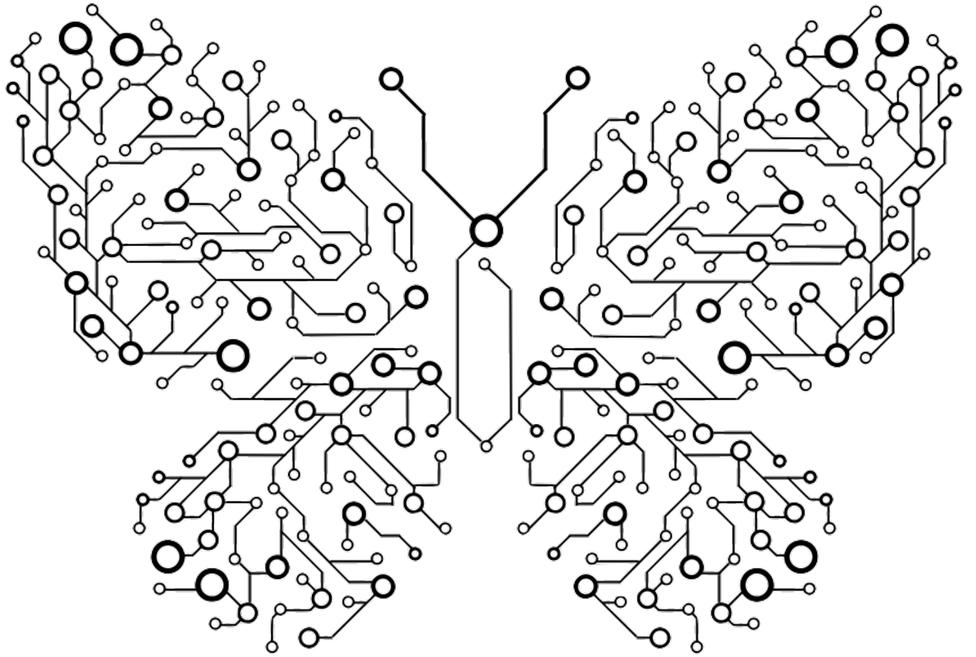
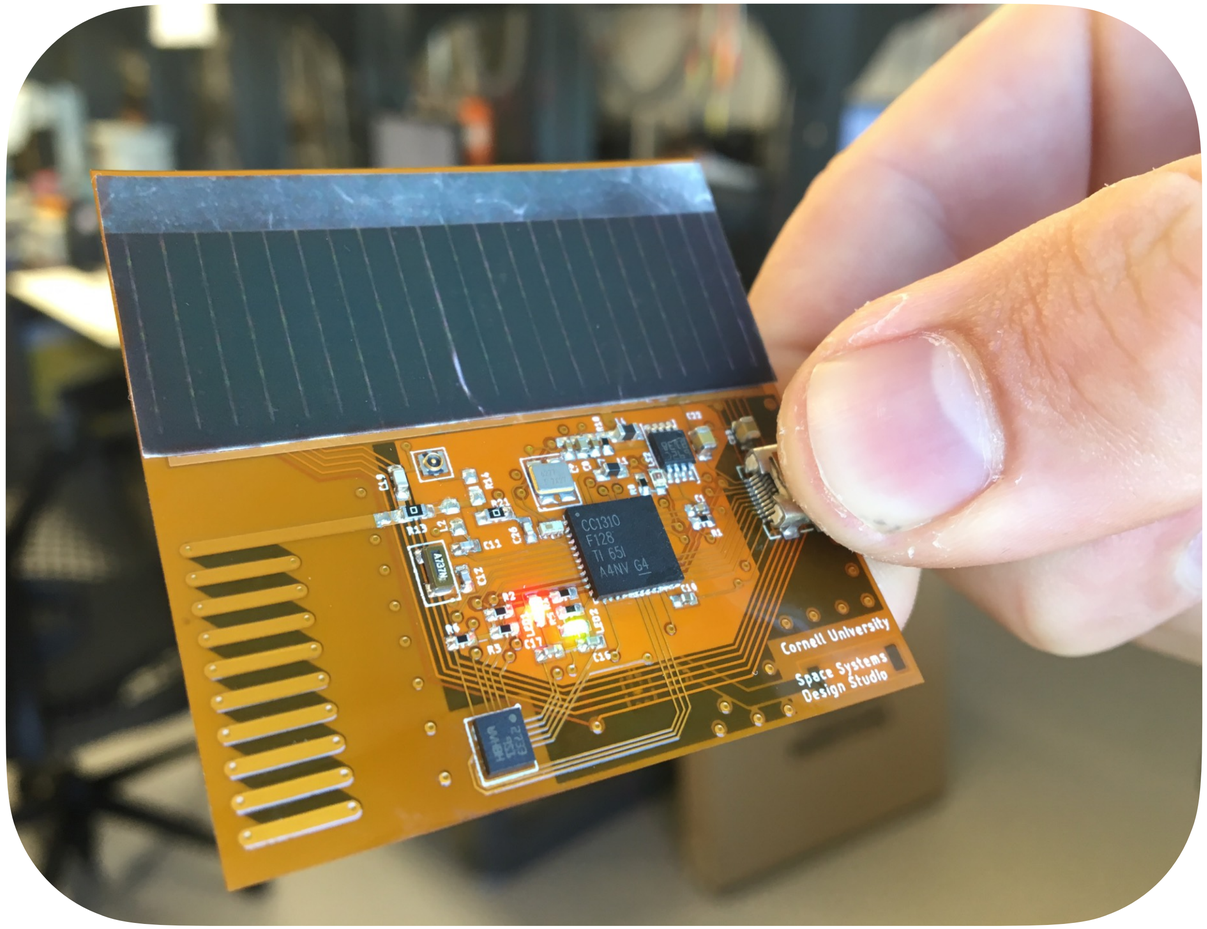


Monarchs

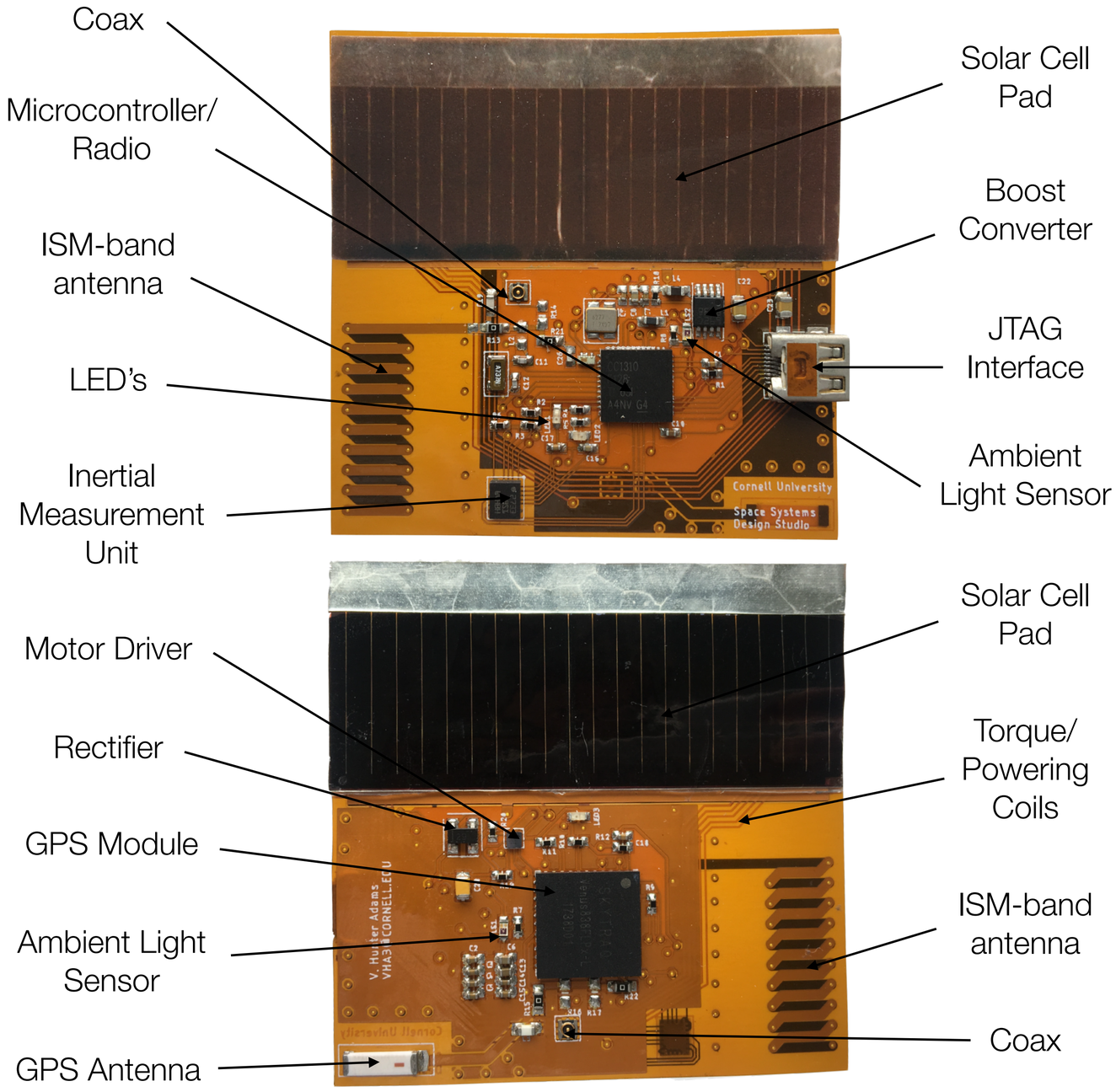
V. Hunter Adams, PhD

Monarch


CC1310
F128
TI 65I
A4NV G4
Cornell University
Space Systems
Design Studio

Monarchs use sensors to make local environmental measurements, then radio those measurements to other Monarchs and to receiver stations.

Demonstration video.



Monarchs gather data that enable cool-climate vineyard managers to take preventative action against grape loss to frost, fungus, and disease.

1. Describe the larger vision that I'm working to achieve.
2. Explain the agricultural market as a standalone opportunity.
3. Explain how this particular opportunity moves me in the direction of my larger vision.

1. **Describe the larger vision that I’m working to achieve.**
2. Explain the agricultural market as a standalone opportunity.
3. Explain how this particular opportunity moves me in the direction of my larger vision.

I am covering Earth with sensors and creating an interface for viewing and filtering data from those sensors in realtime for

- market prediction.
- scientific research.
- industry-specific utilization.

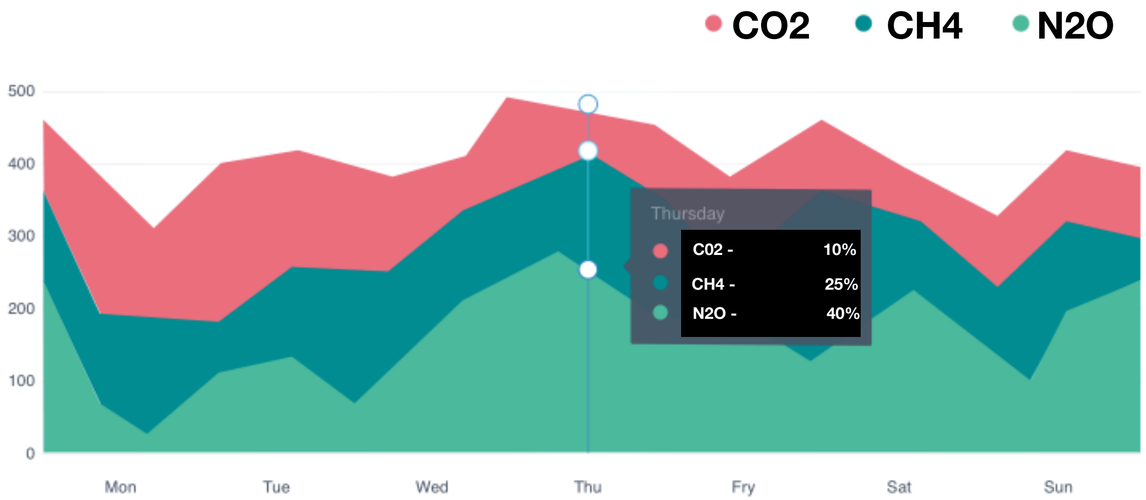

(−80.653°, 28.1152°)
Orange orchard
Last Updated: 1m ago


(−102.7891°, 46.8907°)
North Dakota Pipeline
Last Updated: 1m ago

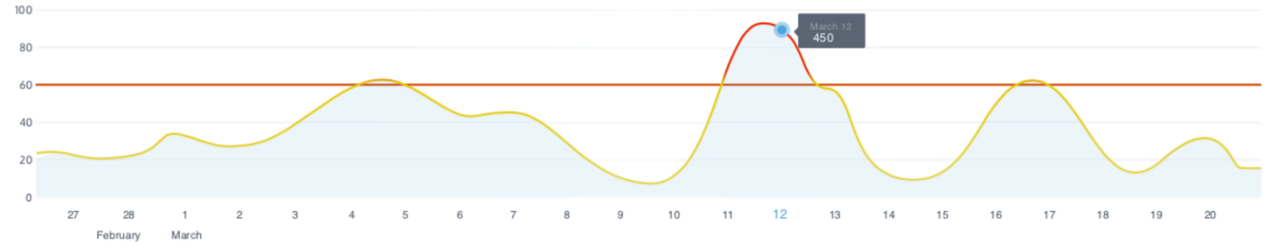

(72.9967°, 0.5303°)
Buoy, Indian Ocean
Last Updated: 1m ago


(−139°, 61.3504°)
Elk, 40-mile Herd
Last Updated: 1m ago

Chemical Effluence



Magnitude of Chemical Effluence

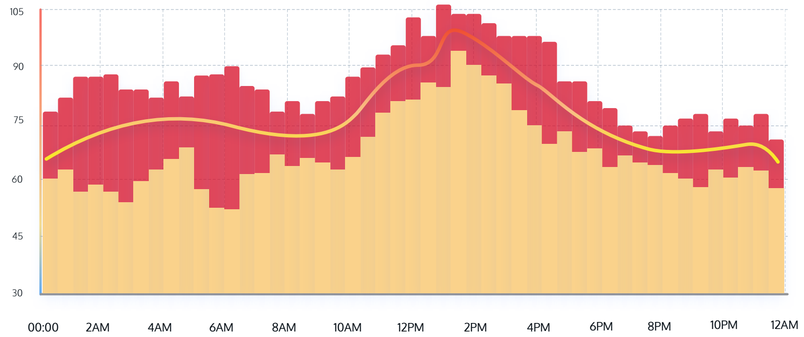


Static Filter:

