



# Low-Carbon Greenhouse Construction and Operation in Ecology Park



## Background

GreenUP is a **hub for collaborative, community-based action on environmental sustainability** based in Peterborough, ON. They operate a **native plant and tree nursery at Ecology Park** (1899 Ashburnham Drive). GreenUP's strategic plan for the park includes developing a greenhouse to extend the growing season and increase capacity, as sustainably as possible.

## Research Questions

- What **alternative greenhouse construction and operations** exist in Southern Ontario and similar climate regions?
- What **materials, systems, and construction methods** are typically used to build alternative greenhouses?
- What are the **benefits and disadvantages** of different greenhouse models?
- What **models would be most suitable for GreenUP** based on their long term propagation goals and the constraints of Ecology Park?

## Methods

- **Site visit to Ecology Park**
- **Interviews** with GreenUP staff members Hayley Goodchild (Coordinator of Native Plant Propagation) and Vern Bastable (Director of Ecology Park)
- Development of **suitability criteria**:
  - Within budget: max \$350,000
  - Locally-sourced materials: within North America, ideally Ontario/Canada
  - Low/zero carbon materials
  - Resilient/easy to repair
  - Able to operate on existing infrastructure
  - Passive, winter-friendly system
  - Space for staff bathroom
  - 300-500 square feet
- **Literature review**
- Six designs were selected and the **three meeting the most suitability criteria were recommended** for further study

## Findings

Table 1: Application of suitability criteria to six proposed greenhouses.

|                          | Victorian | ETFE | Walipini | Harnois                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Polycarbonate hempcrete  | Timber papercrete |     |    |    |    |    |                  |     |     |    |     |     |     |                     |    |     |    |    |     |     |               |    |     |     |     |     |     |               |   |   |   |   |   |   |
|--------------------------|-----------|------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-------------------|-----|----|----|----|----|------------------|-----|-----|----|-----|-----|-----|---------------------|----|-----|----|----|-----|-----|---------------|----|-----|-----|-----|-----|-----|---------------|---|---|---|---|---|---|
| In budget?               | Yes       | -    | -        | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Yes                      | Yes               |     |    |    |    |    |                  |     |     |    |     |     |     |                     |    |     |    |    |     |     |               |    |     |     |     |     |     |               |   |   |   |   |   |   |
| Local?                   | Yes       | Yes  | Yes      | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Yes                      | Yes               |     |    |    |    |    |                  |     |     |    |     |     |     |                     |    |     |    |    |     |     |               |    |     |     |     |     |     |               |   |   |   |   |   |   |
| Low/zero carbon?         | No        | Yes  | Yes      | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Yes                      | Yes               |     |    |    |    |    |                  |     |     |    |     |     |     |                     |    |     |    |    |     |     |               |    |     |     |     |     |     |               |   |   |   |   |   |   |
| Resilient?               | Yes       | Yes  | Yes      | Yes </tr <tr> <td>Existing infrastructure?</td> <td>Yes</td> <td>Yes</td> <td>No</td> <td>No</td> <td>No</td> <td>No</td> </tr> <tr> <td>Winter tolerant?</td> <td>Yes</td> <td>Yes</td> <td>No</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> </tr> <tr> <td>Space for bathroom?</td> <td>No</td> <td>Yes</td> <td>No</td> <td>No</td> <td>Yes</td> <td>Yes</td> </tr> <tr> <td>Desired size?</td> <td>No</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> <td>Yes</td> </tr> <tr> <td><b>Total:</b></td> <td>5</td> <td>7</td> <td>4</td> <td>6</td> <td>7</td> <td>7</td> </tr> | Existing infrastructure? | Yes               | Yes | No | No | No | No | Winter tolerant? | Yes | Yes | No | Yes | Yes | Yes | Space for bathroom? | No | Yes | No | No | Yes | Yes | Desired size? | No | Yes | Yes | Yes | Yes | Yes | <b>Total:</b> | 5 | 7 | 4 | 6 | 7 | 7 |
| Existing infrastructure? | Yes       | Yes  | No       | No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | No                       | No                |     |    |    |    |    |                  |     |     |    |     |     |     |                     |    |     |    |    |     |     |               |    |     |     |     |     |     |               |   |   |   |   |   |   |
| Winter tolerant?         | Yes       | Yes  | No       | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Yes                      | Yes               |     |    |    |    |    |                  |     |     |    |     |     |     |                     |    |     |    |    |     |     |               |    |     |     |     |     |     |               |   |   |   |   |   |   |
| Space for bathroom?      | No        | Yes  | No       | No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Yes                      | Yes               |     |    |    |    |    |                  |     |     |    |     |     |     |                     |    |     |    |    |     |     |               |    |     |     |     |     |     |               |   |   |   |   |   |   |
| Desired size?            | No        | Yes  | Yes      | Yes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Yes                      | Yes               |     |    |    |    |    |                  |     |     |    |     |     |     |                     |    |     |    |    |     |     |               |    |     |     |     |     |     |               |   |   |   |   |   |   |
| <b>Total:</b>            | 5         | 7    | 4        | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 7                        | 7                 |     |    |    |    |    |                  |     |     |    |     |     |     |                     |    |     |    |    |     |     |               |    |     |     |     |     |     |               |   |   |   |   |   |   |

