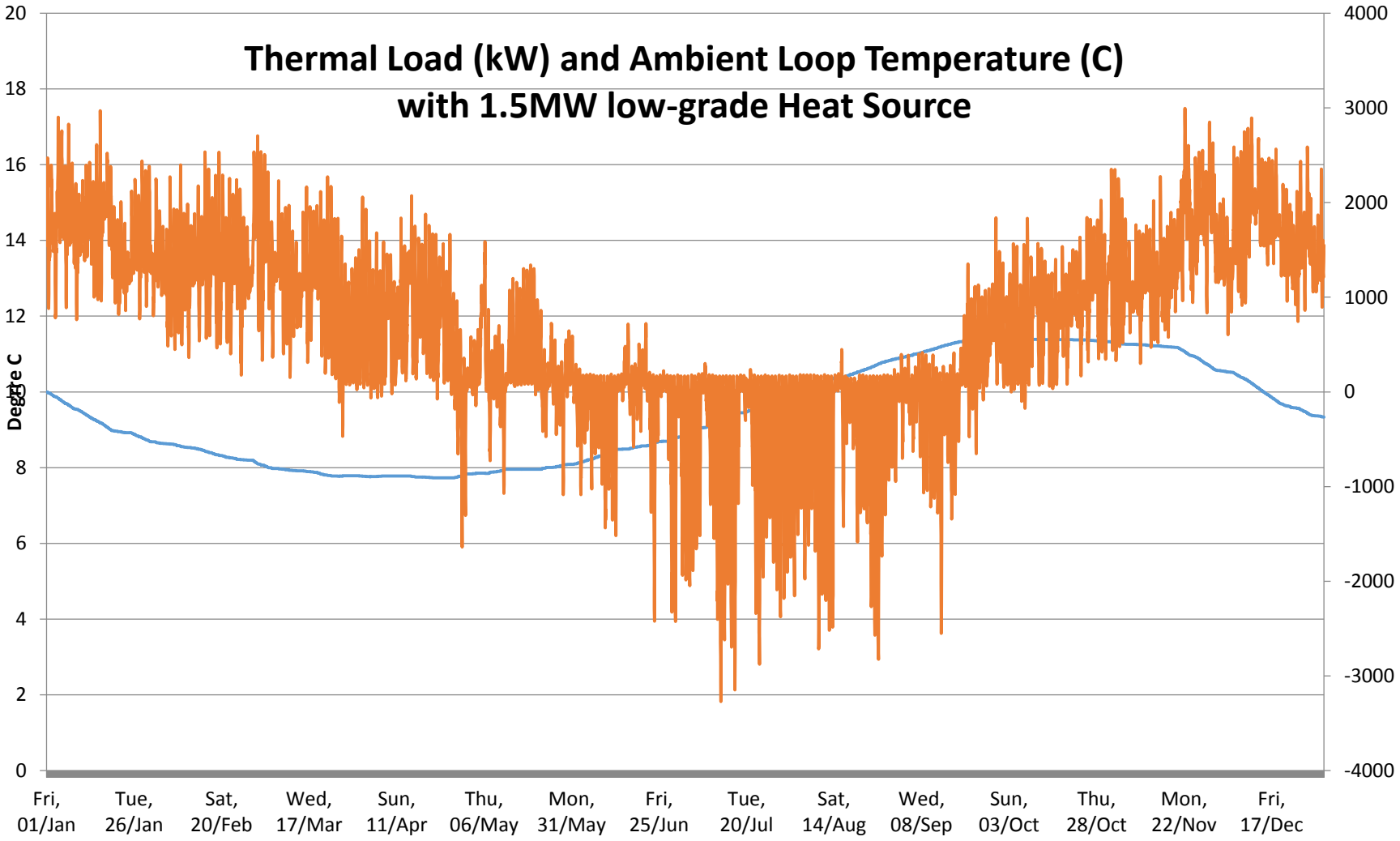
- Conversion of the existing DFPS into Ambient Loop
- Energy recovery between cooling dominant commercial buildings and heating dominant residential buildings
- Distributed "low-grade/low-carbon" energy sources