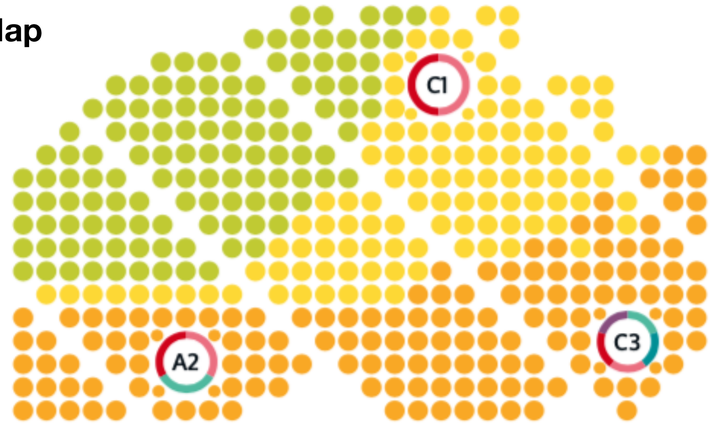
- **Infrastructure**
  - **Ithaca Walmart Parking**
  - Bridges
  - Subways
  - More
- Aircraft
- Transportation
- National parks
- Agriculture
- Wildlife
- More

Data:

Average Occupancy



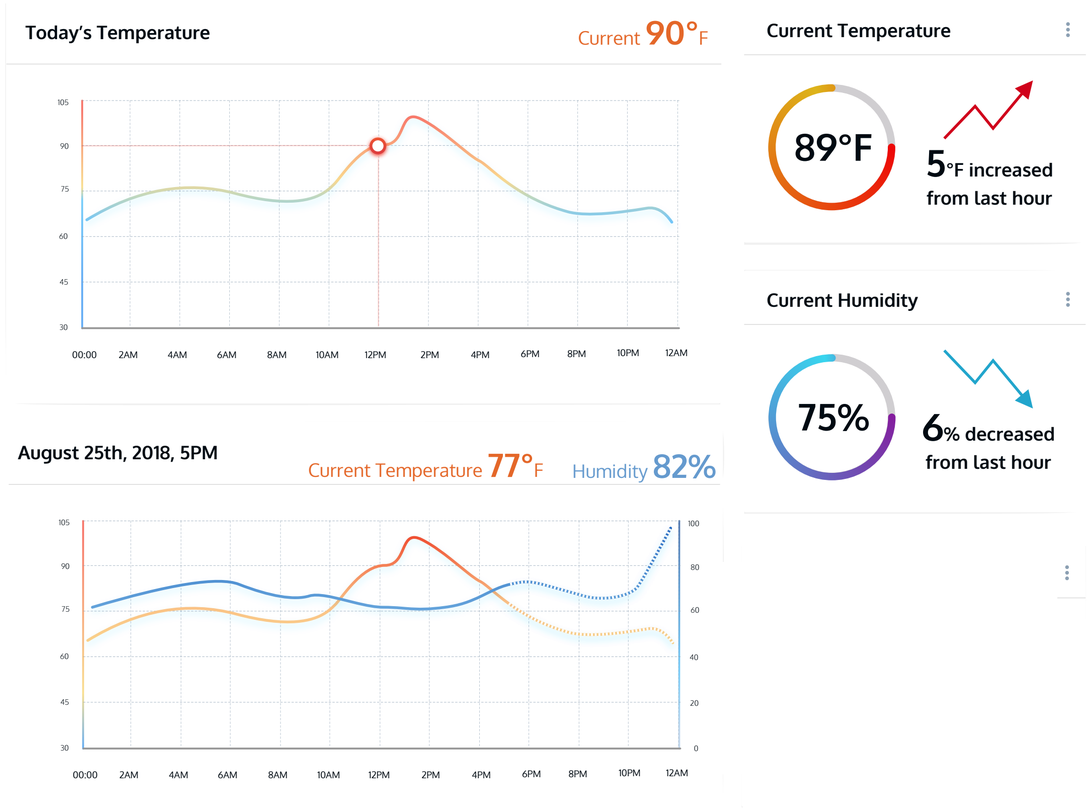
Map



Tracking Filter:

- **Aircraft**
  - United
  - **American**
  - Delta
  - Turkish Air
  - More
- Infrastructure
- Transportation
- National parks
- Agriculture
- Wildlife
- More

In-Transit Data



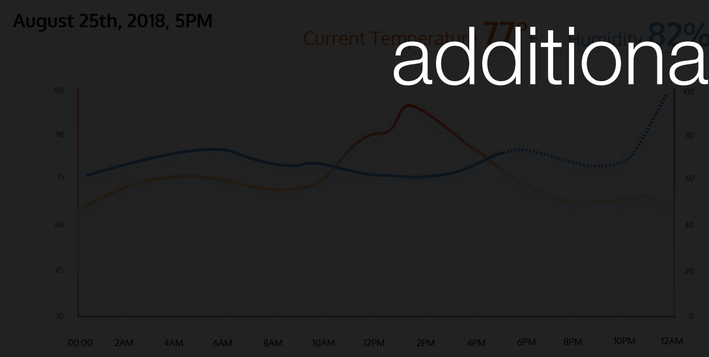
Tracking Filter:

- **Aircraft**
  - United
  - **American**
  - Delta
  - Turkish Air
  - More
- Infrastructure
- Transportation
- National parks
- Agriculture
- Wildlife
- More

The challenges:

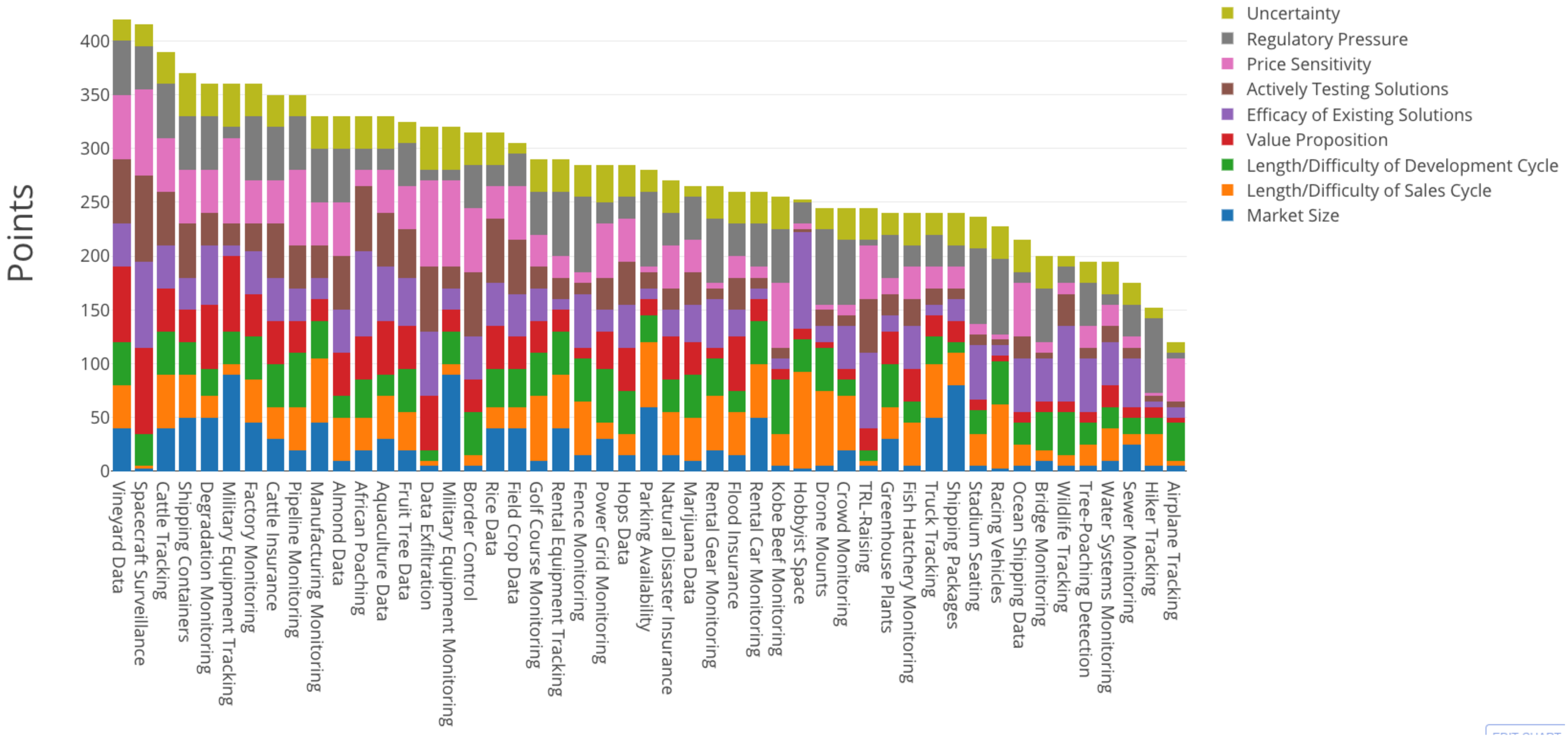
- Identify a market that is promising in its own right, and that moves me in the direction of this vision.
- Identify a business model for which value is added for all customers with the deployment of each additional sensor.

In-Transit Data



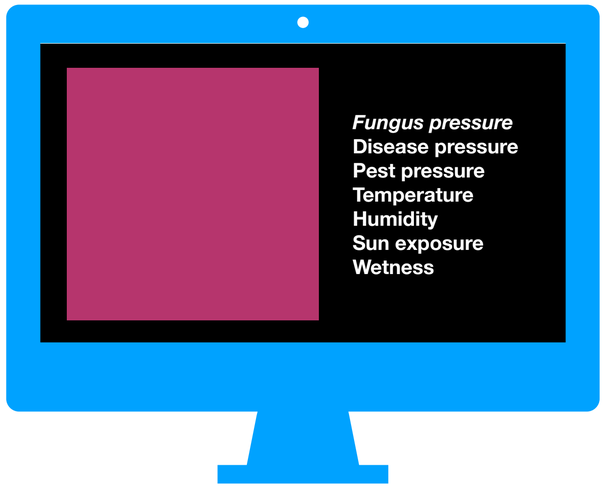
1. Describe the larger vision that I'm working to achieve.
2. **Explain the agricultural market as a standalone opportunity.**
3. Explain how this particular opportunity moves me in the direction of my larger vision.

Markets Considered

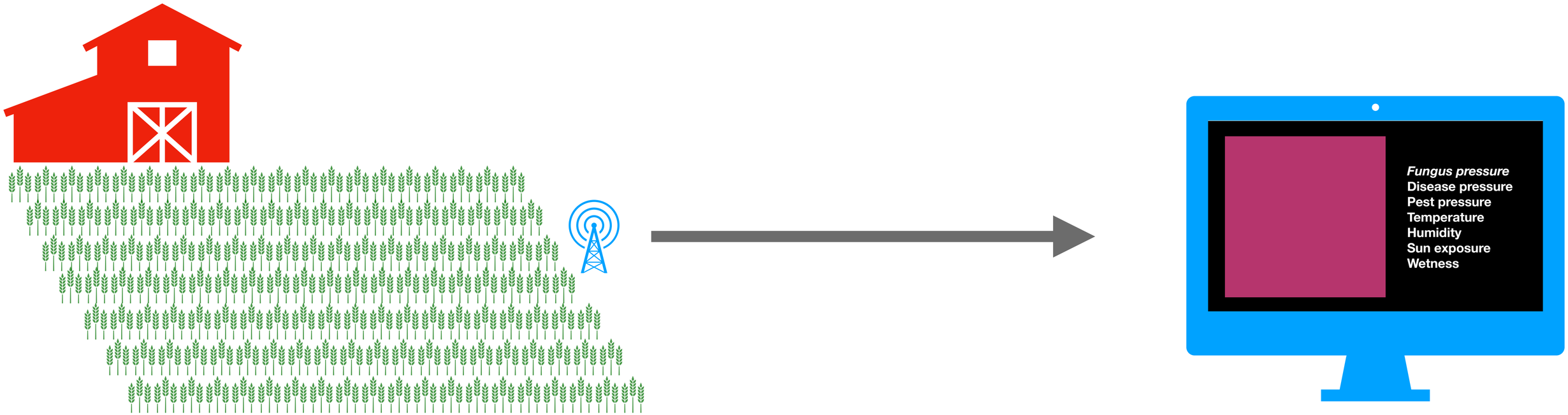


Cool-climate vineyards

The Problem

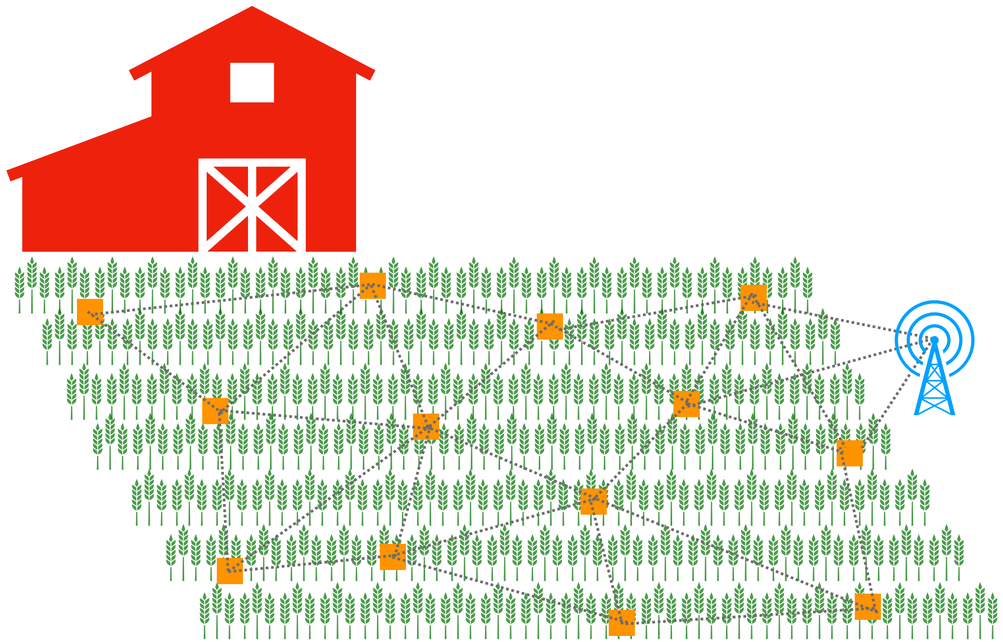

Fungus pressure
Disease pressure
Pest pressure
Temperature
Humidity
Sun exposure
Wetness

The Problem



Because vineyard managers to not know how conditions vary across their land, they must apply chemical sprays as often as is legal, rather than as often as is necessary. This is expensive, both in labor and materials.