## Recommendations and Next Steps

- To remain competitive with other garden centres and expand the growing season, a greenhouse at Ecology Park is required to support native plant nursery operations.
- **ETFE** (Figure 1), **polycarbonate hempcrete** (Figure 2), and **timber papercrete** (Figure 3) greenhouses are recommended to the GreenUP Board of Directors as possible options for Ecology Park.
- Further feasibility studies will be required in the future to ensure successful greenhouse project development and implementation.



## References



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 ERSC 3160H (Winter 2024)  
 Host: Hayley Goodchild, GreenUP  
 TCRC Supervisor: Brittany Finigan  
 Faculty Supervisor: Dr. Shaun Watmough, TSE

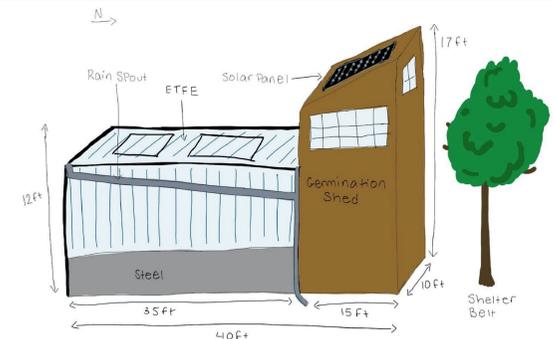


Figure 1: potential ETFE greenhouse design

**Ethylene tetrafluoroethylene (ETFE)** panels and reinforced steel make up the siding of this design. A germination shed, placed on the North-facing side, has an angled roof equipped with **solar panels** and includes a staff bathroom. **Rain collection infrastructure** and a shelter belt are also proposed.

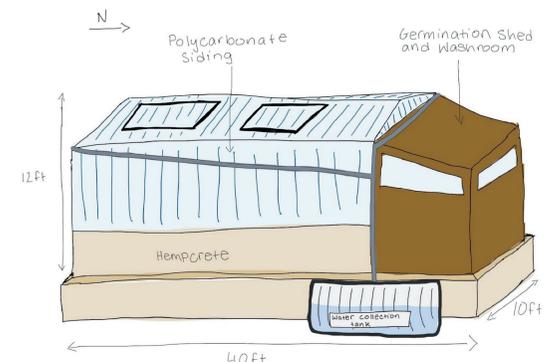


Figure 2: Potential polycarbonate hempcrete greenhouse design

This greenhouse has a partial body of **polycarbonate panels** and a base and partial body of **hempcrete**, a biocomposite material that is a mixture of hemp hurds and lime, sand, or pozzolans. A staff bathroom is included and **rain collection infrastructure** is proposed.

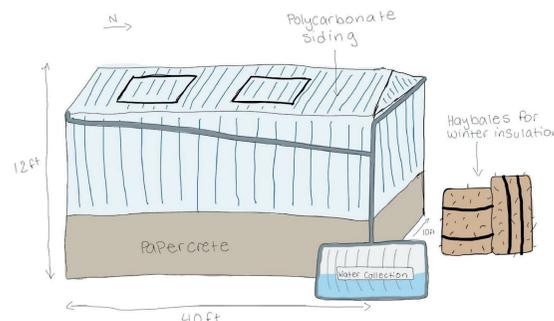


Figure 3: Potential timber papercrete greenhouse design

**Papercrete**, a mixture of recycled paper and cement, forms the base and structure of this greenhouse. **Polycarbonate panels** form the body and **sustainable timber** is used for framing and flooring, with **straw bales** as insulation.