Northern Greenhouse Research Project

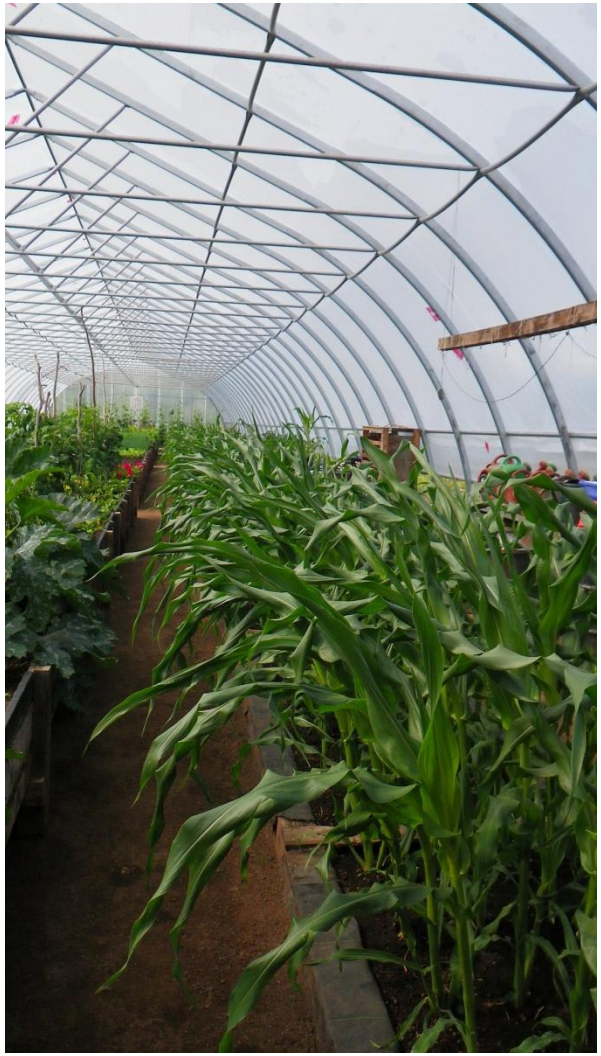
Exploring the Challenges of Greenhouseing in Northern Climates

Cold Climate and Technology Innovation
Yukon Research Centre, Yukon College
Prepared by
Treharne Drury

Cold Climate Innovation
YUKON RESEARCH CENTRE · Yukon College

Outline

- **Background**
  - Vision
  - Partners
  - Timeline
- **Objectives**
  - Overcoming Challenges
  - Adapting Innovations
  - Learning Outcomes
  - Research Opportunities
- **Incorporated Technology**
  - Quad glazing
  - Stirling Engine
  - LED grow lights
  - VIP insulated shades
  - Greenhouse Mechanization
  - Thermal Storage and Heat Modulation
- **Into the Future**
  - Long Term Objectives
  - Future Research



Background

- Vision
  - NGRP was developed between School of Access and Technology Innovation
  - Provide school of access with a tool for educating students about growing and gardening
  - Project was designed to provide hands-on education for the students and northern growing research opportunities
  - In addition, the project was designed as a test bed for a variety of new technologies to make growing more efficient and compatible with the north
  - Provide source of greens to the student cafeteria in winter

Background

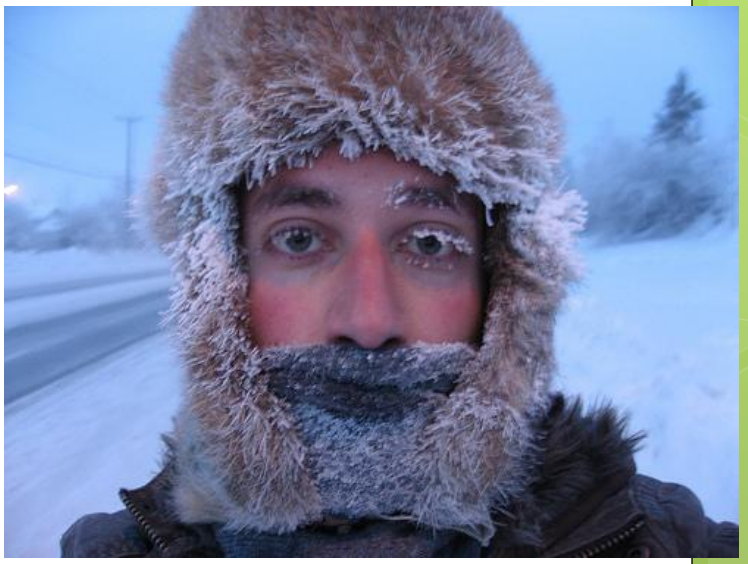
- Partners
  - Technology Innovation (YRC)
  - Yukon College
    - School of Access
    - School of Trades, plumbing and carpentry
- Timeline
  - Stage 1, Building the greenhouse
    - Sept. 01, 2011 – Dec. 31,2011
  - Stage 2, Commission Whispergen, Install mechanized shutters, begin growing plants
    - Jan. 01,2012 – April 31, 2012