The Solution



Distributed environmental measurements from within leaf canopies across the vineyard measure microclimates, enabling managers to only perform chemical sprays when and where they are necessary.

New York State Integrated Pest Management Program

NEWA Network for Environment and Weather Applications

Website status:
No issues reported
11/9/2018 12:44:09 PM

Weather Data | Pest Forecasts | Station Pages | Crop Management | Crop Pages | Weather Stations | Help

Weather Data Quick Links

Past 12 months shown. Current month highlighted.

Daily Summary
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Hourly Data
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Growing Degree Days (Base 50F)
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Growing Degree Days (Base 50F BE)
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Growing Degree Days (Base 86/50F)
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

National Weather Service Forecast

Enter "City, ST" or "zip code"
City,ST Go

This Station's 7-Day Forecast

National Doppler Radar Sites

Helpful Links

How to Use and Interpret Pest Forecasts
Select a link from list...

Pest Management Guidelines
Select a link from list...

University Cooperative Extension Programs
Select a link from list...

About NEWA

About NEWA
Contact Us
NEWA Press Releases & Reports
Vision Statement
Your NEWA Blog

Interlaken (Airy Acres), NY Weather Station Page

These Station Page forecasts are most accurate when you use your own biofix dates. Otherwise, the current results displayed will use NEWA's default biofix dates. **Enter your biofix dates on the forecast page, where prompted, for more accurate model predictions.** After getting the Station Page forecast results, use the interface on the left to get query results for prior years, dates, and locations.

Interlaken (Airy Acres) Pest Forecasts

Apple Scab
Fire Blight
Sooty Blotch/Flyspeck
Leaf Wetness Events
Spotted Tentiform Leafminer
Oriental Fruit Moth
Codling Moth
Plum Curculio
Obliquebanded Leafroller
Apple Maggot
San Jose Scale
Grape Diseases
Grapevine Downy Mildew
Grape Berry Moth
Cabbage Maggot
Onion Maggot
Onion Diseases
Potato Diseases
Tomato Diseases

Station Location

Lat/Lon: 42.64/-76.73
Elevation: 242 ft.

Last Download

11/9/2018 12 PM

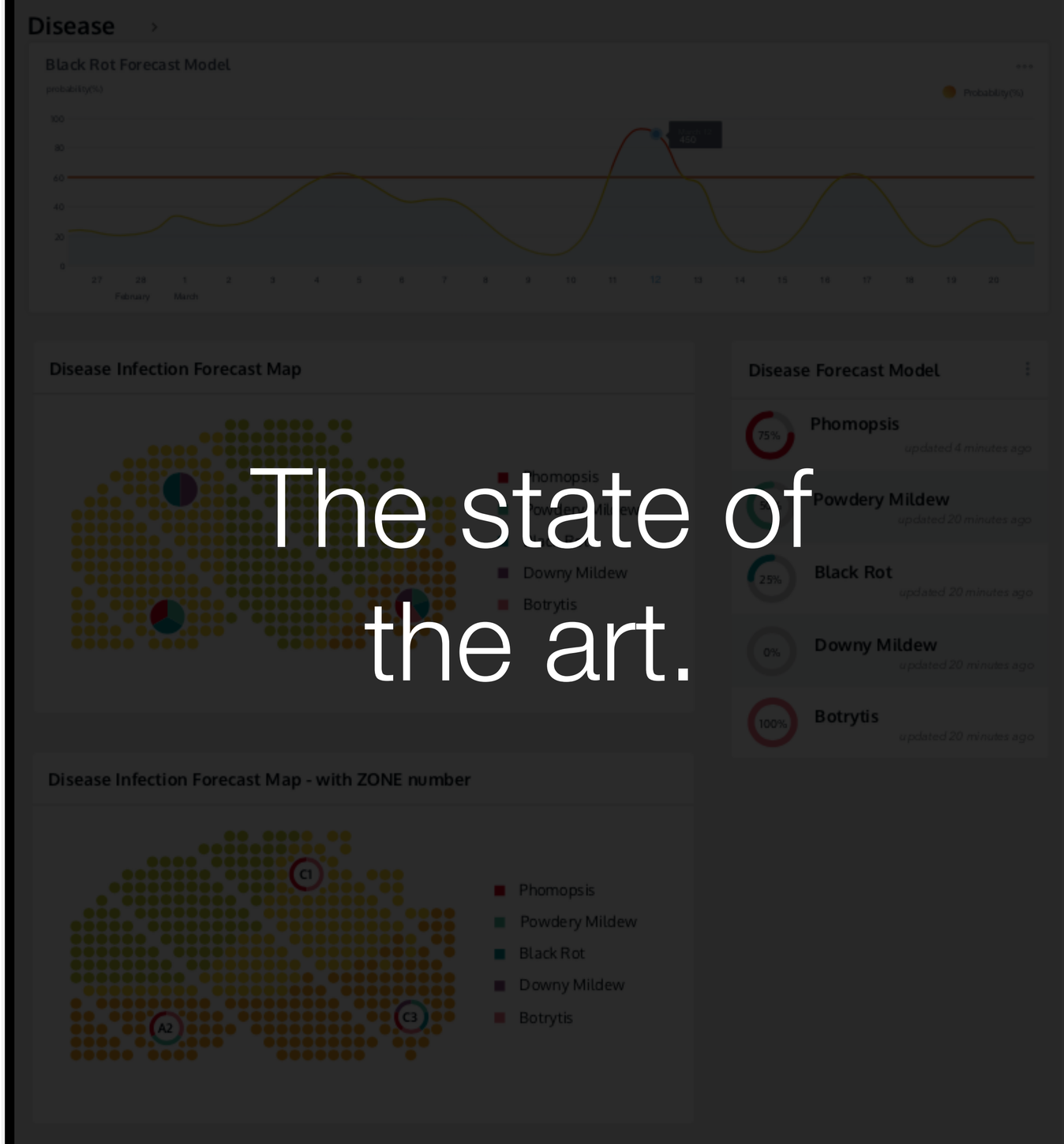
Station Sensors

Temperature
Leaf Wetness
Precipitation
Relative Humidity
Wind Speed
Wind Direction
Solar Radiation

Statewide and Regional Pest Forecasts

Sweet Corn Stewart's Wilt Forecast
Sweet Corn Stewart's Wilt Map
Soybean Rust
Potato/Tomato Late Blight DSS
Cucurbit Downy Mildew
Turfgrass Diseases

Disclaimer: ***These are theoretical predictions and forecasts.*** *The theoretical models predicting pest development or disease risk use the weather data collected (or forecasted) from the weather station location. These results should not be substituted for actual observations of plant growth stage, pest presence, and disease occurrence determined through scouting or insect pheromone traps.*



The state of the art.

New York State Integrated Pest Management Program

NEWA Network for Environment and Weather Applications

Website status:
No issues reported
11/9/2018 12:44:09 PM

Weather Data | Pest Forecasts | Station Pages | Crop Management | Crop Pages | Weather Stations | Help

Weather Data Quick Links

Past 12 months shown. Current month highlighted.

Daily Summary
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Hourly Data
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Growing Degree Days (Base 50F)
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Growing Degree Days (Base 50F BE)
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Growing Degree Days (Base 86/50F)
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

National Weather Service Forecast

Enter "City, ST" or "zip code"
City,ST Go

This Station's 7-Day Forecast

National Doppler Radar Sites

Helpful Links

How to Use and Interpret Pest Forecasts
Select a link from list...

Pest Management Guidelines
Select a link from list...

University Cooperative Extension Programs
Select a link from list...

About NEWA

About NEWA
Contact Us
NEWA Press Releases & Reports
Vision Statement
Your NEWA Blog

Interlaken (Airy Acres), NY Weather Station Page

These Station Page forecasts are most accurate when you use your own biofix dates. Otherwise, the current results displayed will use NEWA's default biofix dates. **Enter your biofix dates on the forecast page, where prompted, for more accurate model predictions.** After getting the Station Page forecast results, use the interface on the left to get query results for prior years, dates, and locations.

Interlaken (Airy Acres) Pest Forecasts

Apple Scab
Fire Blight
Sooty Blotch/Flyspeck
Leaf Wetness Events
Plum Curculio
Obliquebanded Leafroller
Apple Maggot
San Jose Scale
Grape Berry Moth
Cabbage Maggot
Onion Maggot
Onion Diseases
Potato Diseases
Tomato Diseases

Station Location

Lat/Lon 42.4/-76.73
Elevation 2

Satellite

Google Map Data Terms of Use

Last Download

11/9/2018 12 PM

Station Sensors

Temperature
Leaf Wetness
Precipitation
Relative Humidity
Wind Speed
Wind Direction
Solar Radiation

Statewide and Regional Pest Forecasts

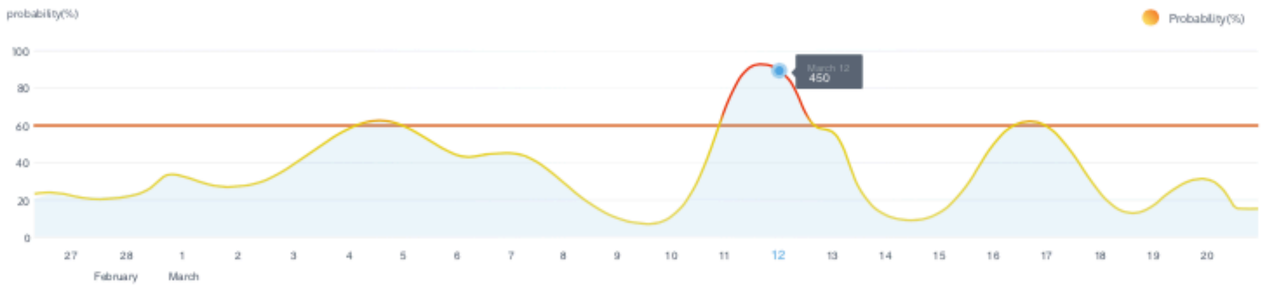
Sweet Corn Stewart's Wilt Forecast
Sweet Corn Stewart's Wilt Map
Soybean Rust
Potato/Tomato Late Blight DSS
Cucurbit Downy Mildew
Turfgrass Diseases

Disclaimer: ***These are theoretical predictions and forecasts.*** *The theoretical models predicting pest development or disease risk use the weather data collected (or forecasted) from the weather station location. These results should not be substituted for actual observations of plant growth stage, pest presence, and disease occurrence determined through scouting or insect pheromone traps.*

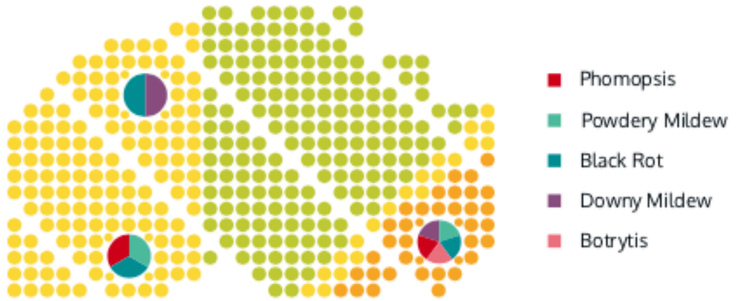
What I'm building.

Disease ›

Black Rot Forecast Model



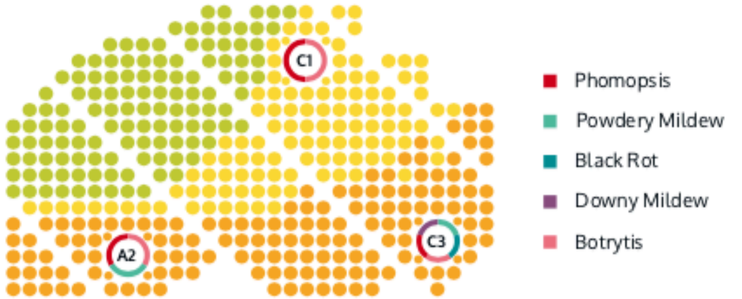
Disease Infection Forecast Map



Disease Forecast Model

75%	Phomopsis	updated 4 minutes ago
50%	Powdery Mildew	updated 20 minutes ago
25%	Black Rot	updated 20 minutes ago
0%	Downy Mildew	updated 20 minutes ago
100%	Botrytis	updated 20 minutes ago

Disease Infection Forecast Map - with ZONE number



New York State Integrated Pest Management Program

NEWA Network for Environment and Weather Applications

Website status:
No issues reported
11/9/2018 12:44:09 PM

Weather Data | Pest Forecasts | Station Pages | Crop Management | Crop Pages | Weather Stations | Help

Weather Data Quick Links

Past 12 months shown. Current month highlighted.

Daily Summary
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Hourly Data
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Growing Degree Days (Base 50F)
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Growing Degree Days (Base 50F BE)
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Growing Degree Days (Base 86/50F)
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

National Weather Service Forecast

Enter "City, ST" or "zip code"
City,ST Go

This Station's 7-Day Forecast

National Doppler Radar Sites

Helpful Links

How to Use and Interpret Pest Forecasts
Select a link from list...

