Terra-Fresh

The use of mini-containers in fresh food supply chains: the small grower perspective

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Pat Phelan, J. Rene Villalobos
International Logistics and Productivity Improvement Laboratory
Arizona State University

http://ilpil.asu.edu, www.terra-fresh.com

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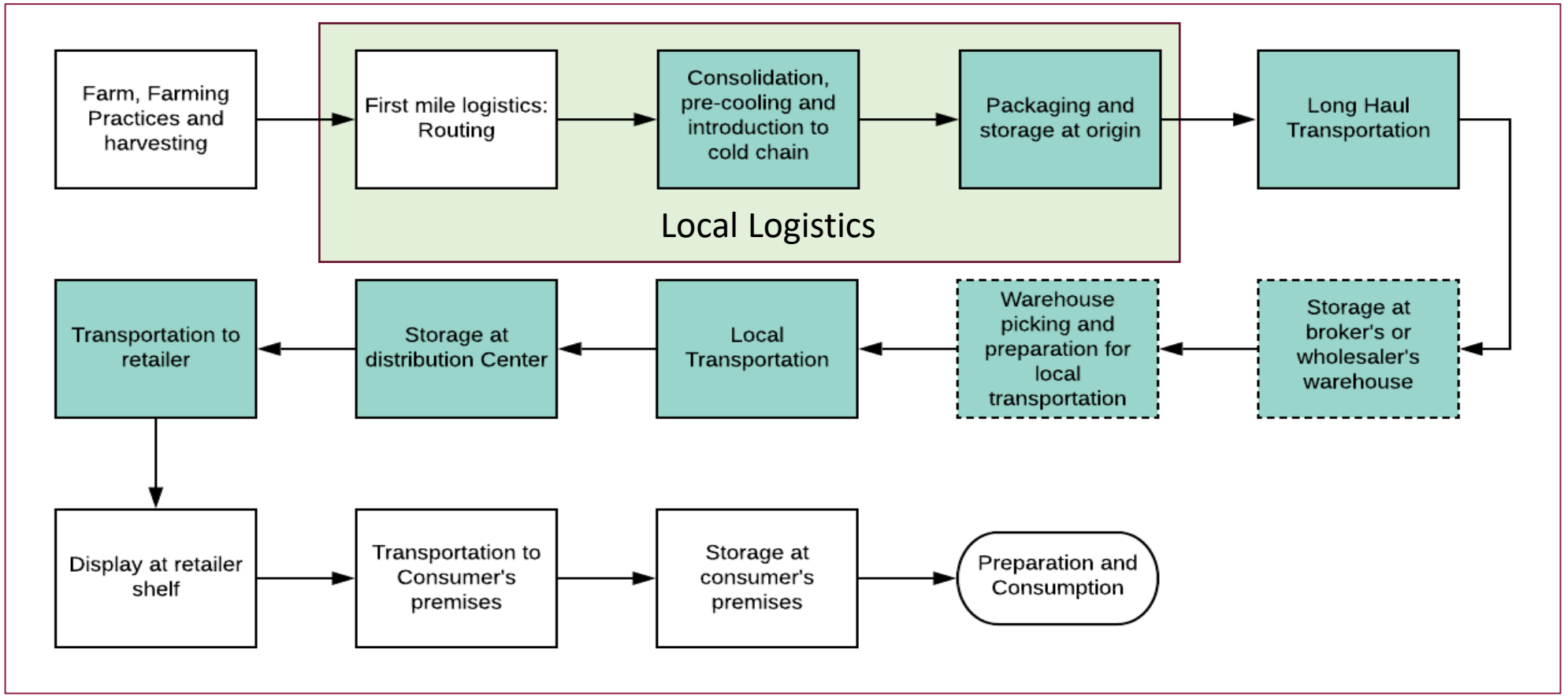
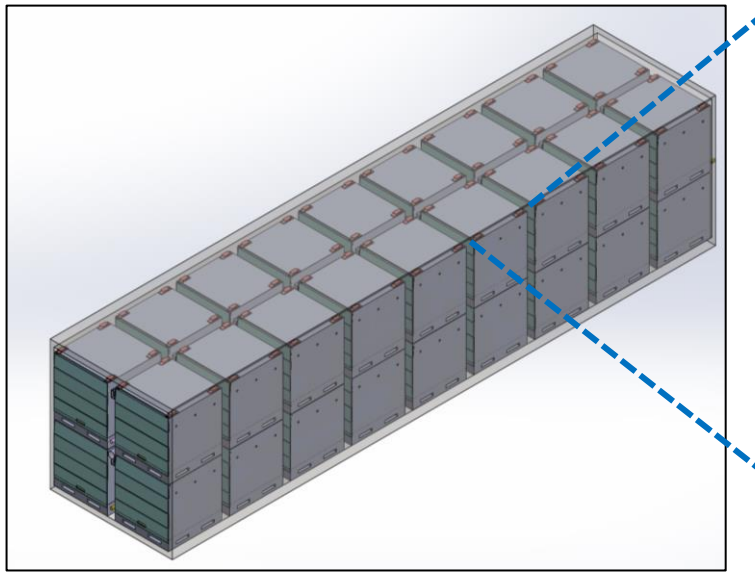
Schematic of Current Fresh Produce Supply Chain