VANCOUVER DFPS – "AMBIENT LOOP"
CONVERSION CONCEPT

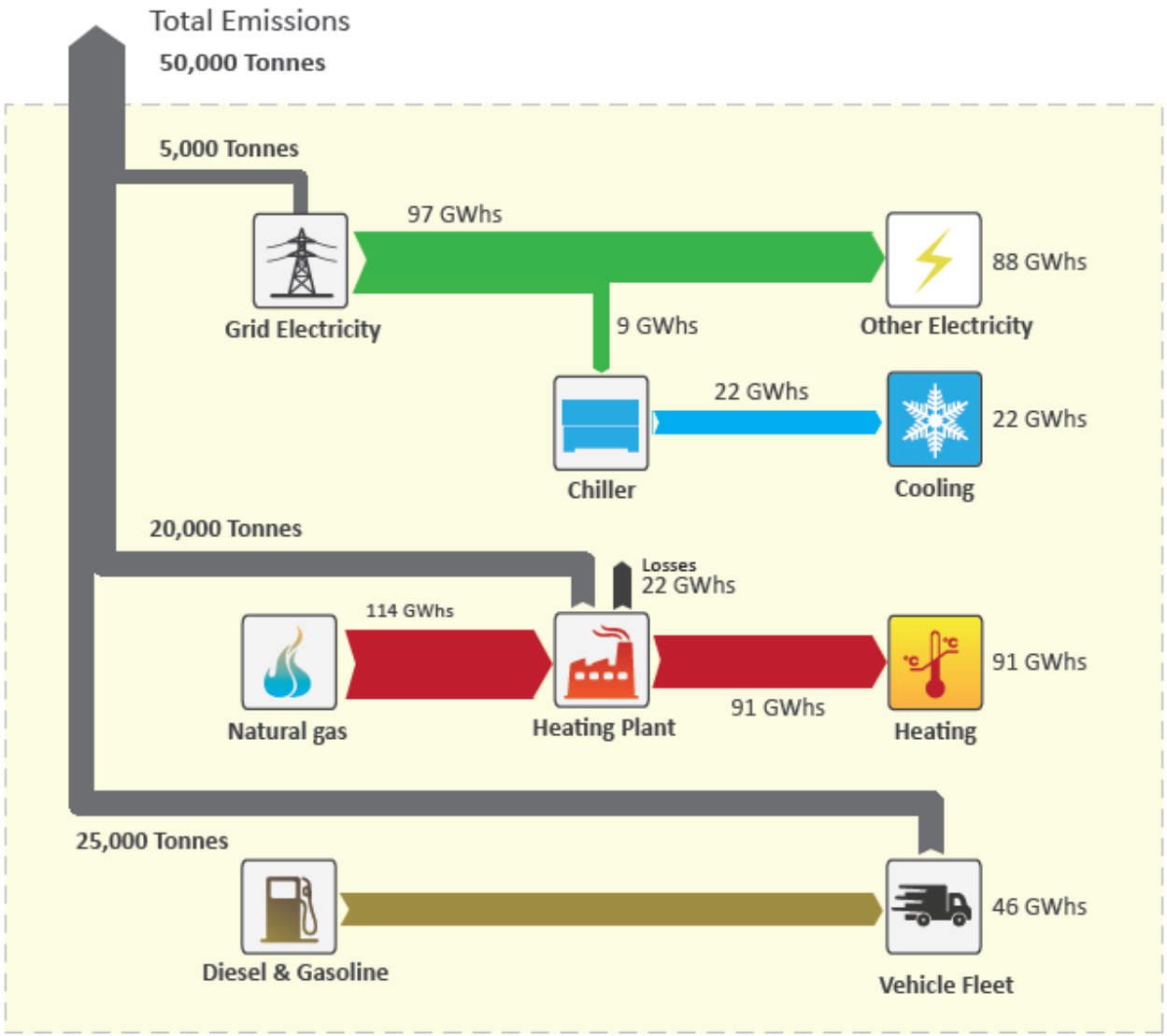


VANCOUVER AMBIENT LOOP
THERMAL PERFORMANCE OF PHASE 1



YVR & SEA ISLAND
LOW CARBON DES CONCEPT

YVR