Pest Management Guidelines
Select a link from list...

University Cooperative Extension Programs
Select a link from list...

About NEWA

About NEWA
Contact Us
NEWA Press Releases & Reports
Vision Statement
Your NEWA Blog

Interlaken (Airy Acres), NY Weather Station Page

These Station Page forecasts are most accurate when you use your own biofix dates. Otherwise, the current results displayed will use NEWA's default biofix dates. **Enter your biofix dates on the forecast page, where prompted, for more accurate model predictions.** After getting the Station Page forecast results, use the interface on the left to get query results for prior years, dates, and locations.

Interlaken (Airy Acres) Pest Forecasts

Apple Scab
Fire Blight
Sooty Blotch/Flyspeck
Leaf Wetness Events
Spotted Tentiform Leafminer
Oriental Fruit Moth
Codling Moth
Plum Curculio
Obliquebanded Leafroller
Apple Maggot
San Jose Scale
Grape Diseases
Grapevine Downy Mildew
Grape Berry Moth
Cabbage Maggot
Onion Maggot
Onion Diseases
Potato Diseases
Tomato Diseases

Station Location

Lat/Lon: 42.64/-76.73
Elevation: 242 ft.

Last Download

11/9/2018 12 PM

Station Sensors

Temperature
Leaf Wetness
Precipitation
Relative Humidity
Wind Speed
Wind Direction
Solar Radiation

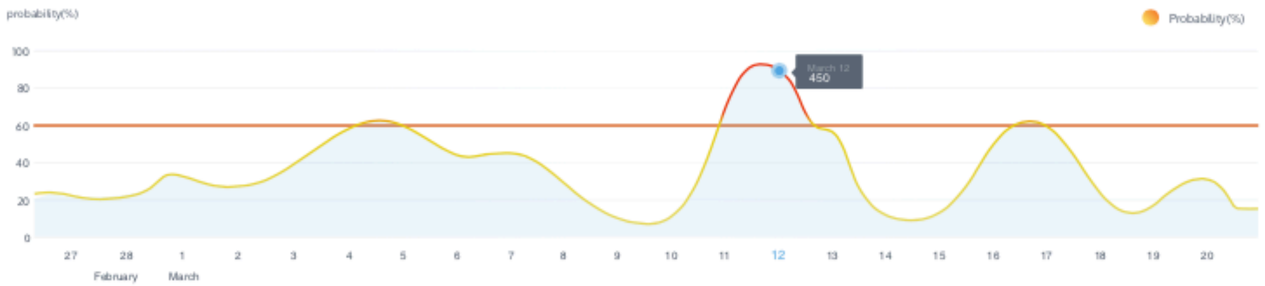
Statewide and Regional Pest Forecasts

Sweet Corn Stewart's Wilt Forecast
Sweet Corn Stewart's Wilt Map
Soybean Rust
Potato/Tomato Late Blight DSS
Cucurbit Downy Mildew
Turfgrass Diseases

Disclaimer: ***These are theoretical predictions and forecasts.*** *The theoretical models predicting pest development or disease risk use the weather data collected (or forecasted) from the weather station location. These results should not be substituted for actual observations of plant growth stage, pest presence, and disease occurrence determined through scouting or insect pheromone traps.*

Disease

Black Rot Forecast Model

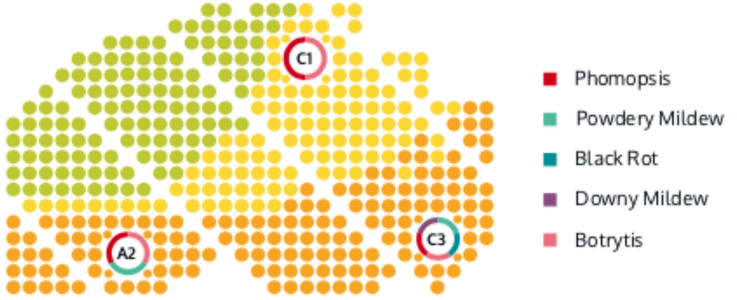


Disease Infection Forecast Map

Disease Forecast Model

75%	Phompsis	updated 4 minutes ago
50%	Powdery Mildew	updated 20 minutes ago
25%	Black Rot	updated 20 minutes ago
0%	Downy Mildew	updated 20 minutes ago
100%	Botrytis	updated 20 minutes ago

Disease Infection Forecast Map - with ZONE number



New York State Integrated Pest Management Program

NEWA Network for Environment and Weather Applications

Website status:
No issues reported
11/9/2018 12:44:09 PM

Weather Data | Pest Forecasts | Station Pages | Crop Management | Crop Pages | Weather Stations | Help

Weather Data Quick Links

Past 12 months shown. Current month highlighted.

Daily Summary
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Hourly Data
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Growing Degree Days (Base 50F)
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Growing Degree Days (Base 50F BE)
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

Growing Degree Days (Base 86/50F)
Dec | Jan | Feb | Mar | Apr | May
Jun | Jul | Aug | Sep | Oct | Nov

National Weather Service Forecast

Enter "City, ST" or "zip code"
City,ST Go

This Station's 7-Day Forecast

National Doppler Radar Sites

Helpful Links

How to Use and Interpret Pest Forecasts
Select a link from list...

Pest Management Guidelines
Select a link from list...

University Cooperative Extension Programs
Select a link from list...

About NEWA

About NEWA
Contact Us
NEWA Press Releases & Reports
Vision Statement
Your NEWA Blog

Interlaken (Airy Acres), NY Weather Station Page

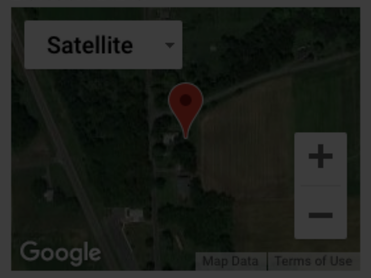
These Station Page forecasts are most accurate when you use your own biofix dates. Otherwise, the current results displayed will use NEWA's default biofix dates. **Enter your biofix dates on the forecast page, where prompted, for more accurate model predictions.** After getting the Station Page forecast results, use the interface on the left to get query results for prior years, dates, and locations.

Interlaken (Airy Acres) Pest Forecasts

Apple Scab
Fire Blight
Sooty Blotch/Flyspeck
Leaf Wetness Events
Spotted Tentiform Leafminer
Oriental Fruit Moth
Codling Moth
Plum Curculio
Obliquebanded Leafroller
Apple Maggot
San Jose Scale
Grape Diseases
Grapevine Downy Mildew
Grape Berry Moth
Cabbage Maggot
Onion Maggot
Onion Diseases
Potato Diseases
Tomato Diseases

Station Location

Lat/Lon: 42.64/-76.73
Elevation: 242 ft.



Last Download

11/9/2018 12 PM

Station Sensors

Temperature
Leaf Wetness
Precipitation
Relative Humidity
Wind Speed
Wind Direction
Solar Radiation

Statewide and Regional Pest Forecasts

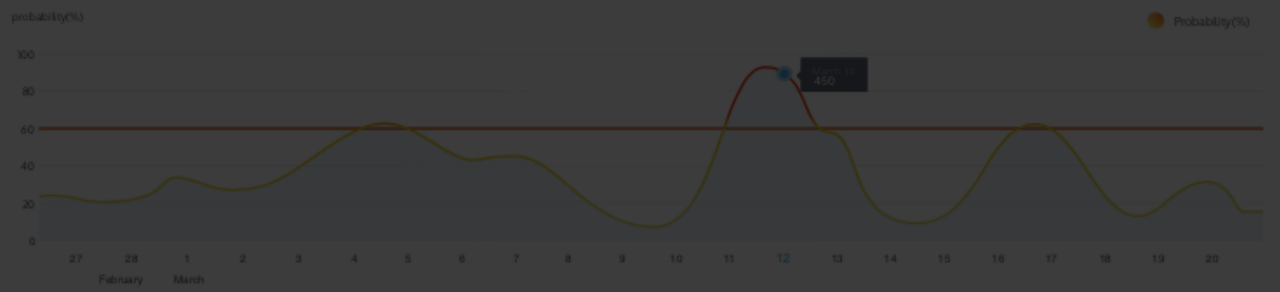
Sweet Corn Stewart's Wilt Forecast
Sweet Corn Stewart's Wilt Map
Soybean Rust
Potato/Tomato Late Blight DSS
Cucurbit Downy Mildew
Turfgrass Diseases

Disclaimer: ***These are theoretical predictions and forecasts.*** *The theoretical models predicting pest development or disease risk use the weather data collected (or forecasted) from the weather station location. These results should not be substituted for actual observations of plant growth stage, pest presence, and disease occurrence determined through scouting or insect pheromone traps.*

How much is this problem worth?

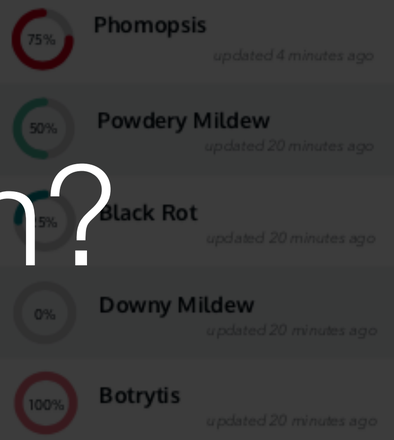
Disease

Black Rot Forecast Model

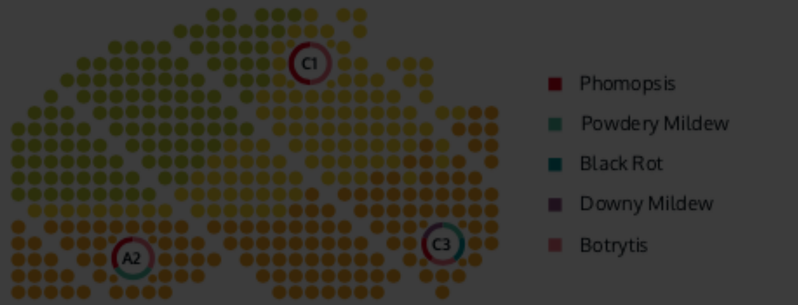


Disease Infection Forecast Map

Disease Forecast Model



Disease Infection Forecast Map - with ZONE number



Size of opportunity

Two types of value creation:

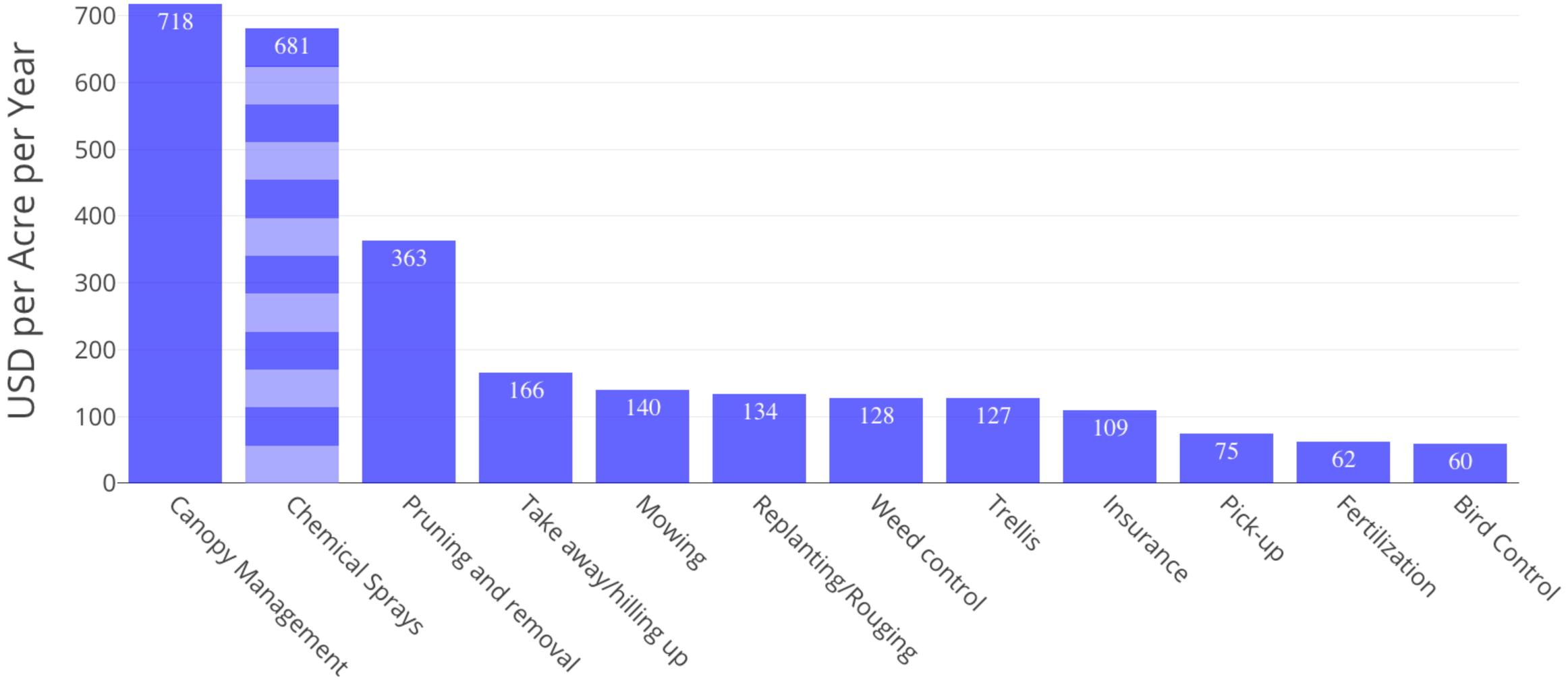
- Reducing the required number of chemical sprays
- Reducing the probability of a bad growing season

Size of opportunity

Two types of value creation:

- **Reducing the required number of chemical sprays**
- Reducing the probability of a bad growing season