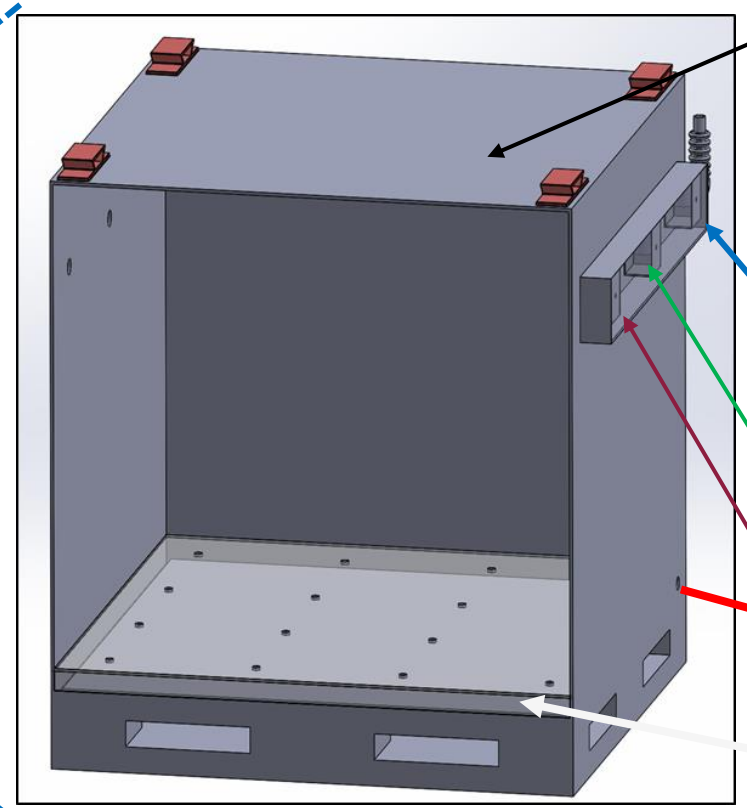


Current Situation of Local Logistics: Small Grower, first mile Perspective

- Lack of logistics capacity and service providers with focus on small growers
- Lack of open-access facilities for processing, packing, pre-cooling, and cold storage
- Lack of critical mass for an individual grower to access efficient logistics (full truck loads, processing, etc.)
- Aggregation of products from different growers in a vehicle made difficult because of regulation and incompatibility of products
- Lack of marketing, planning and negotiating platforms to make an efficient demand-supply match
- **Not ready for the new market conditions**

Out-of-the-Box Solution: A Box, the Mini-Container





Sensor/Traceability module Inside
- Temperature
- RH
- CO_2
- Ethylene
- Vibration
- Transmission/recording/monitoring in real time of location and environmental conditions
- Unique ID for traceability purposes