EXISTING ENERGY DEMAND



YVR & SEA ISLAND DES
CONSIDERED DES TECHNOLOGIES

BIOMASS TRI-GENERATION

Heathrow Airport T2 10MW Biomass Cogeneration Plant

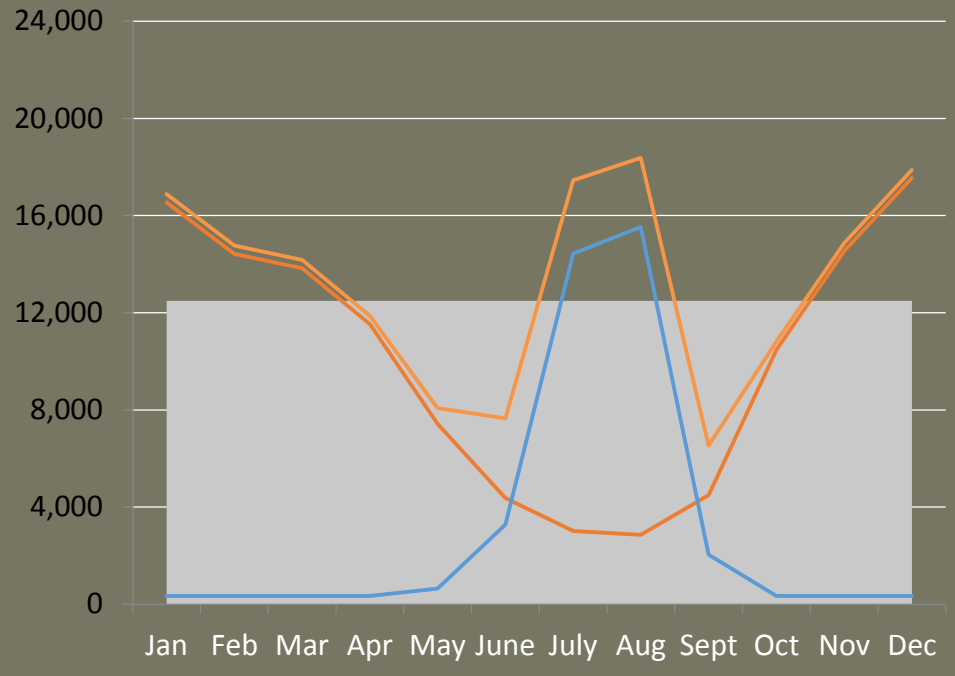
WASTE-TO-ENERGY