Objectives

- Overcoming Challenges
  - Northern growing poses unique challenges
    - Cold weather
    - Low light winter growing conditions
    - Moisture build up inside the greenhouse
    - Heating management of the greenhouse
    - Air exchanges and CO^2 depletion within the GH
    - Expensive heating costs

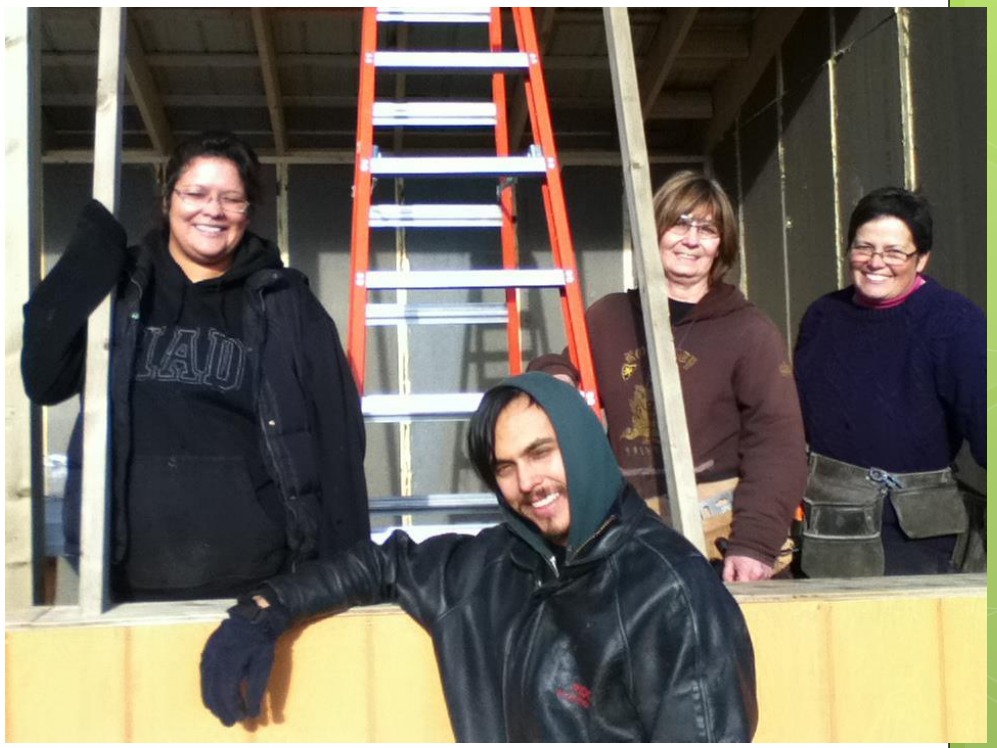
Objectives

- Adapting Existing Technologies
  - Yukon is a uniquely northern location for most of the technologies used
  - Poses certain challenges in adapting these technologies to specific projects
    - HRV icing
    - Glazing never tested in these latitudes
    - VIP installation poses specific challenges, installation and protection
    - LED as supplemental lighting in low light winter months



Objectives

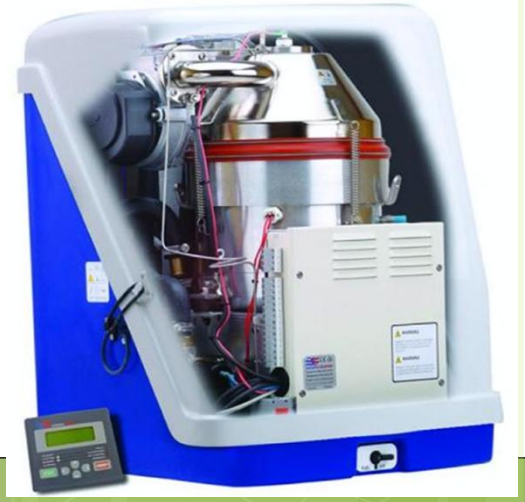
- Learning Outcomes
  - Light management – shutters and LED grow lights
  - Thermal storage maximization
  - Moisture management – drip irrigation and HRV
  - Cold and dark tolerant plants
- Research Opportunities
  - Greenhouse space can be made available to researchers