Motorized Control Valves

Cold Air Supply

Humidity/Dehumidify Supply

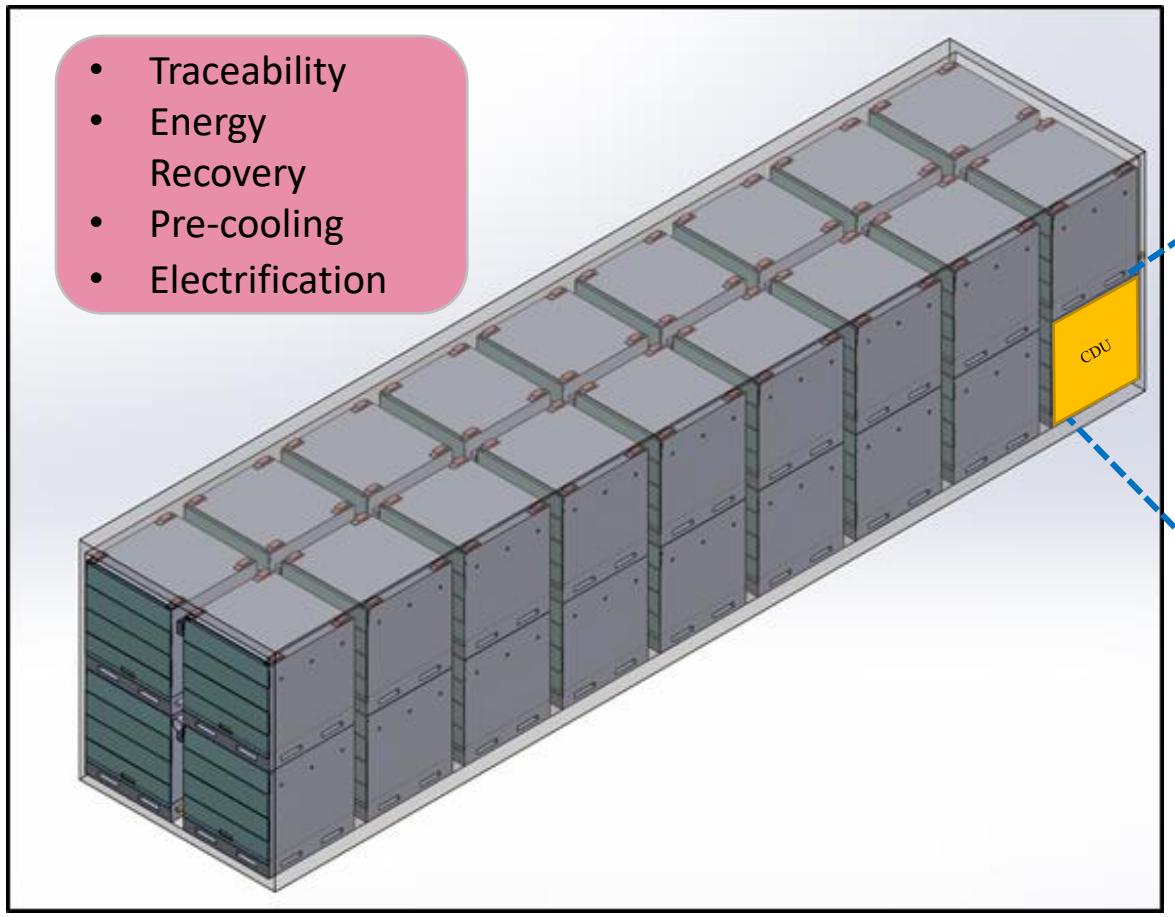
N_2 Supply

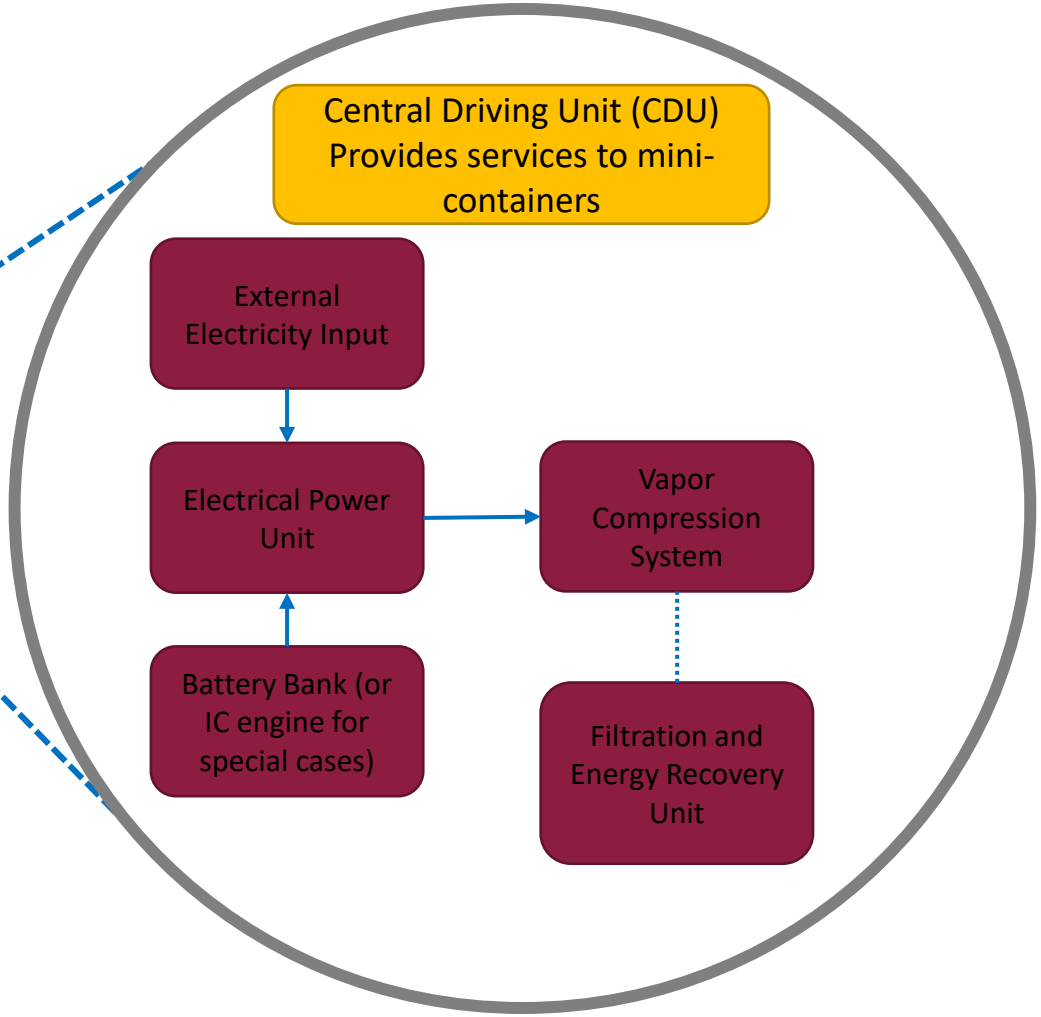
Return Air