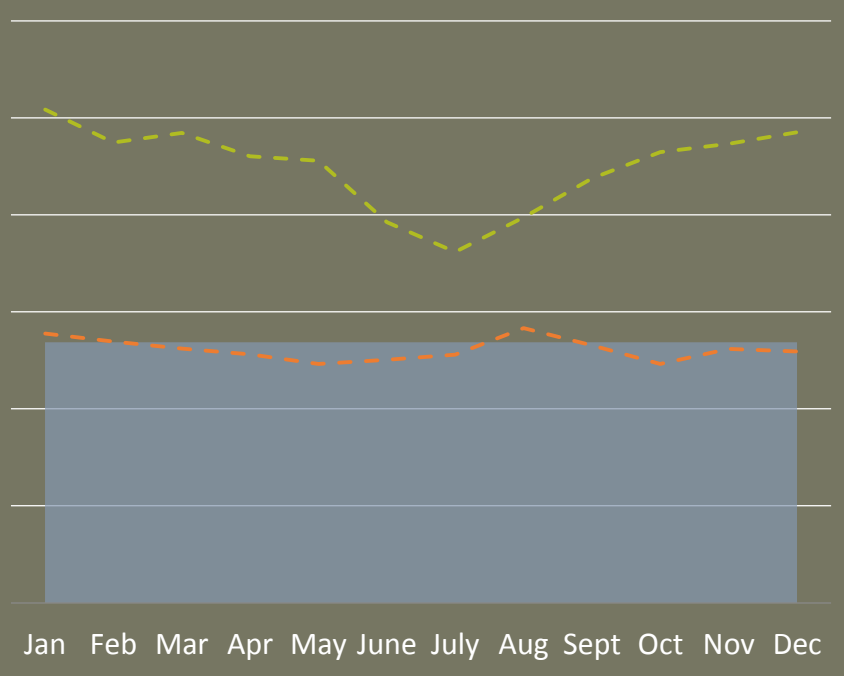
"Batch Oxidization System" by WTEC

ABSORPTION CHILLERS

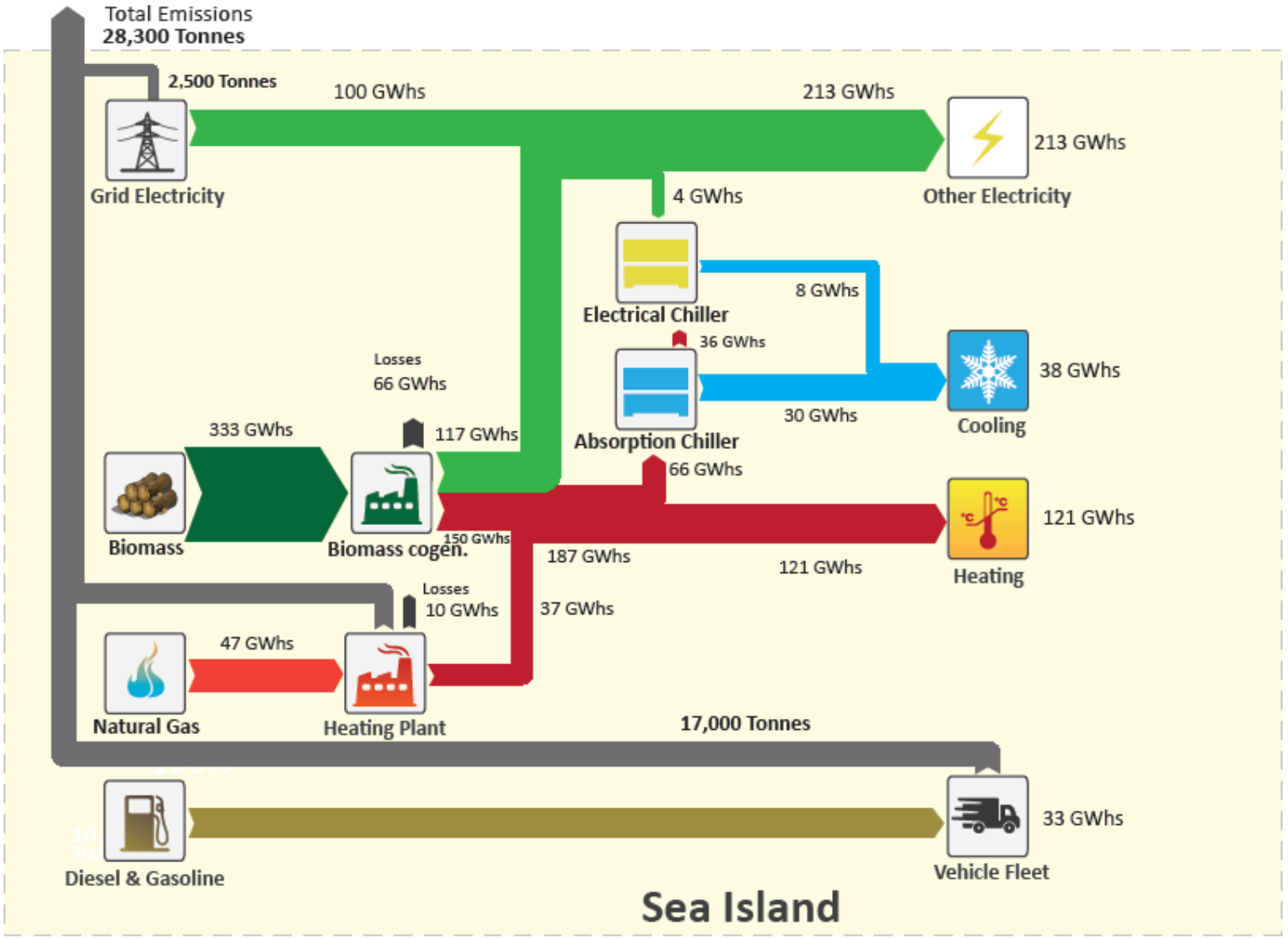
Absorption Chillers – University of Lund DES, Sweden