Incorporated Technology

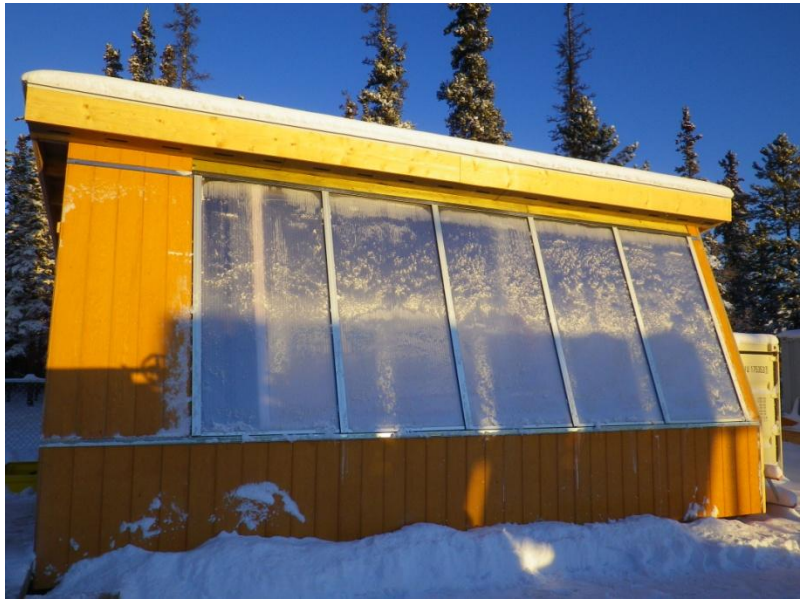
- **Stirling Engine**
  - **WhisperGen, Personal Power Station - PPS16**

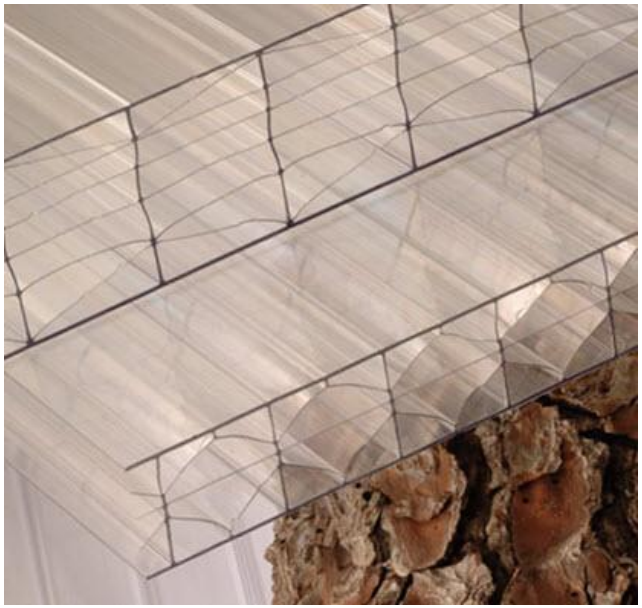
- 800w electrical power
- 5.5Kw thermal power
  - 19,000Btu
- 90% efficient as CHP
- 12% efficient as elec.
- 78% efficient as heat
- 0.75L/hr @ max out



Incorporated Technology

- Quad-pane 25mm polycarbonate Glazing
  - R-4 greenhouse glazing – Polygal Thermogal
    - Light transmission and R-Value equivalent to double glass
    - Light scattering better than without glazing