Water/Debris Collection Area

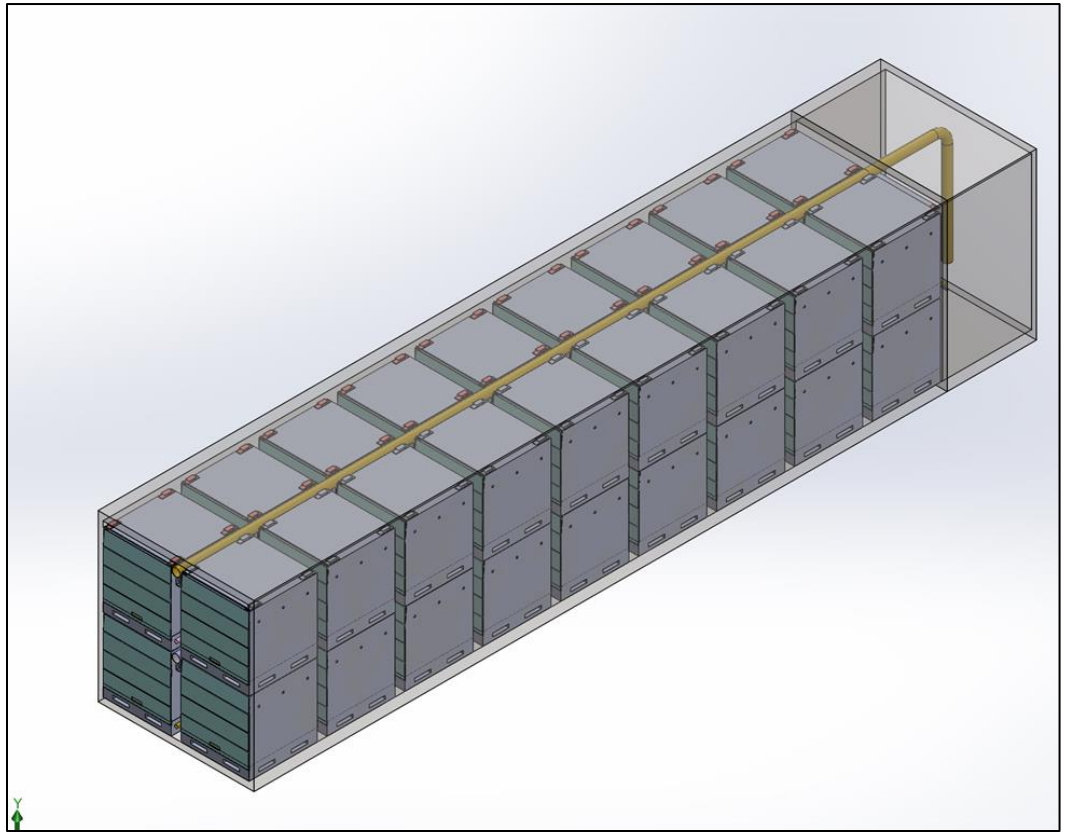
U.S. Provisional Patent Application No. 63/039,279, filed June 15, 2020, entitled “Systems, Methods, and Apparatuses for Implementing