DES CONCEPT FOR YVR & SEA ISLAND:
"OPTIMAL" CONCEPT

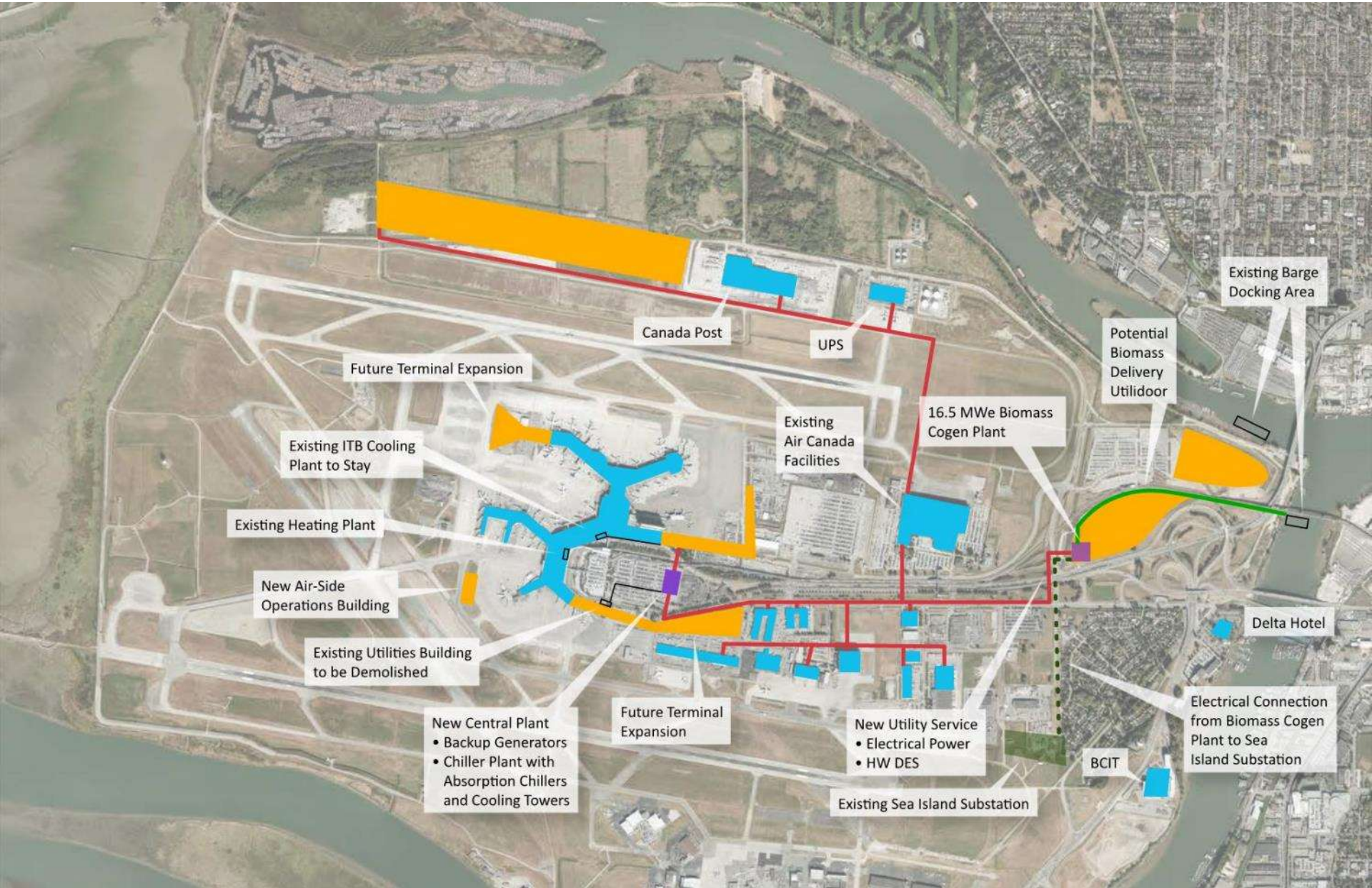




YVR & SEA ISLAND
"OPTIMAL" CONCEPT DES ENERGY DEMAND



YVR & SEA ISLAND
"OPTIMAL" DES CONCEPT

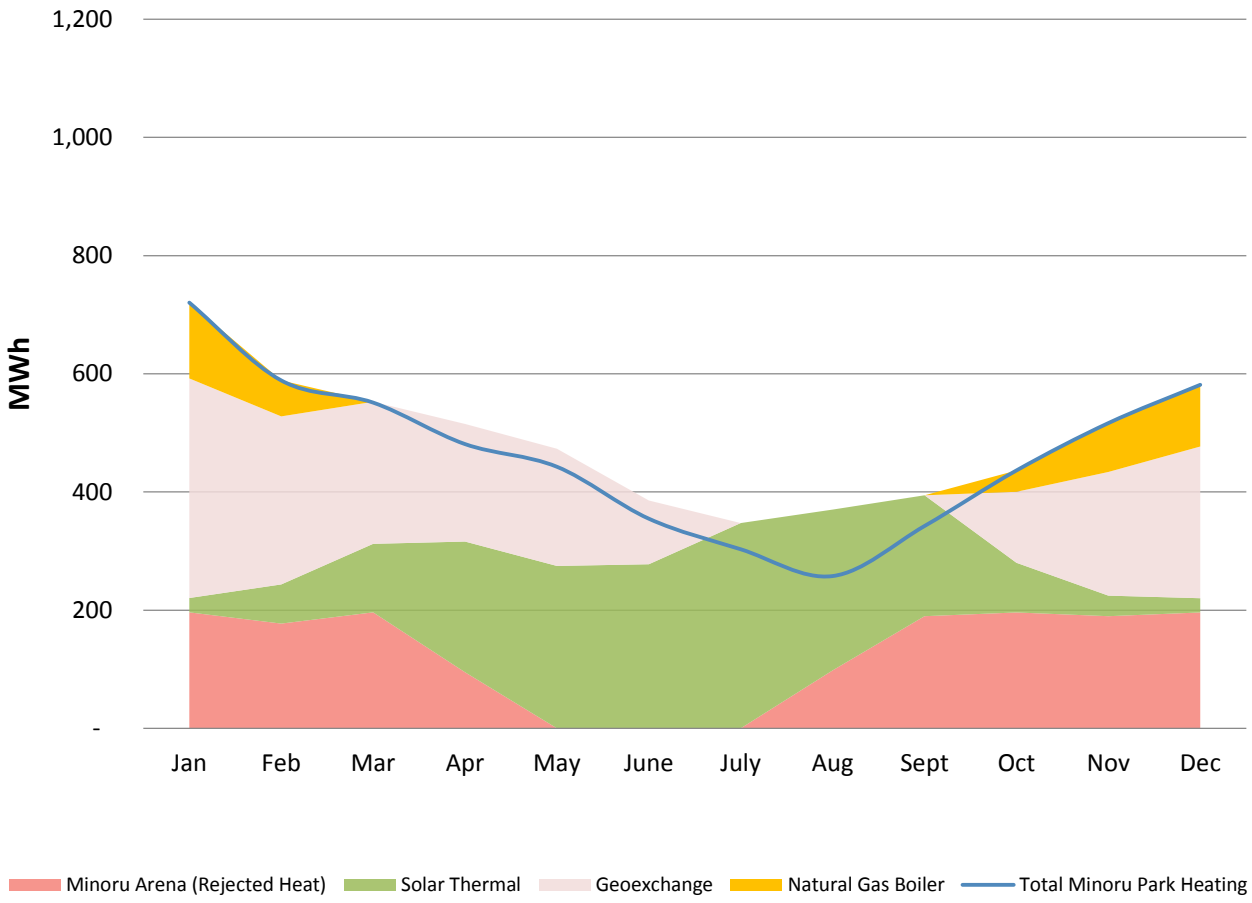


RICHMOND - MINORU PARK
DISTRICT ENERGY STRATEGY

HYBRID ON-SITE DISTRICT ENERGY STRATEGY

