# 2016 Deep Winter Greenhouse Research Convening

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## OVERVIEW


On November 4, 2016, the University of Minnesota Extension Regional Sustainable Development Partnerships (RSDP) hosted a convening of Deep Winter Greenhouse (DWG) practitioners to review previous and ongoing research and to host discussions to identify future research needs. A total of 36 people participated in the convening and represented the following: 6 current DWG producers, 6 prospective DWG producers (expected to begin within 2 years), 1 student researcher, 10 UMN faculty and staff (representing horticulture, soil science, horticulture, renewable energy, organic agriculture, applied economics, sustainable building science, and food safety), 1 finance professional, 9 RSDP staff, and 3 RSDP board members. Participants represented each of the five RSDP regions in Minnesota.

The convening was broken into two sections: presentations and discussion. Presentation topics included a review of passive solar greenhouse design specifications, overviews of different passive solar greenhouse systems, nitrate buildup in soil and plant tissue, year-round production potential in Minnesota, business analysis, and future research opportunities. Following presentations, participants broke into small groups to discuss future research needs and opportunities.

Presentations from the 2016 Deep Winter Greenhouse Convening can be viewed at the following URL: **http://tinyurl.com/j969yed**

RSDP staff collected notes from small group discussions to help identify future research needs. These summarized notes will assist researchers in identifying future projects and research questions for future DWG project proposals.

## POTENTIAL FUTURE PROJECTS AND RESEARCH TOPICS

### Crop production

- Common mineral deficiencies
- Water source impacts on minerals and nutrients
- Protocols, how-to manuals and problem solving flow charts for producers
- Temperature requirements for cold-tolerant plants and spacing of plants in greenhouse to respond to temperature needs

- Best performing cold tolerant plants and varieties
- New crop possibilities (perennials, tomatoes, Mediterranean crops)
- Solutions for common pests
- Feasibility for animal feeds/ grain sprouting.
- Offseason uses (e.g. summer food dehydration)
- Day/night timing responses of different plant varieties
- Lighting (LED, 'Cree' bulbs, other)

## DWG building and operation

- Automation, venting, temperature control, humidity control, irrigation
- Appropriate technology solutions needed for small producers
- Sub-metering and monitoring to track building performance and thermal mass
- Thermal mass effectiveness and materials comparison (water, sand, gravel)
- Use of shade cloth as insulation to retain heat at night and shade in summer
- Model air tight circulation systems
- Find balance between heat and ventilation
- Minimizing mold growth
- Ensure barriers between treated wood and soil

## Food safety

- Best practices for managing nitrate in soil to prevent accumulation in plant tissue
- Basic nutrient management
- Incorporating post-harvest handling into design and flow
- Food safety standards and protocols
- Drip irrigation
- Water and food safety: rainwater, cisterns, reuse of water

## Business and finance:

- Longitudinal cost model: operational return on investment
- Impact on other activities (debt, mortgage, collateral, risk
- Profit margin on greens or different products (related to proximity to metro area)
- Balance of technology adoption and scale for greatest return (lights, heat, co2)
- Function and role of DWG into a whole-farm system
- Value-added options (solar panel het, root cellar, etc.)
- How to identify product pricing

## Environmental impact:

- Fossil fuel reductions from production and/or reductions in transportation

## Other:

- Information exchange platforms
- Farm Hack type tool for DWG producers to catalog individual experiences
- Seek funding for product development
- Develop a DWG Beginners Toolkit
- Merchandizing: Pricing and packaging