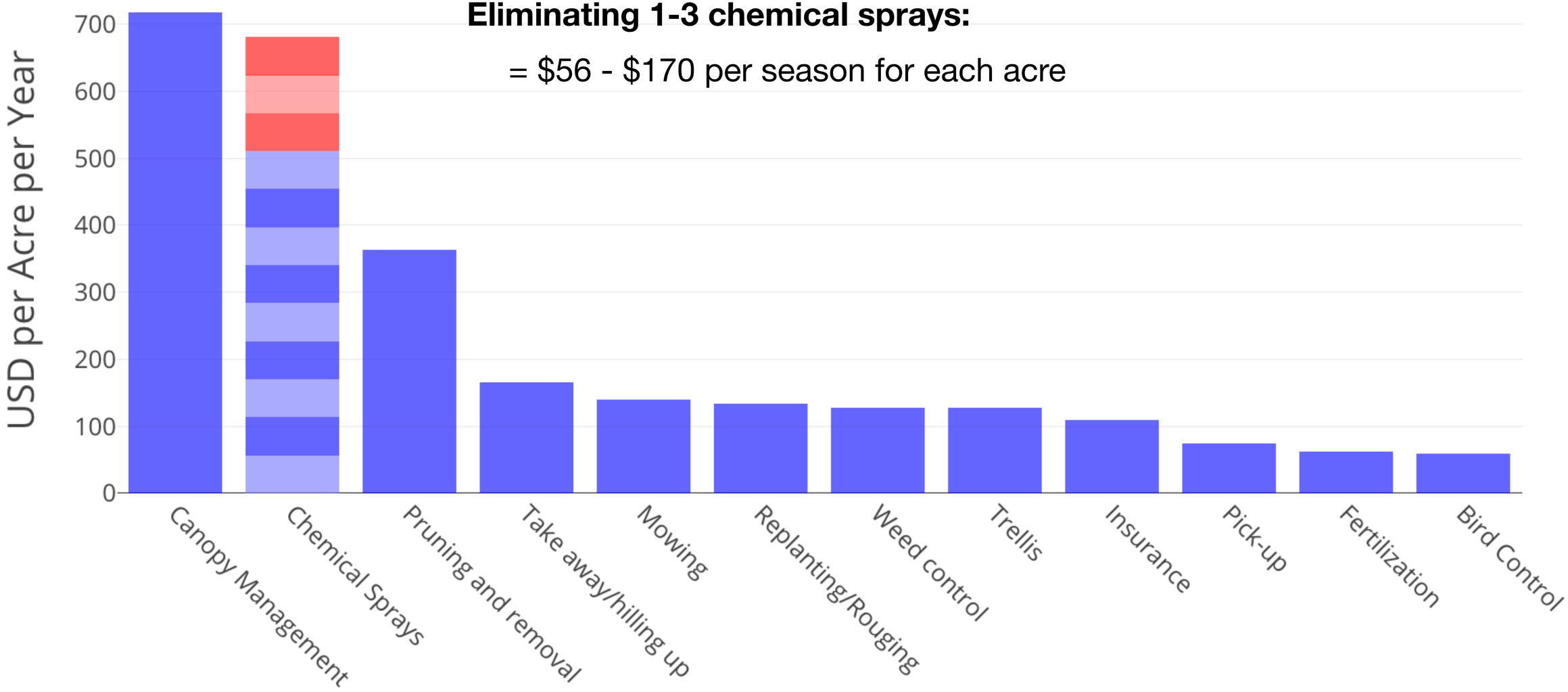
Annual variable costs per acre



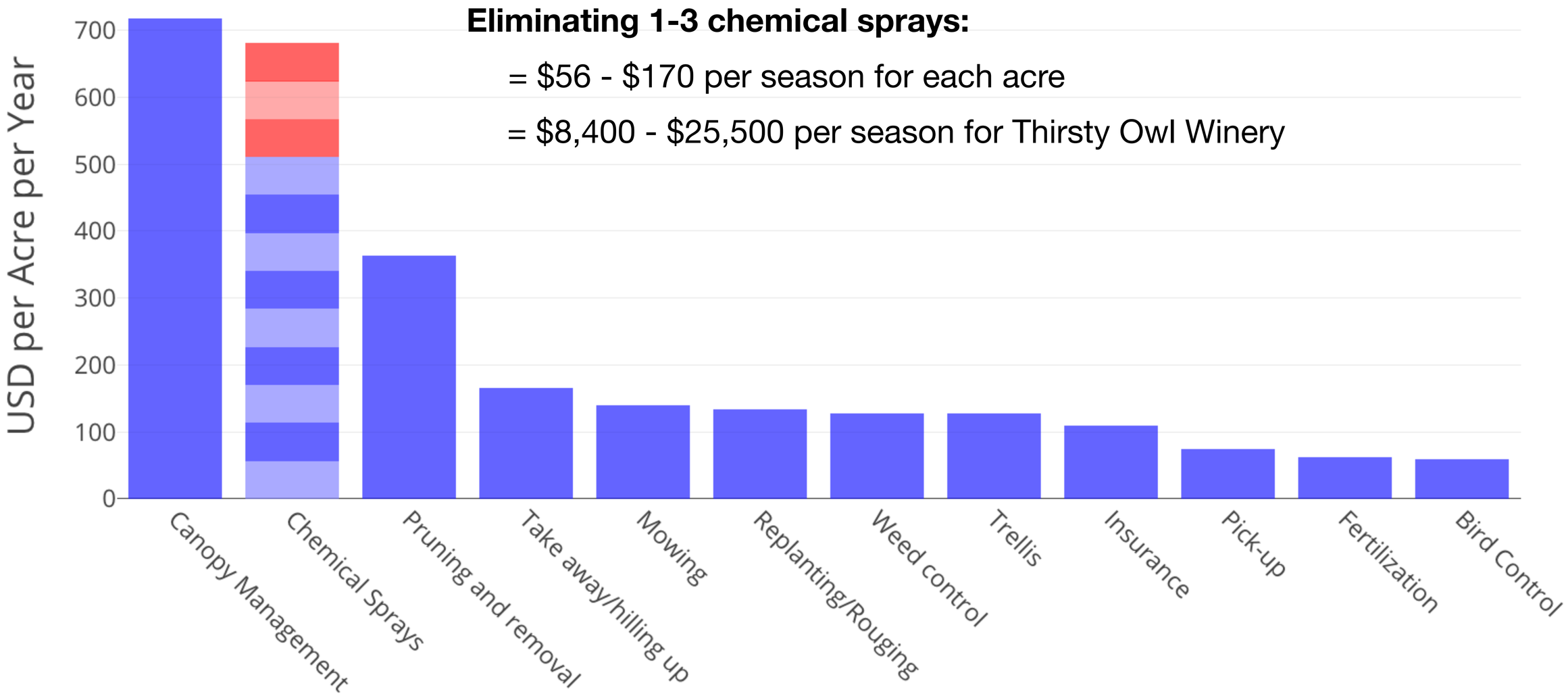
Annual variable costs per acre

Eliminating 1-3 chemical sprays:

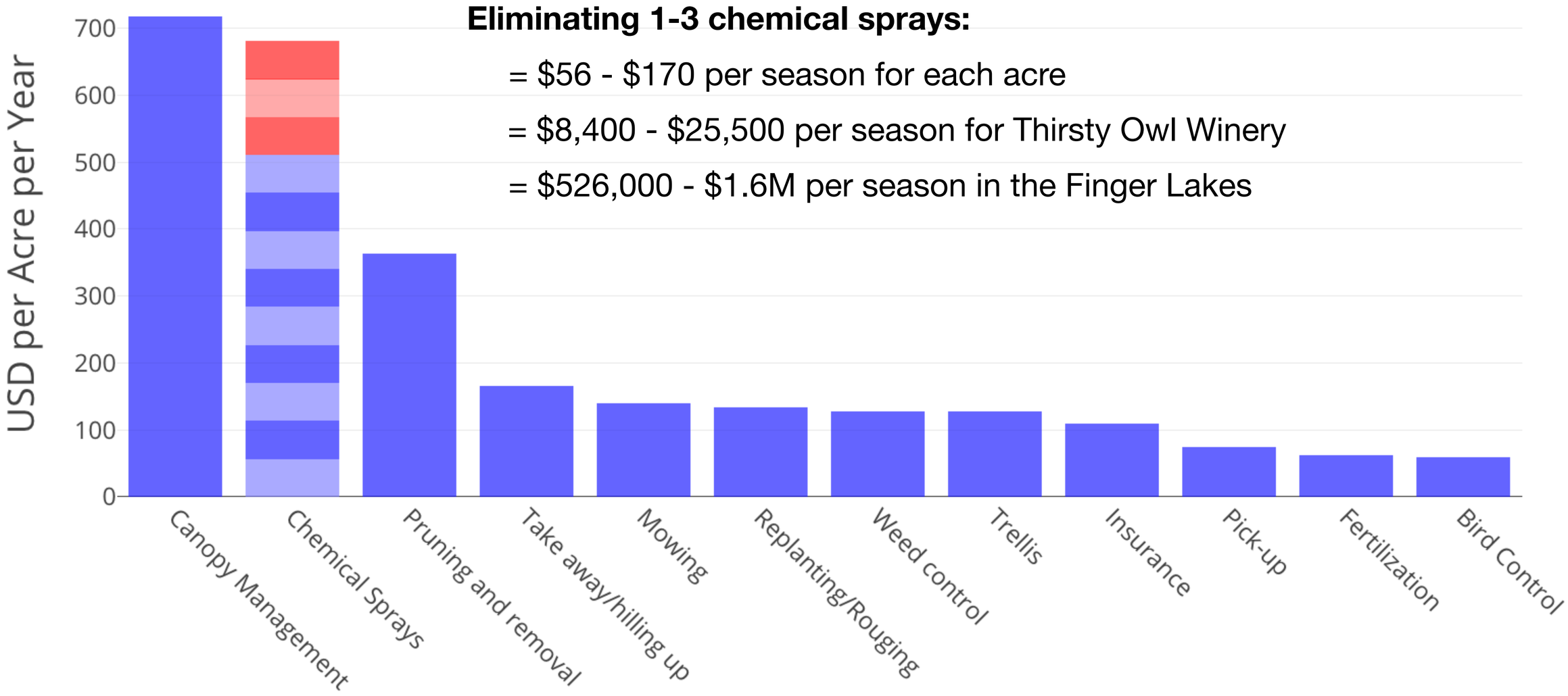
= $56 - $170 per season for each acre



Annual variable costs per acre



Annual variable costs per acre



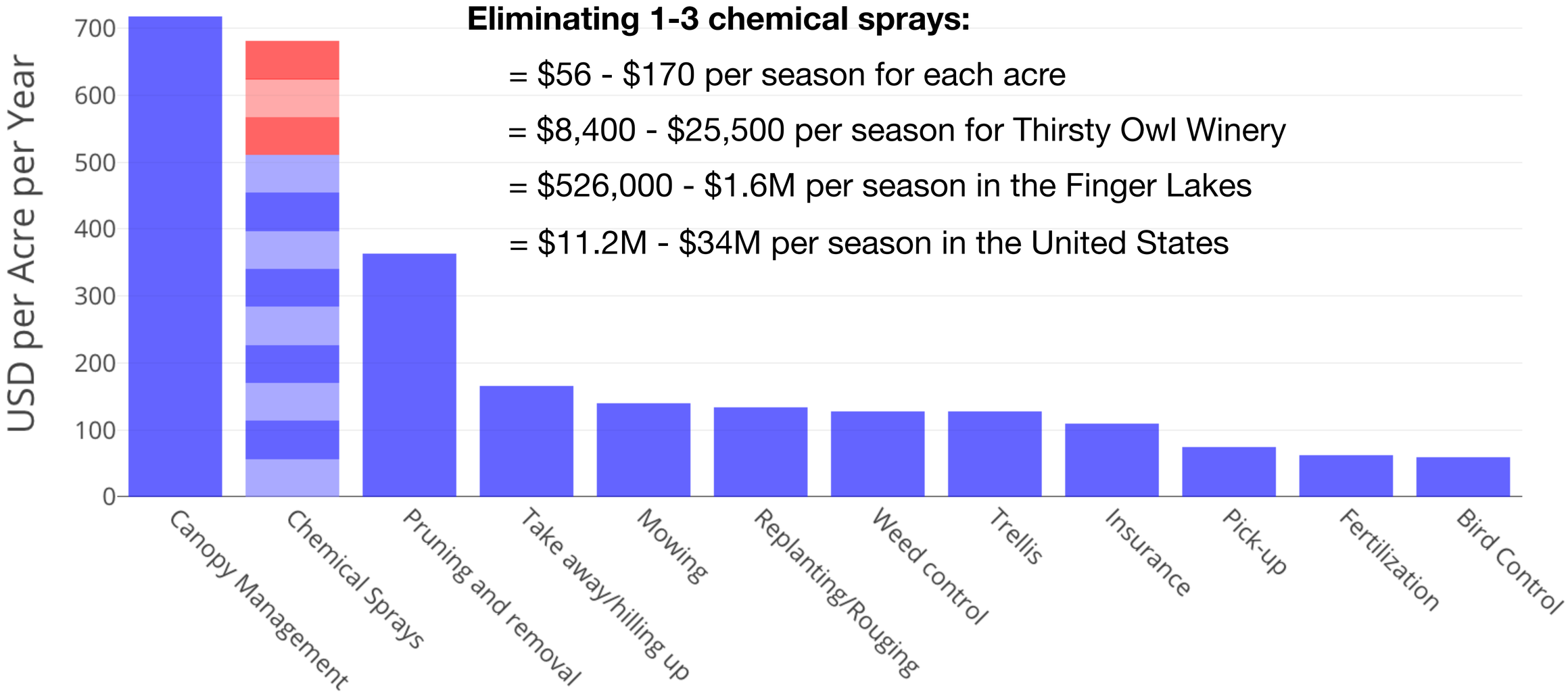
Eliminating 1-3 chemical sprays:

= $56 - $170 per season for each acre

= $8,400 - $25,500 per season for Thirsty Owl Winery

= $526,000 - $1.6M per season in the Finger Lakes

Annual variable costs per acre



Eliminating 1-3 chemical sprays:

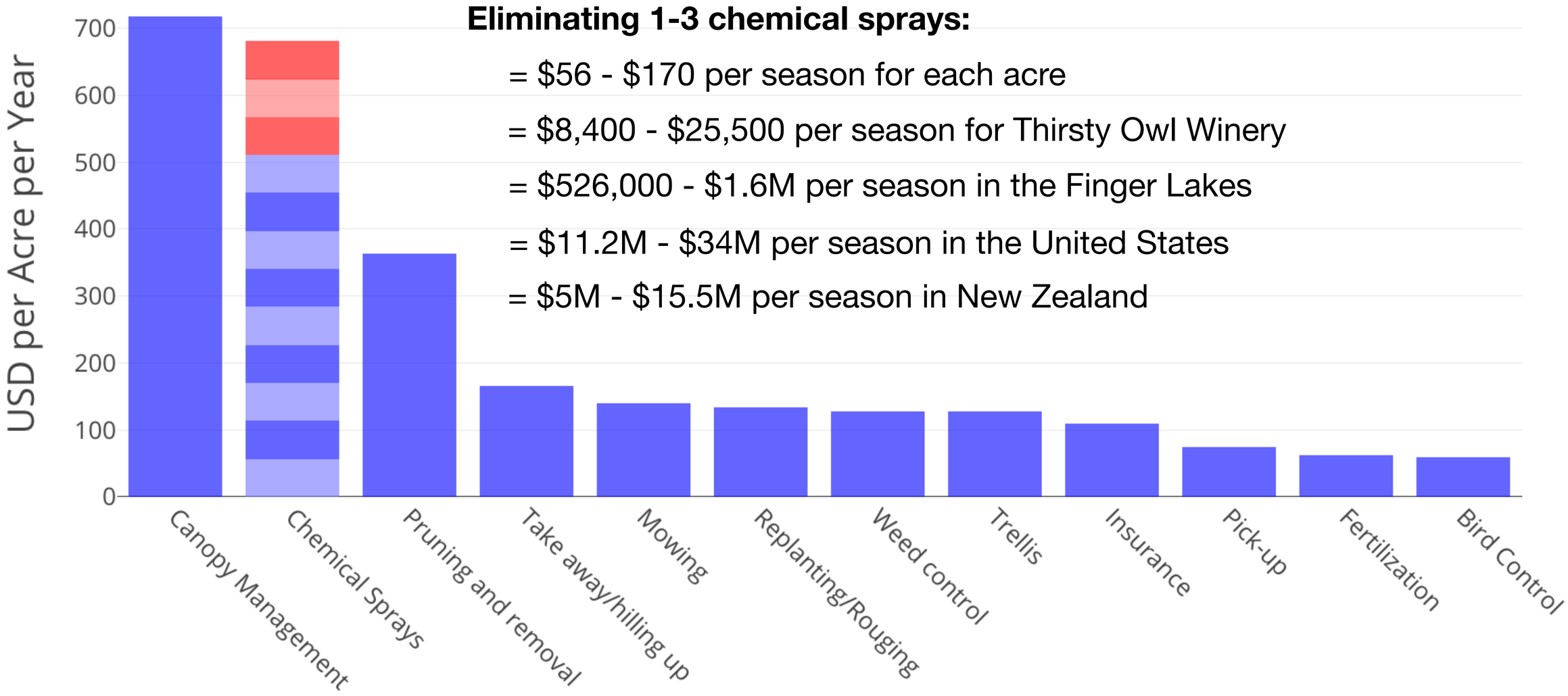
= $56 - $170 per season for each acre

= $8,400 - $25,500 per season for Thirsty Owl Winery

= $526,000 - $1.6M per season in the Finger Lakes

= $11.2M - $34M per season in the United States

Annual variable costs per acre



Eliminating 1-3 chemical sprays:

= $56 - $170 per season for each acre

= $8,400 - $25,500 per season for Thirsty Owl Winery

= $526,000 - $1.6M per season in the Finger Lakes

= $11.2M - $34M per season in the United States

= $5M - $15.5M per season in New Zealand

Size of opportunity

Two types of value creation:

- Reducing the required number of chemical sprays
- **Reducing the probability of a bad growing season**

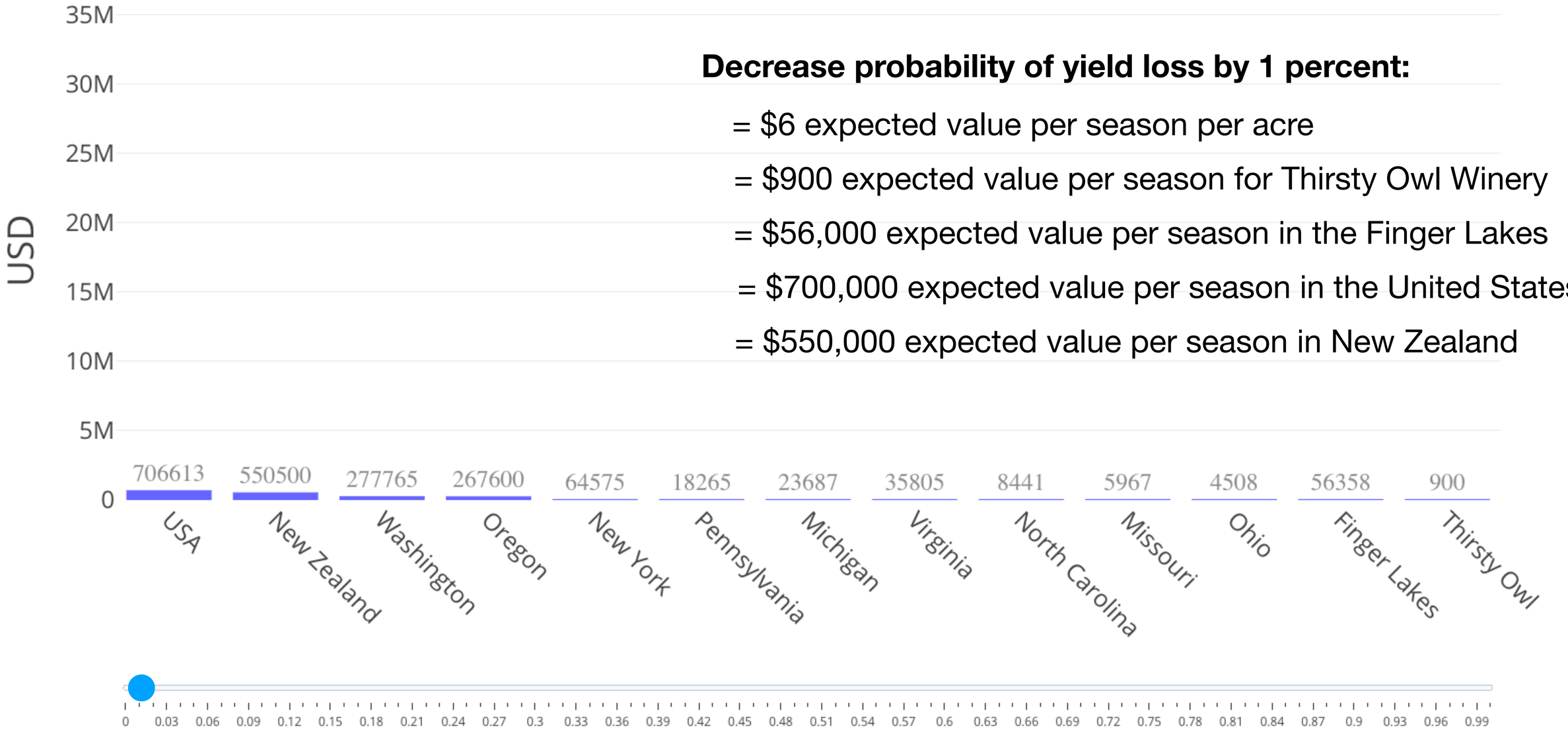
A bad season is a bad season because of frost, fungus, and disease.

Value proposition (articulated differently):

Monarchs reduce the probability of bad growing seasons by some percentage between 0 (no reduction in probability) and 100 (total elimination of bad growing seasons)

The difference between a good season and a bad season in a cool climate vineyard is (conservatively) 1 ton/acre.

Expected value added by decreasing probability of bad year



Decrease probability of yield loss by 1 percent:

= $6 expected value per season per acre

= $900 expected value per season for Thirsty Owl Winery

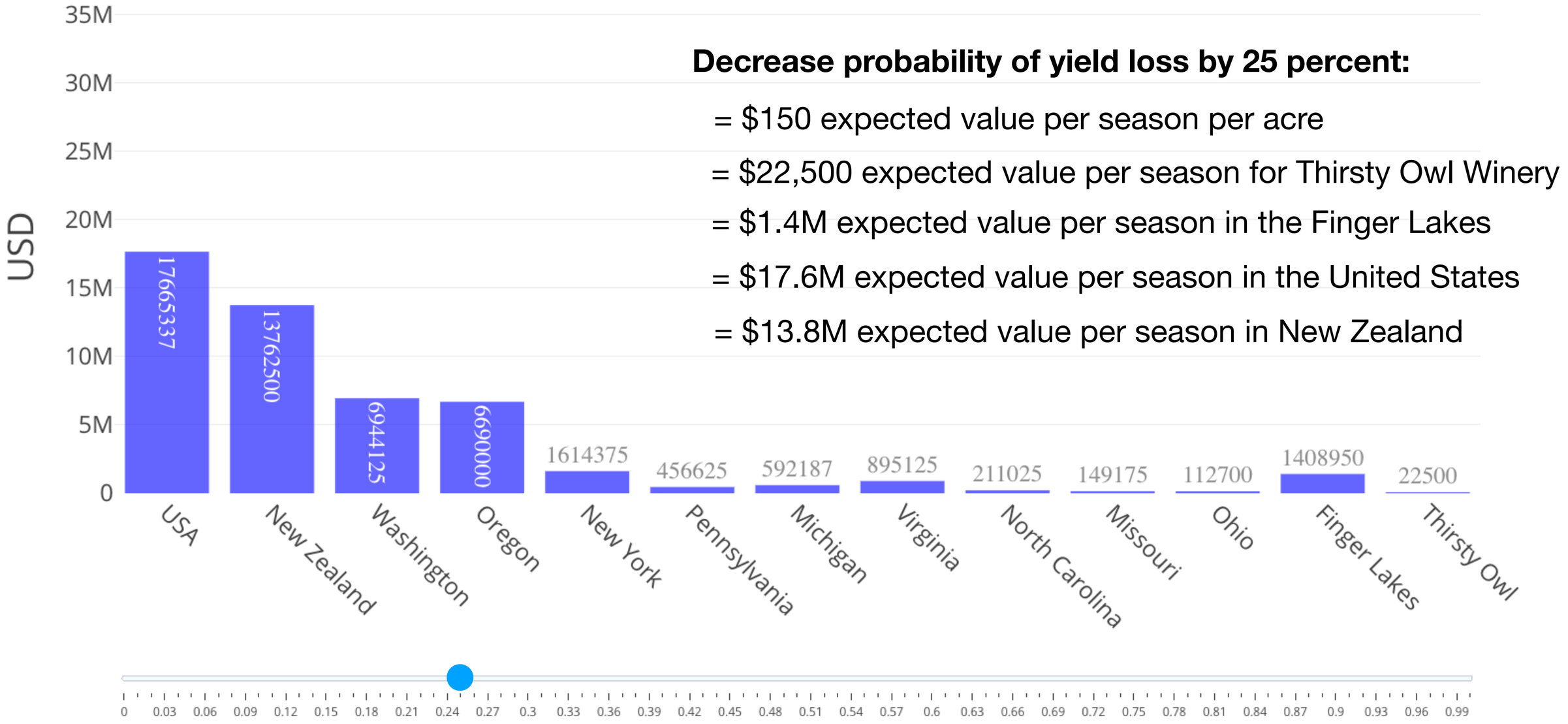
= $56,000 expected value per season in the Finger Lakes

= $700,000 expected value per season in the United States

= $550,000 expected value per season in New Zealand

Probability of preventing yield loss: 0.01

Expected value added by decreasing probability of bad year



Decrease probability of yield loss by 25 percent:

= $150 expected value per season per acre

= $22,500 expected value per season for Thirsty Owl Winery

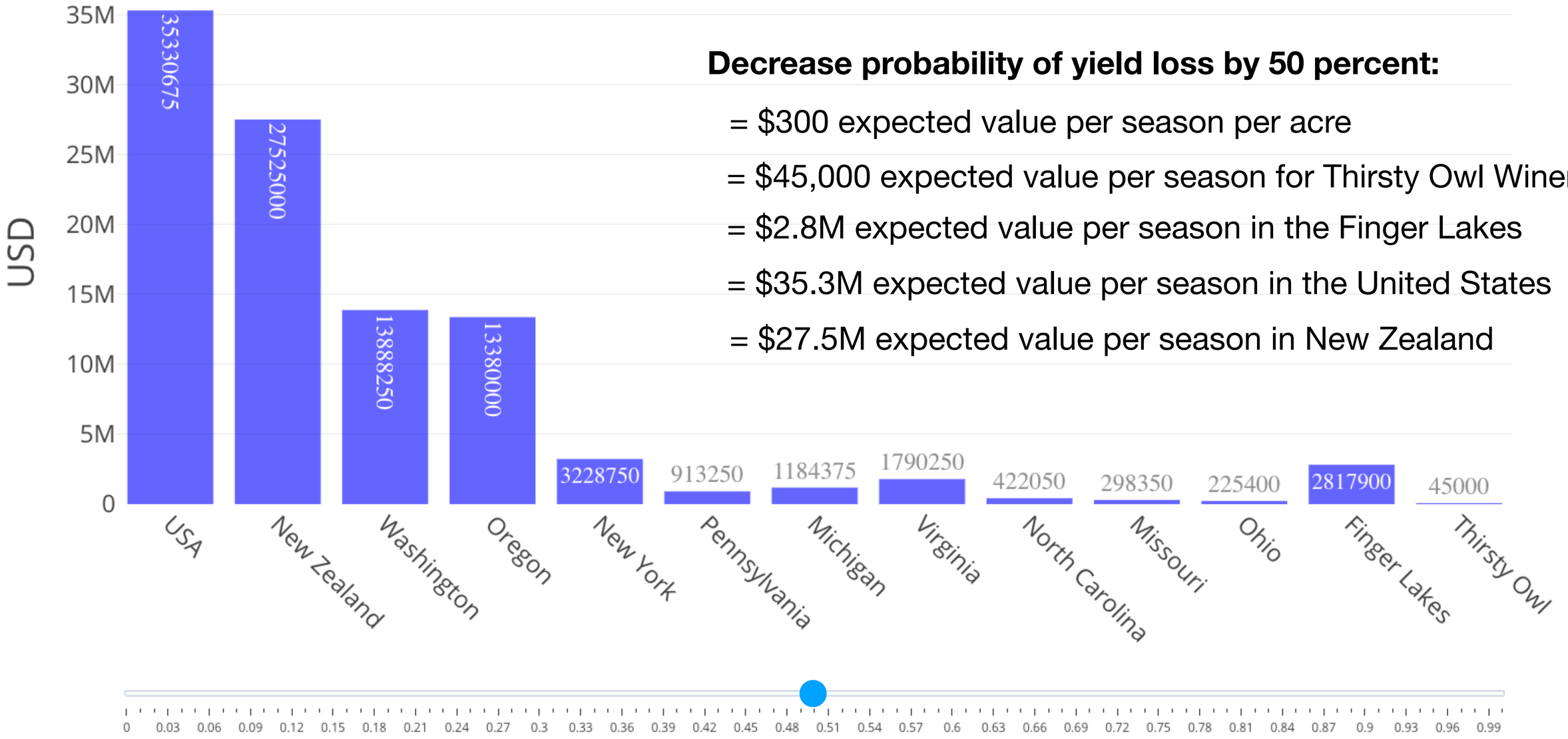
= $1.4M expected value per season in the Finger Lakes