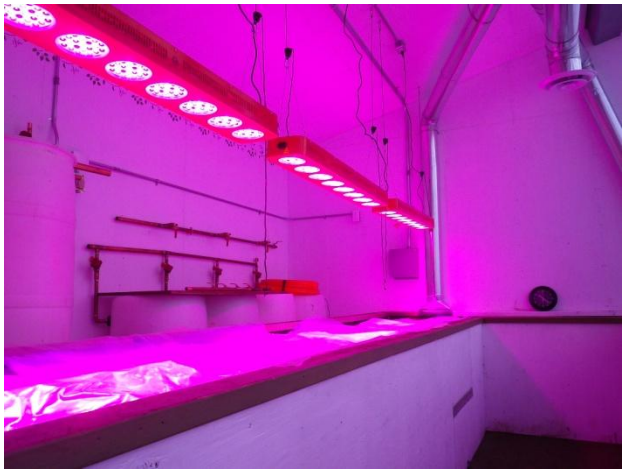




Incorporated Technology

- LED grow lights, Hydrogrow and LED Growmaster

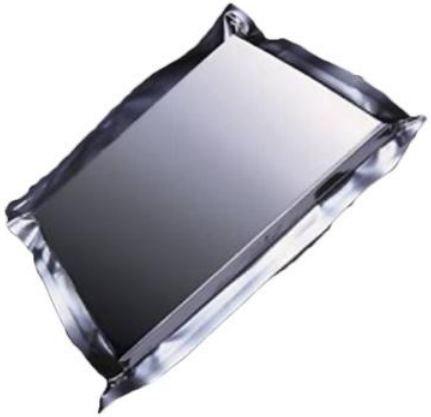
LED Growmaster – 9w/light

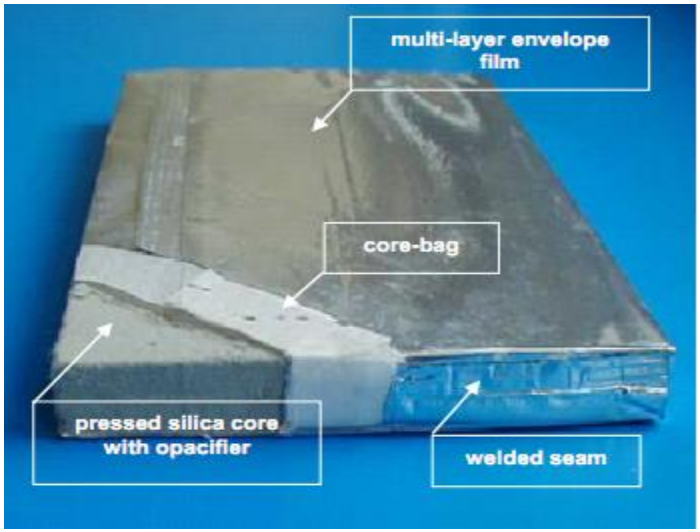


Hydrogrow – 155w/light

Incorporated Technology

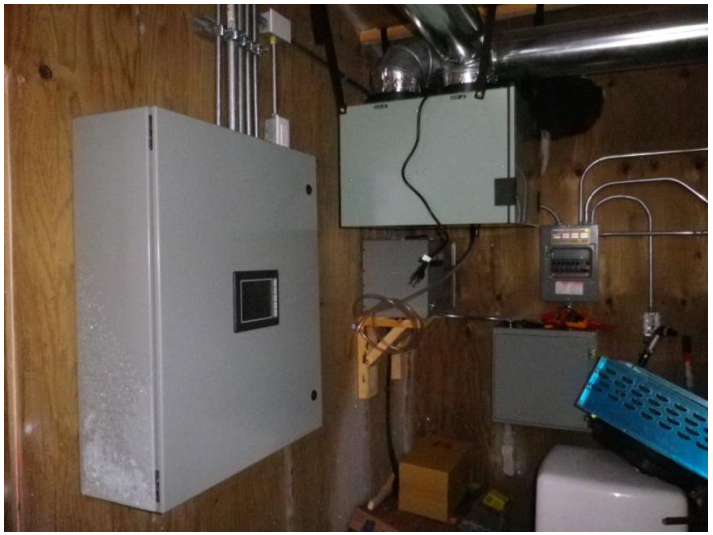
- VIP - insulated shades
  - R-28 per 1/2inch
  - Peel and Stick
  - Mechanized shades to maximize efficiency