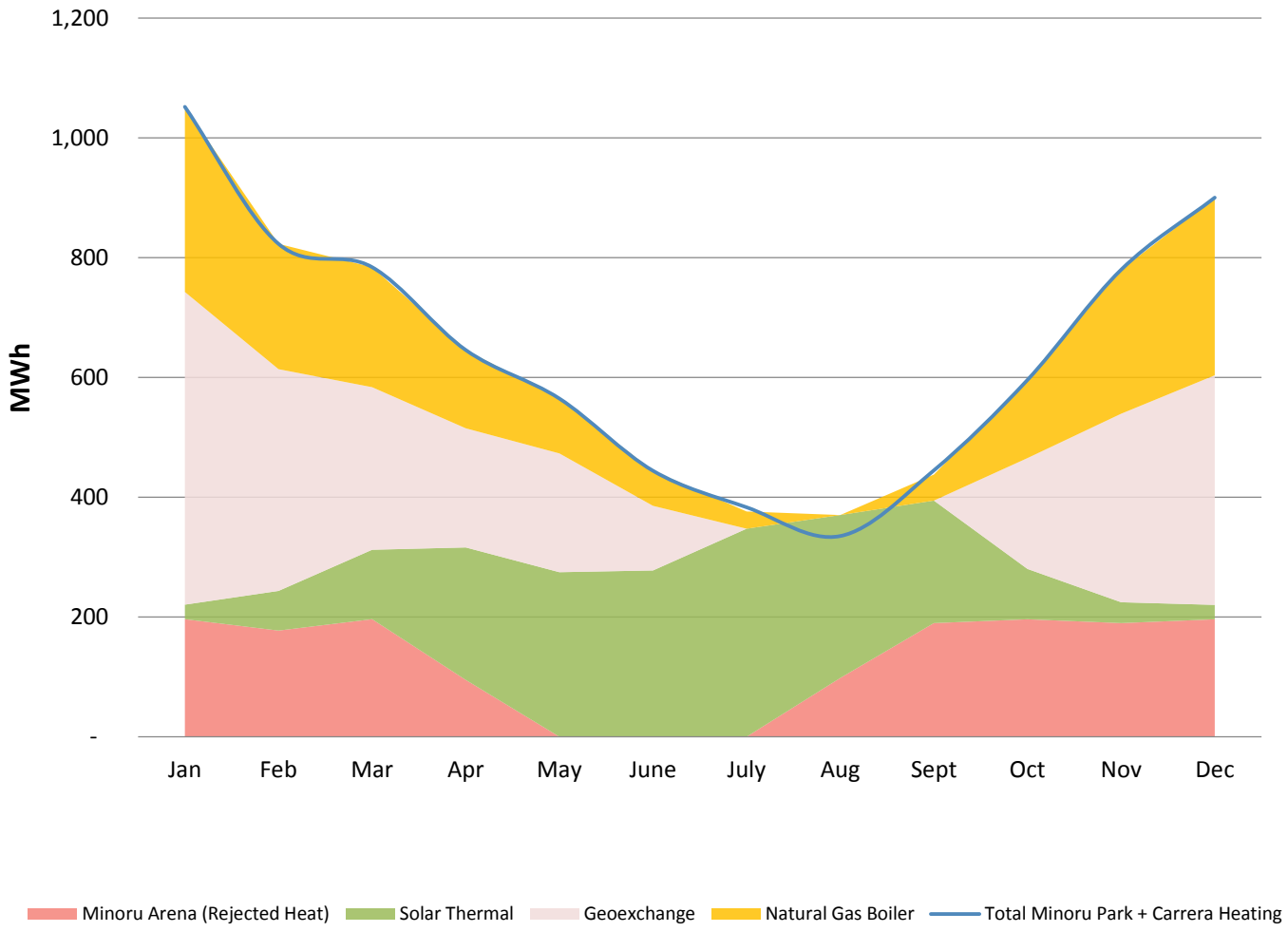
- Minoru Ice Rink Heat Rejection Recovery, Solar Thermal, and Geo-exchange
- Peaking and backup heating by local Waste Biomass or Natural gas boilers
- Minoru Ice Rink and Solar Thermal are utilised first
- Geo-exchange sized to meet remaining heat demand