= $17.6M expected value per season in the United States

= $13.8M expected value per season in New Zealand

Probability of preventing yield loss: 0.25

Expected value added by decreasing probability of bad year



Decrease probability of yield loss by 50 percent:

= $300 expected value per season per acre

= $45,000 expected value per season for Thirsty Owl Winery

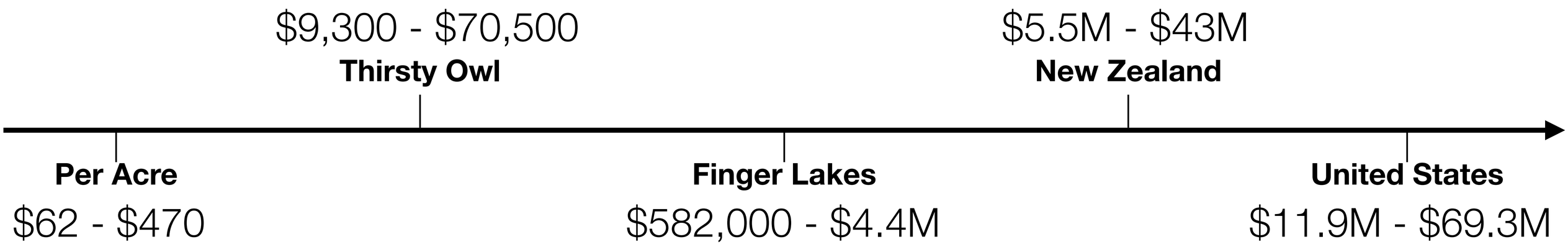
= $2.8M expected value per season in the Finger Lakes

= $35.3M expected value per season in the United States

= $27.5M expected value per season in New Zealand

Probability of preventing yield loss: 0.5

Size of opportunity



Size of opportunity

These ranges will be further constrained after field testing.

The Business Model Canvas

Designed for: **Monarch**

Designed by: Hunter Adams

On:

Iteration:

Key Partners

- Cornell Extension Program (and other academic extension programs)
- New Zealand Winegrowers Research Centre

Key Activities

- Electronics prototyping
- Printed circuit board design
- Hardware installation and maintenance
- Software development

Key Resources

- IP over a critical aspect of the system
- Electronics prototyping facility
- Humans

Value Propositions

- Enable cool-climate vineyard managers to take preventative action agains wine-grape lost to frost.
- Decrease the number of fungicide sprays by 2-3 per season for cool-climate vineyards
- Reduce the probability of a bad growing season by enabling targeted maintenance for frost, fungus, and disease.

Customer Relationships

- Maintenance & updates
- Incentivize data sharing

Channels

- Direct sales
- Online sales

Customer Segments

- Vineyard managers at cool-climate vineyards (end user).

Cost Structure

- Printed circuit board fabrication and assembly
- Receiver station fabrication, assembly, and installation
- Building/facilities costs
- Human beings
- Cloud storage

Revenue Streams

- Hardware sales (low margins to reduce barrier to entry)
- Data monetization through a subscription service - charged in dollars per acre (based on customer discovery preferences)
- Up-sell data analytics

Fundamental points:

1.

2.

The Business Model Canvas

Designed for: **Monarch**

Designed by: Hunter Adams

On:

Iteration:

Key Partners

- Cornell Extension Program (and other academic extension programs)
- New Zealand Winegrowers Research Centre

Key Activities

- Electronics prototyping
- Printed circuit board design
- Hardware installation and maintenance
- Software development

Key Resources

- Intellectual property aspect of the system
- Electronics prototyping facility
- Humans

Value Propositions

- Enable cool-climate vineyard managers to take preventative action agains wine-grape lost to frost.
- Decrease the number of fungicide sprays by 2-3 per season in cool-climate vineyards
- Reduce the labor hours during growing season by enabling targeted maintenance for frost, fungus, and disease.

Customer Relationships

- Maintenance & updates
- Incentivize data sharing

Channels

- Direct sales
- Online sales

Customer Segments

- Vineyard managers at cool-climate vineyards (end user).

Fundamental points:

1. The hardware is incidental to the data.
2.

Cost Structure

- Printed circuit board fabrication and assembly
- Receiver station fabrication, assembly, and installation
- Building/facilities costs
- Human beings
- Cloud storage

Revenue Streams

- Hardware sales (low margins to reduce barrier to entry)
- Data monetization through a subscription service - charged in dollars per acre (based on customer discovery preferences)
- Up-sell data analytics

The Business Model Canvas

Designed for: **Monarch**

Designed by: Hunter Adams

On: Date:

Iteration:

Key Partners

- Cornell Extension Program (and other academic extension programs)
- New Zealand Winegrowers Research Centre

Key Activities

- Electronics prototyping
- Printed circuit board design
- Hardware installation and maintenance
- Software development

Key Resources

- Intellectual property aspects of the system
- Electronics prototyping facility
- Humans

Value Propositions

- Enable cool-climate vineyard managers to take preventative action agains wine-grape lost to frost.
- Decrease the number of fungicide sprays by 2-3 per season in cool-climate vineyards
- Reduce the [illegible] growing season by enabling targeted maintenance for frost, fungus, and disease

Customer Relationships

- Maintenance & updates
- Incentivize data sharing

Channels

- Direct sales
- Online sales

Customer Segments

- Vineyard managers at cool-climate vineyards (end user).

Cost Structure

- Printed circuit board fabrication and assembly
- Receiver station fabrication, assembly, and installation
- Building/facilities costs
- Human beings
- Cloud storage

Revenue Streams

- Hardware sales (low margins to reduce barrier to entry)
- Data monetization through a subscription service - charged in dollars per acre (based on customer discovery preferences)
- Up-sell data analytics

Fundamental points:

1. The hardware is incidental to the data.
2. I benefit from the network effect.

The Business Model Canvas

Designed for: **Monarch**

Designed by: Hunter Adams

On:

Iteration:

Key Partners

- Cornell Extension Program (and other academic extension programs)
- New Zealand Winegrowers Research Centre

Key Activities

- Electronics prototyping
- Printed circuit board design
- Hardware installation and maintenance
- Software development

Key Resources

- IP over a critical aspect of the [illegible]
- Electronics prototyping facility
- Humans

Value Propositions

- Enable cool-climate vineyard managers to take preventative action agains wine-grape lost to frost.
- Decrease the number of fungicide sprays by [illegible] cool-climate vineyards
- [illegible] probability of a bad growing season by [illegible] maintenance for frost, fungus, and disease.

Customer Relationships

- Maintenance & updates
- Incentivize data sharing

Channels

- Direct sales
- Online sales

Customer Segments

- Vineyard managers at cool-climate vineyards (end user).

Cost Structure

- Printed circuit board fabrication and assembly
- Receiver station fabrication, assembly, and installation
- Building/facilities costs
- Human beings
- Cloud storage

Revenue Streams

- Hardware sales (low margins to reduce barrier to entry)
- Data monetization through a subscription service - charged in dollars per acre (based on customer discovery preferences)
- Up-sell data analytics

1. Describe the larger vision that I'm working to achieve.
2. Explain the agricultural market as a standalone opportunity.
3. **Explain how this particular opportunity moves me in the direction of my larger vision.**

The Business Model Canvas

Designed for: **Monarch**

Designed by: Hunter Adams

On:

Iteration:

Key Partners

- Cornell Extension Program (and other academic extension programs)
- New Zealand Winegrowers Research Centre

Key Activities

- Electronics prototyping
- Printed circuit board design
- Hardware installation and maintenance
- Software development

Key Resources

- IP over a critical aspect of the system
- Electronics prototyping facility
- Humans

Value Propositions

- Enable cool-climate vineyard managers to take preventative action agains wine-grape lost to frost.
- Decrease the number of fungicide sprays by 1-3 per season at cool-climate vineyards
- Reduce the probability of a bad growing season by enabling targeted maintenance for frost, fungus, and disease.

Customer Relationships

- Maintenance & updates
- Incentivize data sharing

Channels

- Direct sales
- Online sales

Customer Segments

- Vineyard managers at cool-climate vineyards (end user).

Cost Structure

- Printed circuit board fabrication and assembly
- Receiver station fabrication, assembly, and installation
- Building/facilities costs
- Human beings
- Cloud storage

Revenue Streams

- Hardware sales (low margins to reduce barrier to entry)
- Data monetization through a subscription service - charged in dollars per acre (based on customer discovery preferences)
- Up-sell data analytics

Insights from customer discovery interviews (135):

- Vineyards in the same region are not hostile to one another, and regularly share knowledge and data to help one another do well.

Insights from customer discovery interviews (135):

- Vineyards in the same region are not hostile to one another, and regularly share knowledge and data to help one another do well.
- Growers take pride in owning and maintaining their own equipment.

Insights from customer discovery interviews (135):

- Vineyards in the same region are not hostile to one another, and regularly share knowledge and data to help one another do well.
- Growers take pride in owning and maintaining their own equipment.
- Growers’ brains operate in units of dollars per acre.

Insights from customer discovery interviews (135):

- Vineyards in the same region are not hostile to one another, and regularly share knowledge and data to help one another do well.
- Growers take pride in owning and maintaining their own equipment.
- Growers' brains operate in units of dollars per acre.
- Growers are reluctant to purchase new technology until they have seen a successful demonstration.

Insights from customer discovery interviews (135):

- Vineyards in the same region are not hostile to one another, and regularly share knowledge and data to help one another do well.
- Growers take pride in owning and maintaining their own equipment.
- Growers' brains operate in units of dollars per acre.
- Growers are reluctant to purchase new technology until they have seen a successful demonstration.
- Academic extension programs are the most significant technology influencer in their areas of influence.

The Business Model Canvas

Designed for: **Monarch**

Designed by: Hunter Adams

On:

Iteration:

Key Partners

- Cornell Extension Program (and other academic extension programs)
- New Zealand Winegrowers Research Centre

Key Activities

- Electronics prototyping
- Printed circuit board design
- Hardware installation and maintenance
- Software development

Key Resources

- IP over a critical aspect of the system
- Electronics prototyping facility
- Humans

Value Propositions

- Enable cool-climate vineyard managers to take preventative action agains wine-grape lost to frost.
- Decrease the number of fungicide sprays by 1-3 per season at cool-climate vineyards
- Reduce the probability of a bad growing season by enabling targeted maintenance for frost, fungus, and disease.

Customer Relationships

- Maintenance & updates
- Incentivize data sharing

Channels

- Direct sales
- Online sales

Customer Segments

- Vineyard managers at cool-climate vineyards (end user).