Aggregable, Environment-controlled Mini-Containers for the Efficient Logistics of Perishable Products.”

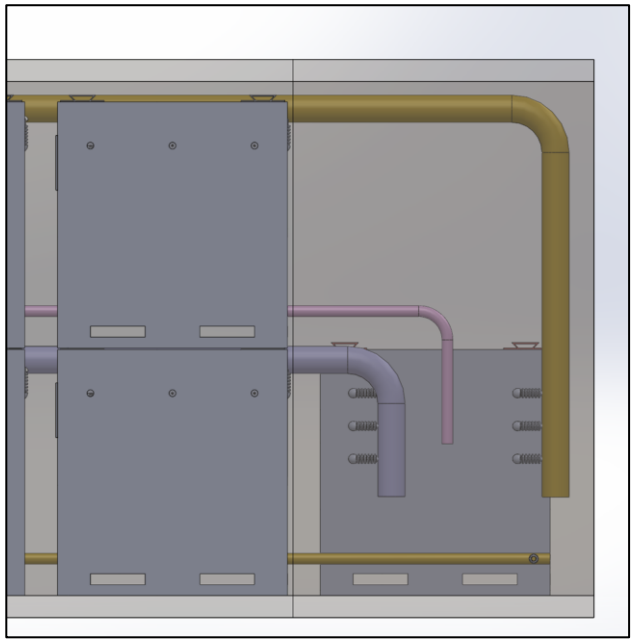
Conceptual Design – Central Driving Unit (CDU)