RICHMOND - MINORU PARK
DISTRICT ENERGY STRATEGY



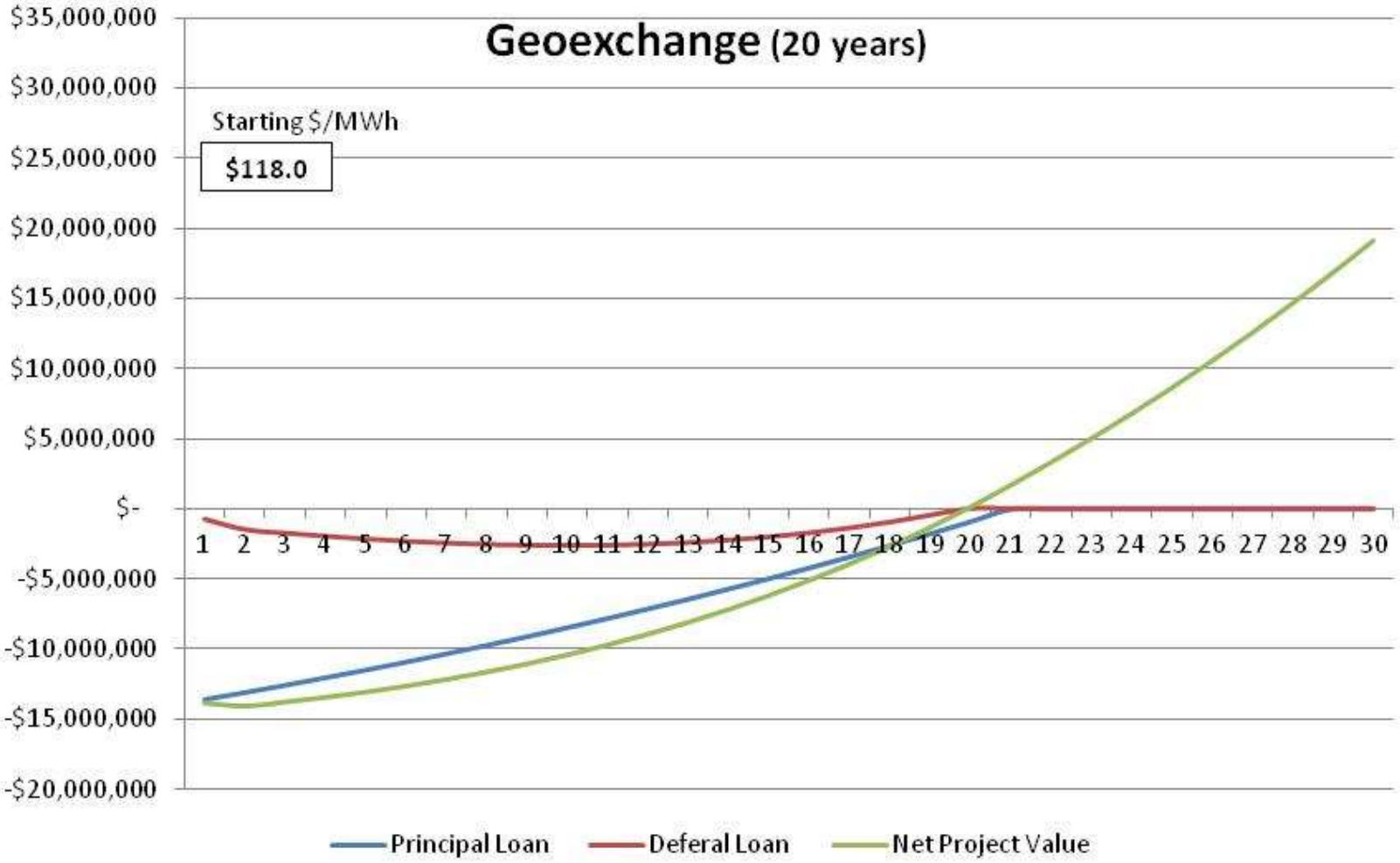
- Hybrid system
  - Minoru Arena
  - Solar Thermal
  - Geo-exchange
  - Nat gas boiler
- System meets 100% of Minoru Park heating demand
- Geo-exchange field: 330 boreholes 12,000m^2