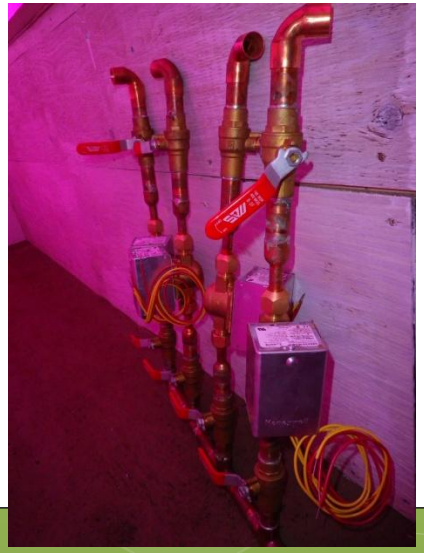


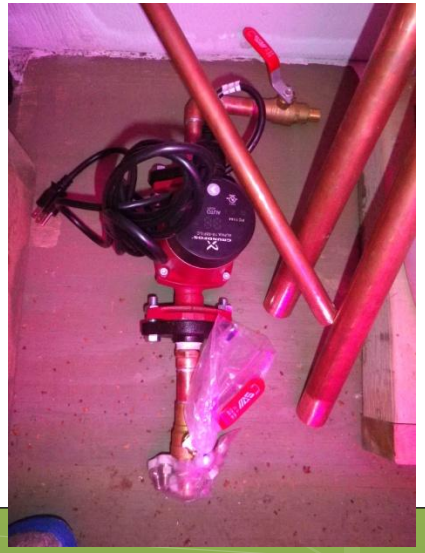


Incorporated Innovations

- Greenhouse Mechanization
  - Greenhouse systems are mechanized for ease of operation
    - Watering (soil moisture)
    - Shutters
    - Lighting
    - Ventilation (CO_2 and RH)
    - Bed Temperature
    - Battery charging and Stirling operation

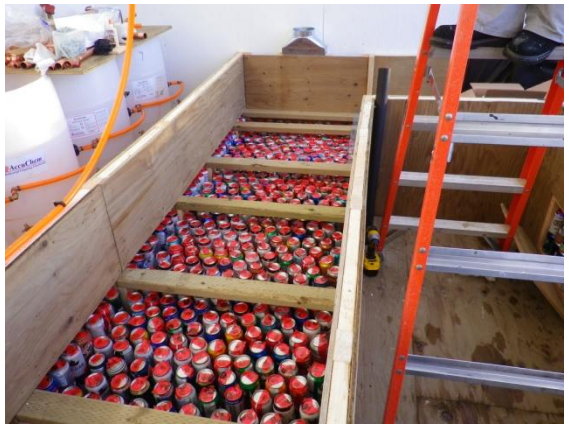


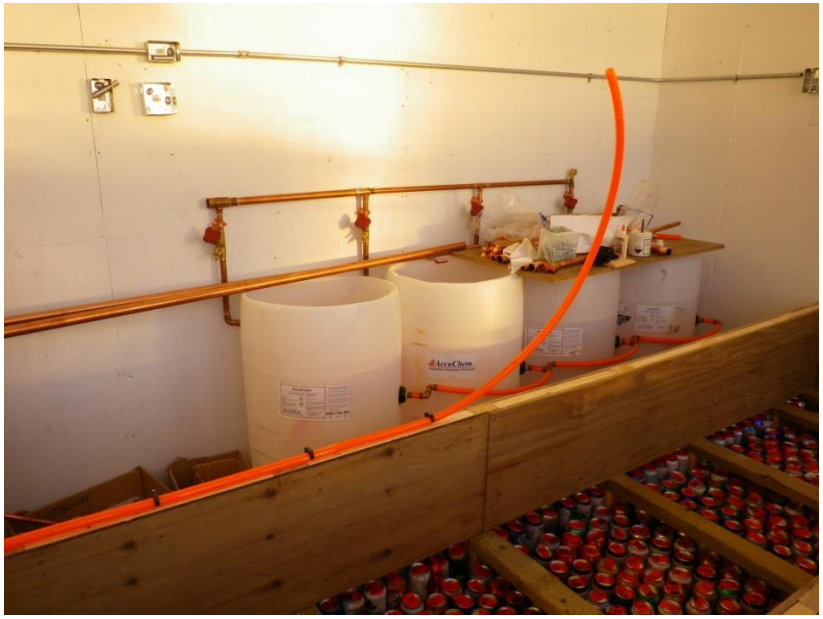




Incorporated Innovations

- Thermal Storage and Heat Modulation
  - Greenhouse utilizes thermal storage in the form of water under the beds to trap day-time heat and release it during the night





Into the Future

- Long Term Objectives
  - Hand over the greenhouse to School of Access for gardening and greenhouseing education
  - Have greenhouse available for research
  - Have greenhouse produce 12 months a year
  - Provide local producers with innovative adoptable ideas

- Future Research
  - Biochar and humic mine soils testing
  - Use as platform to assess new technology