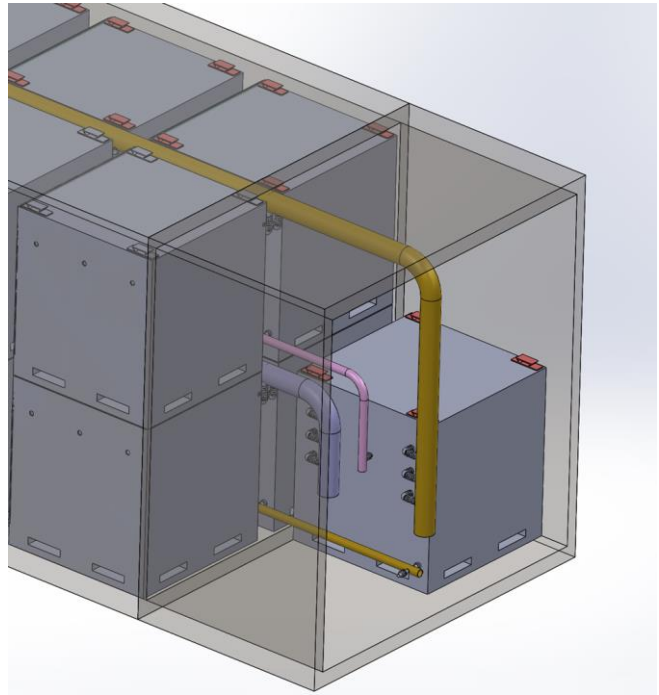




Conceptual Design: Supply/Return Piping



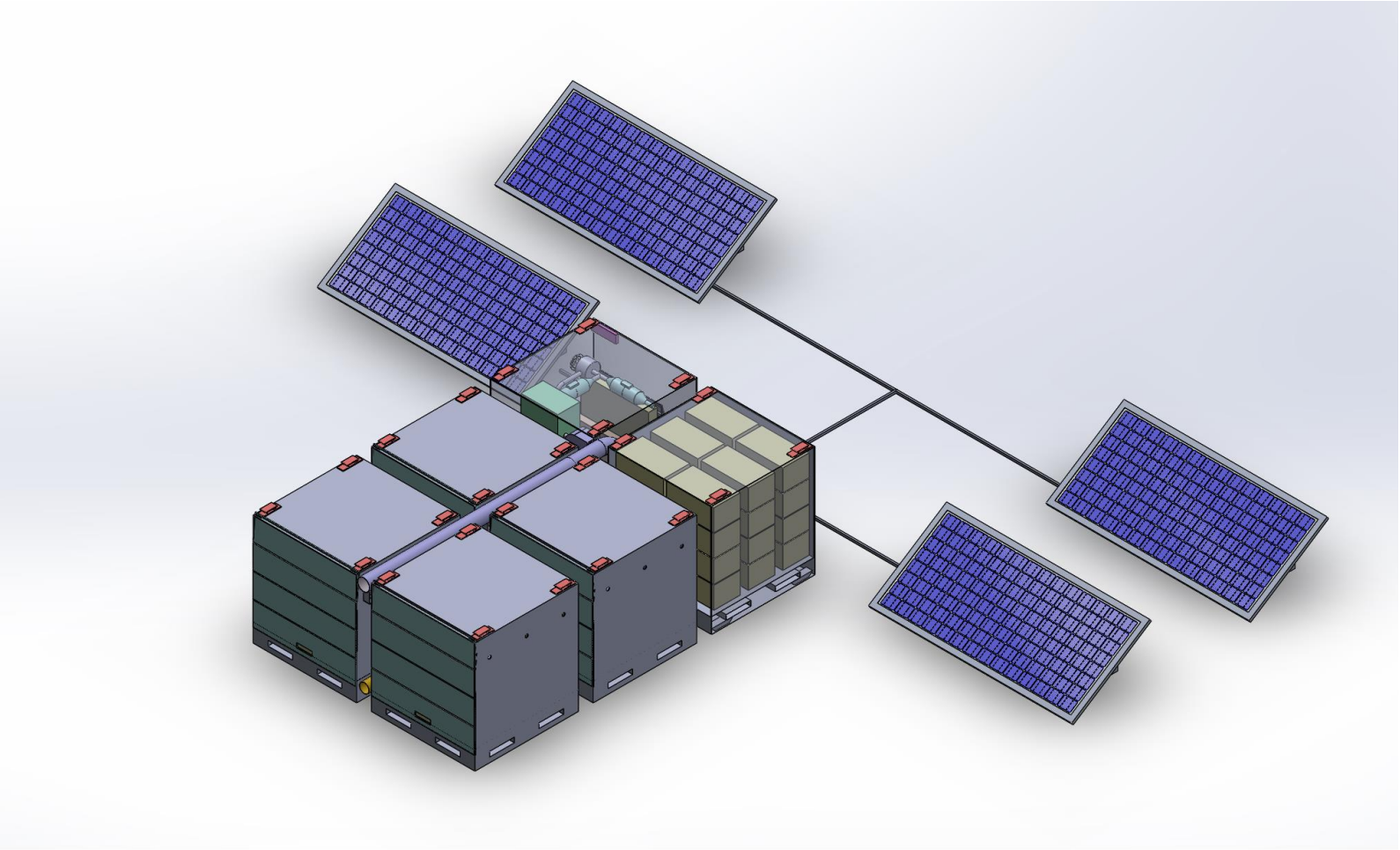




Cold-Chain and Mini-Containers

- We can identify three different types of activities in the cold chain of FFV: precooling, storage and transportation.
- Mini-containers have the potential to integrate these activities seamlessly without the need of additional handling
- The mini-containers can potentially connect the grower directly to the final customer without being unlocked, preserving the life-shelf of the product, reducing food waste to a minimum, providing full traceability and reducing energy footprint

Solar Electrification Potential for Pre-Cooling and Storage

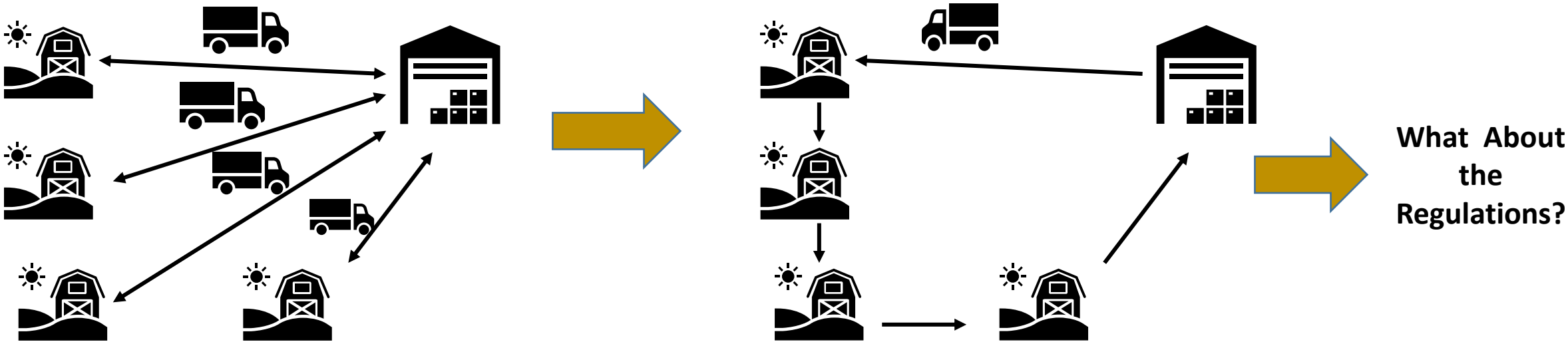


MCs + CDU (CDU = Central Driving Unit) can be stored at the farm, and solar PV can be used to provide electric power to maintain the required environmental conditions

Note: The hybrid design of the MC allows for Solar PV to be supplemented with grid electricity and fuel-driven generators as needed.

First Mile Logistics Problems

- **Harvest sizes too small to fill a full truck**
- **Very often regulations mandate that harvests from different growers cannot be consolidated in the same freight vehicle**
- **Lack of logistics agents with focus on harvest aggregation**



The Mini-Container as a Minimal Marketing Unit

- The mini-container can help standardize the logistics and trading units in the spot and forward markets
- For instance, a mini-container (interior dimensions of 44X44X39.5” or) is equivalent to:

Crop	Package	Weight (lbs)	Length	Width	Height	Package/MC	lbs
Tomatoes	box	30	18.5	11.81	9.44	24	720
Lettuce, Romaine	cartons	30	22	14	11	18	540
Beans	bushel cartons/crates	21	15.43	11.81	10.7	24	504
Bell Pepper	box	25	14	14	12	27	675
Cauliflower	cartons film wrapped	25	19.9	11.81	10.7	24	600
Celery	cartons	31	19	19	9	16	500
Chayote	40 lb cartons	40	18.11	12.4	12	18	720
Cucumber	box	40	14	14	12	27	1080
Brussel sprouts	cartons	3	10	10	4.8	128	384
Spinach	box	20	20	13	7.8	30	600