RICHMOND - MINORU PARK + CARRERA
DISTRICT ENERGY STRATEGY

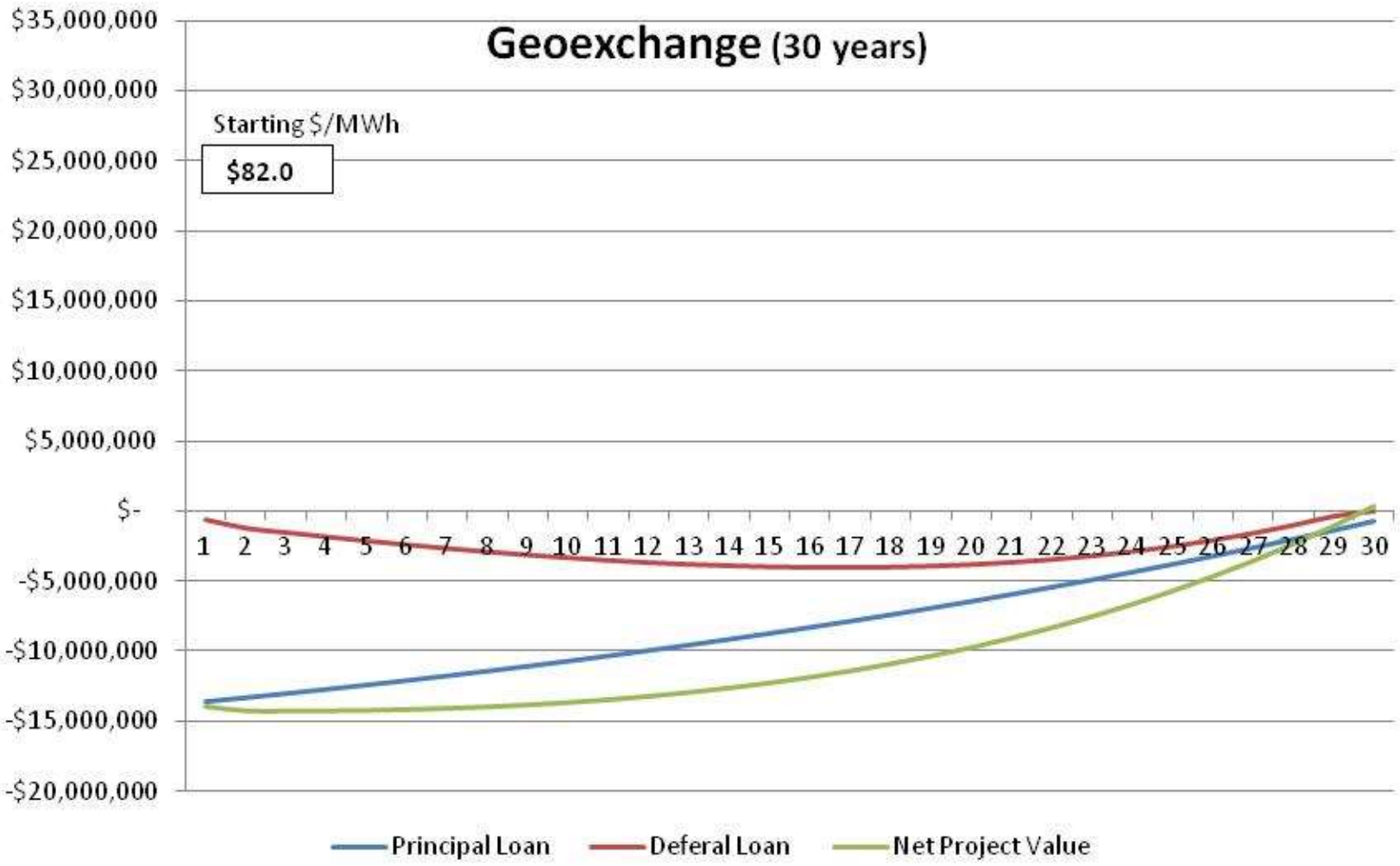


- Hybrid system
  - Minoru Arena
  - Solar Thermal
  - Geo-exchange
  - Nat gas boiler
- System meets 100% of Minoru Park + Carrera heating demand
- Geo-exchange field: 450 boreholes 15,300m^2

FINANCIAL ANALYSIS
BUSINESS CASE PRO-FORMA: 20 YEAR DEBT PAYOFF



FINANCIAL ANALYSIS
BUSINESS CASE PRO-FORMA: 30 YEAR DEBT PAYOFF




Questions ?
Thank You