Current Version of Prototype

Some of the Benefits of the Mini-Containers

- Allow the aggregation of storage/transportation-incompatible small harvests into a single truck, reducing costs and the food waste generated by waiting for transportation
- Allow the virtual creation of cold storage facilities in places with limited access to these facilities, a major source of food waste
- Allow the immediate introduction to the cold chain of harvests by having a CDU at the farmer's premises to do the precooling of crops
- **Allow the reduction of carbon footprint of food by reducing waste, operating with batteries and by enabling better vehicle routing, a major source of energy waste and carbon emissions**
- Enable direct small farm-to-market transaction, skipping intermediaries and inefficient extra handling of the crops
- Allow precise temperature and environmental control as well as full traceability and real-time tracking, characteristics appealing to industries such as pharmaceuticals
- Ideal for the upcoming automated and autonomous logistics systems

Sponsors Mini-Container Project

Faculty/Students

Faculty:

- J. Rene Villalobos
- Pat Phelan

Students:

- Keshawa Bandara
- Levi Siwek
- Derall Riley
- Mahmmoud Syam
- Sergio Garcia

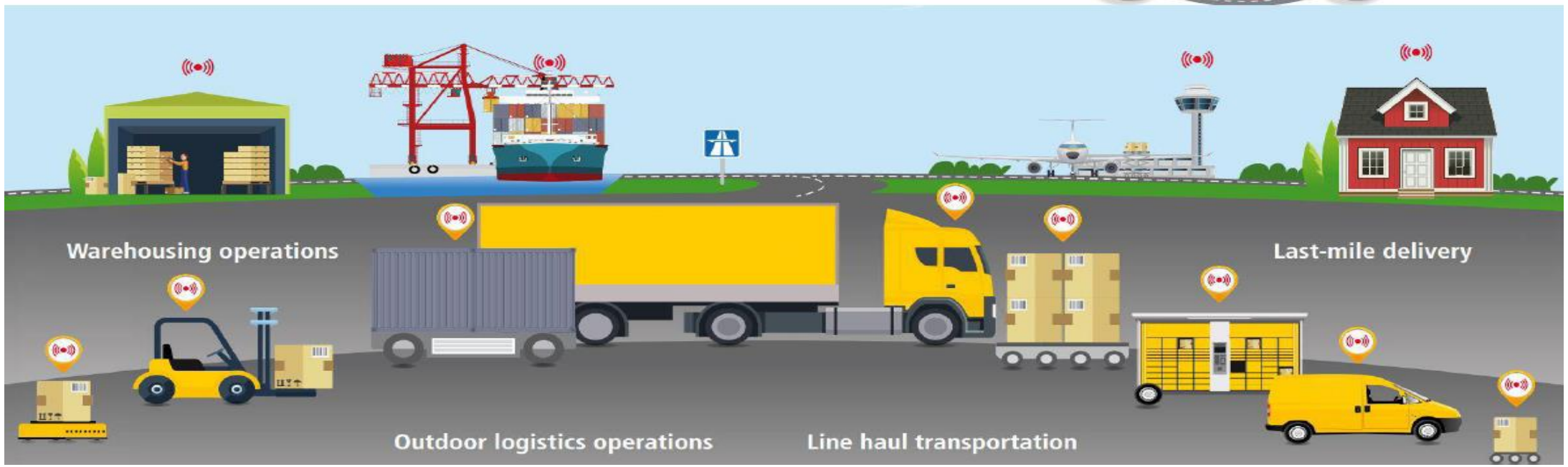
Thank you.

International Logistics and Productivity Improvement Laboratory (http://ilpil.asu.edu/)
School of Computing, Informatics and Decision Systems Engineering

ARIZONA STATE UNIVERSITY

Autonomous Vehicles on Logistics

- Optimizes supply chains and logistics operations of the future, as players employ automation to increase efficiency and flexibility.
- In combination with smart technologies could reduce labour costs while boosting equipment and facility productivity.
- A fully automated and lean supply chain can help reduce load sizes and stocks by leveraging smart distribution technologies and smaller AVs.



Source: Presentation on Autonomous Vehicles by Joshi et al., National University of

Conceptual Design – CDU Details