Cost Structure

- Printed circuit board fabrication and assembly
- Receiver station fabrication, assembly, and installation
- Building/facilities costs
- Human beings
- Cloud storage

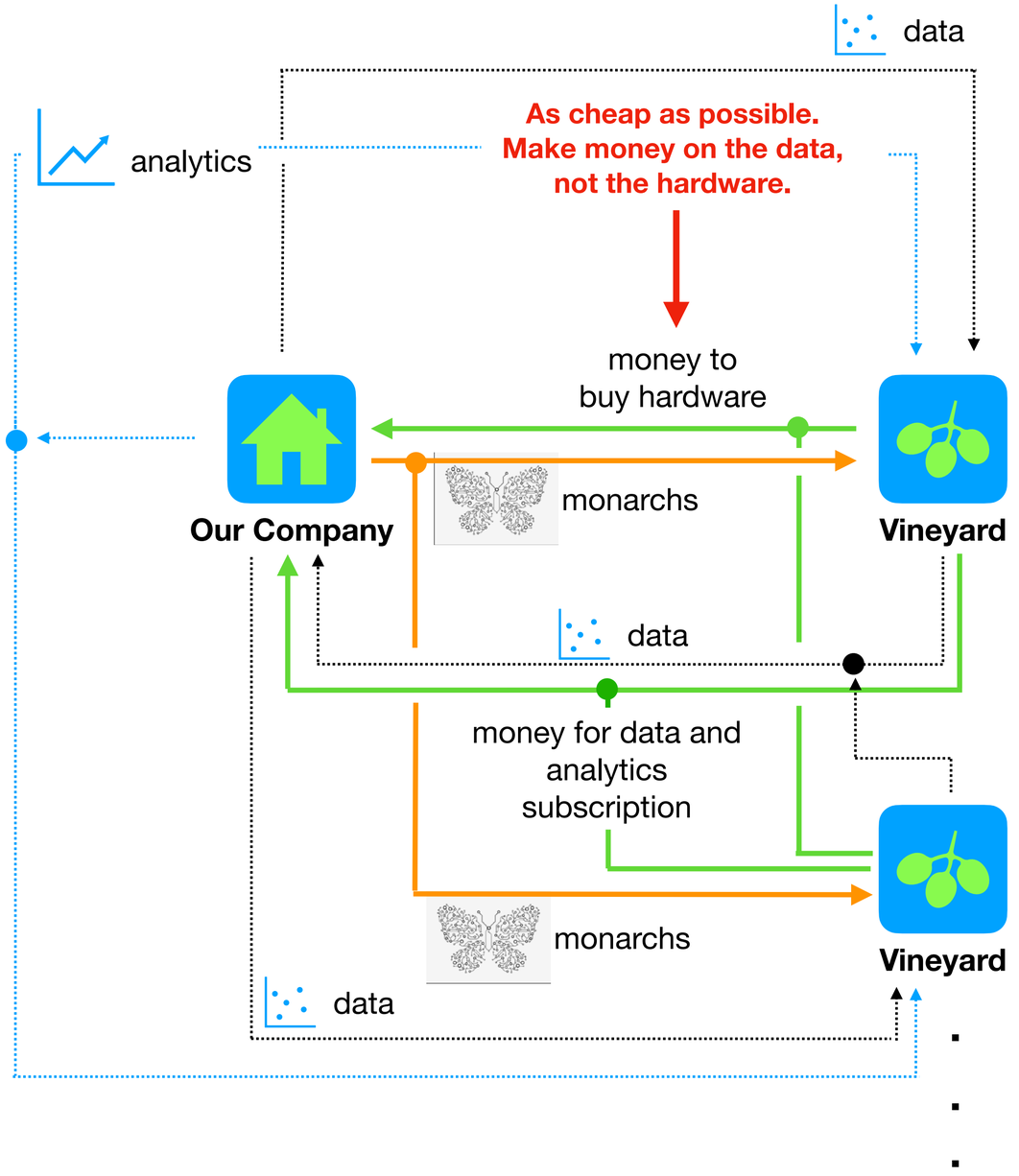
Revenue Streams

- Hardware sales (low margins to reduce barrier to entry)
- Data monetization through a subscription service - charged in dollars per acre (based on customer discovery preferences)
- Up-sell data analytics

Vineyards make an up-front payment for the hardware, and then pay a per-acre subscription fee for data and analytics.

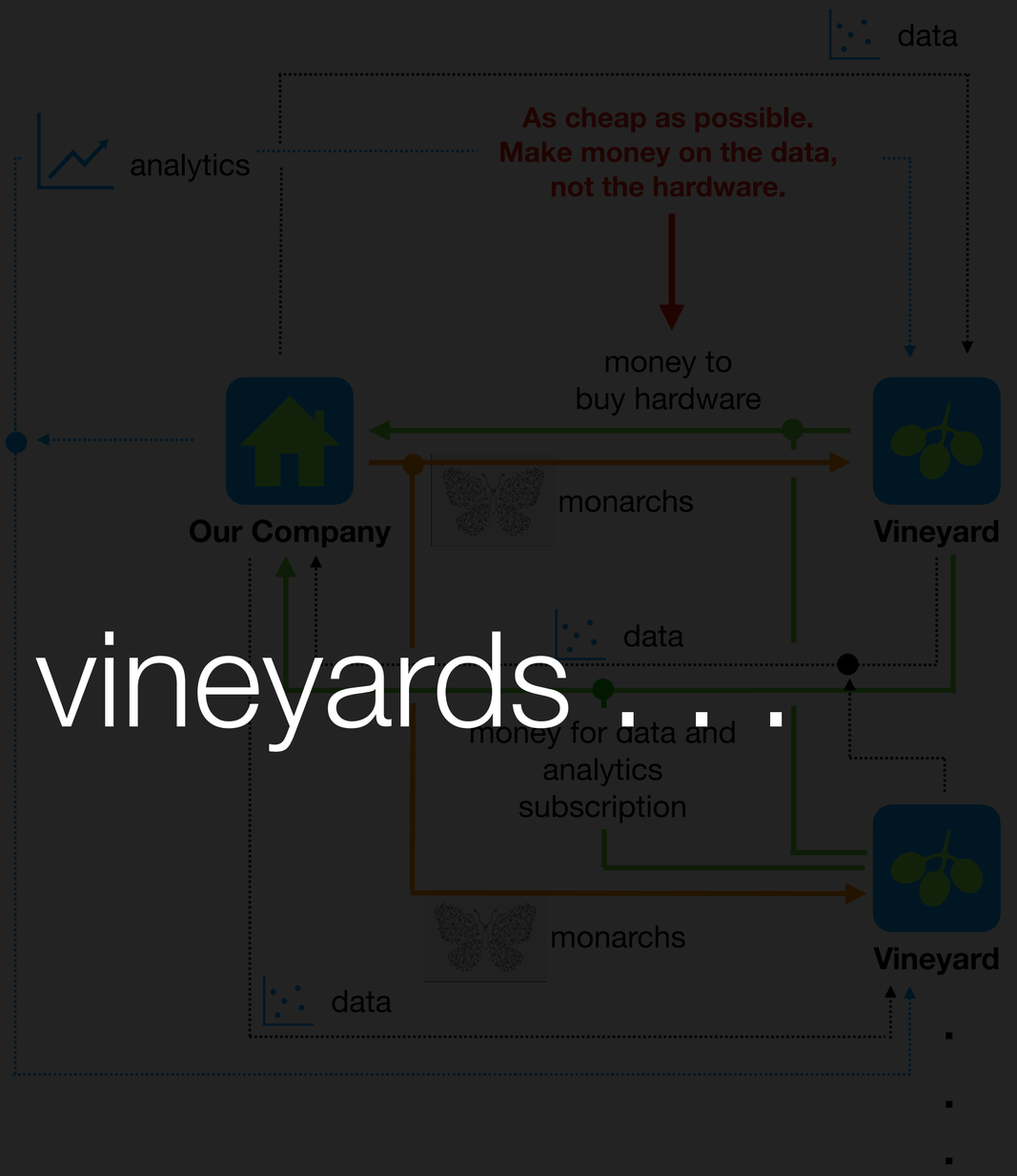
(value-based pricing)

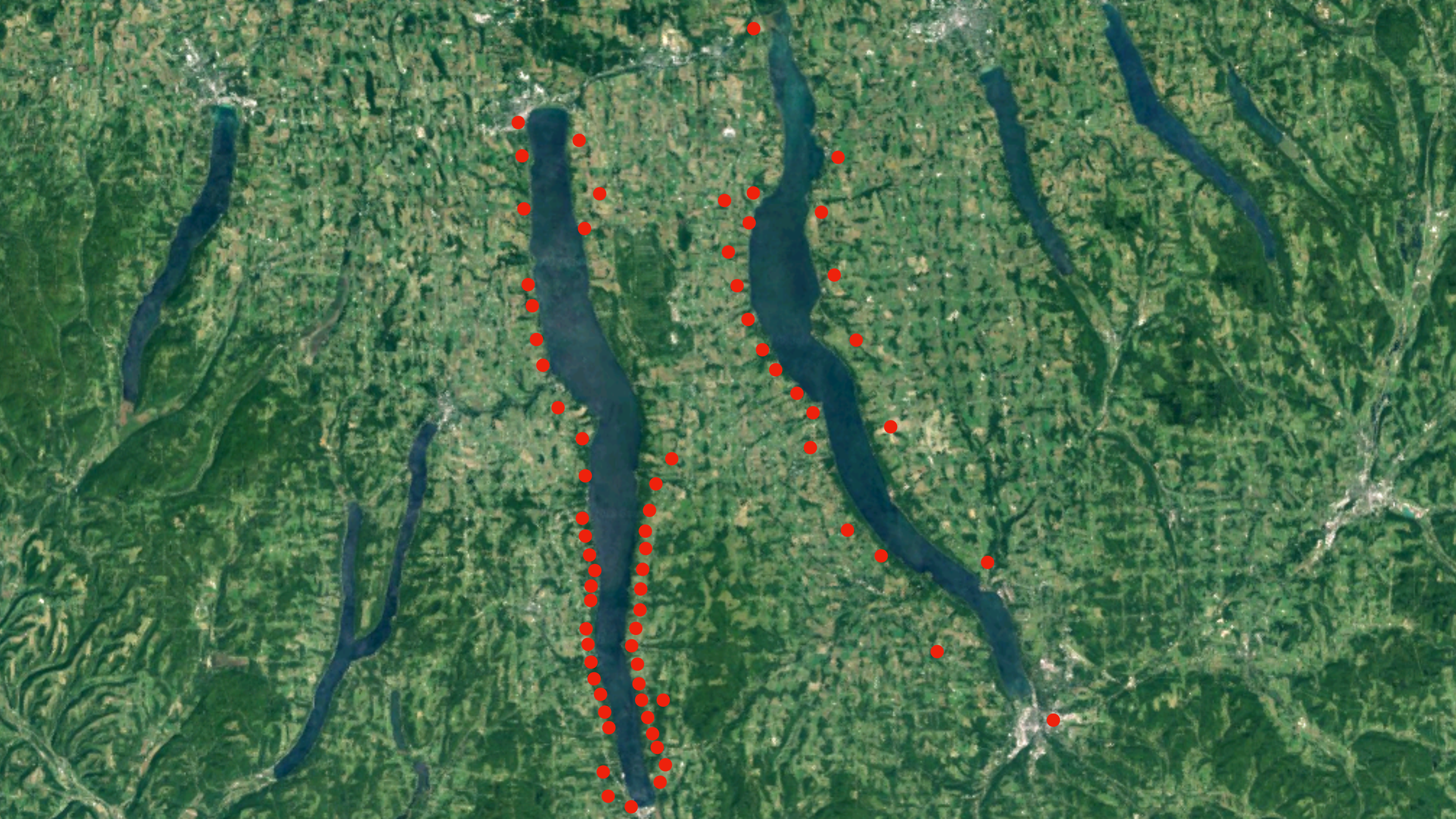
Still figuring this out.

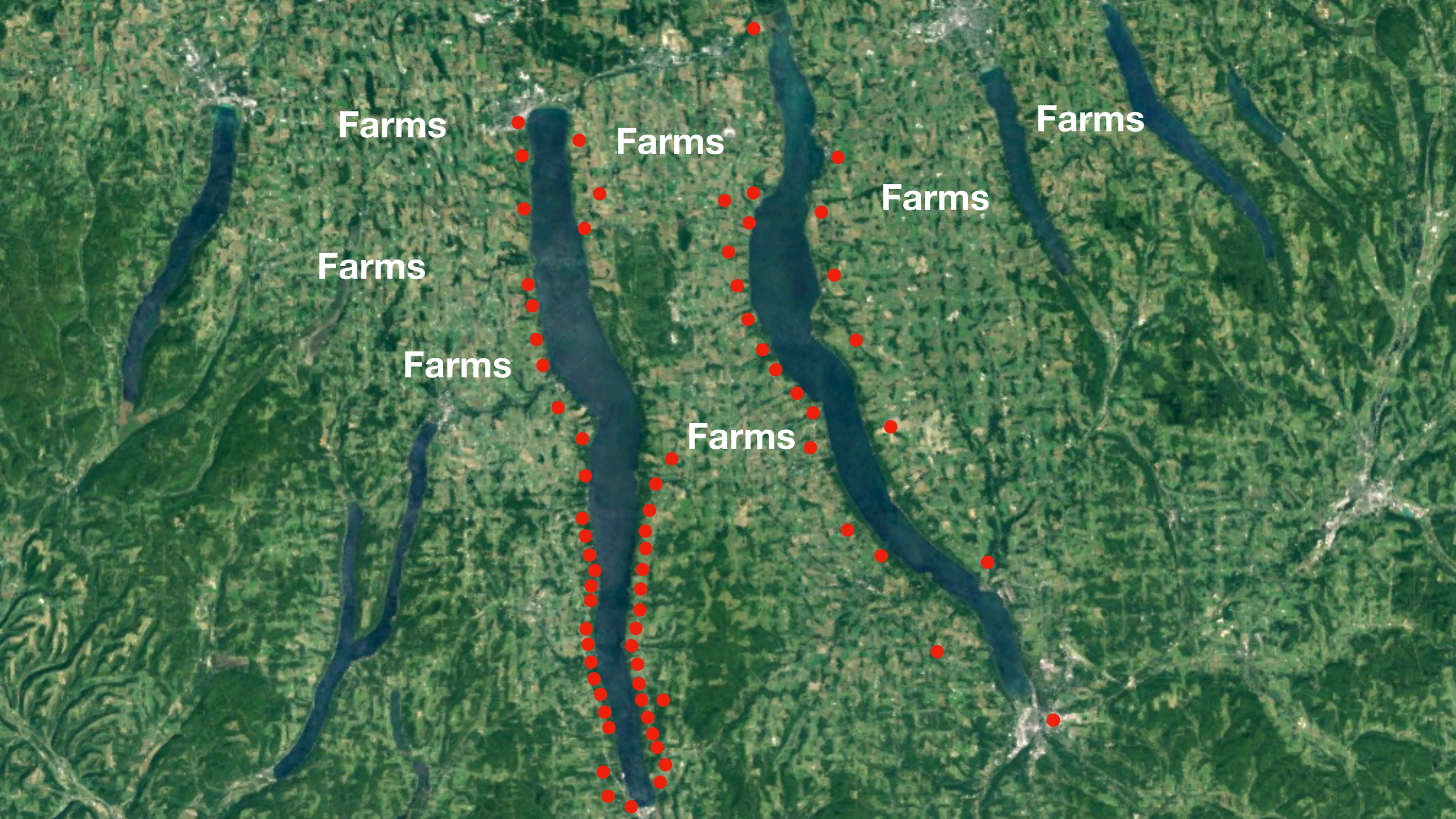


Vineyards make an up-front payment for the hardware and then pay a per-acre subscription fee for data and analytics.

Scaling beyond vineyards . . .

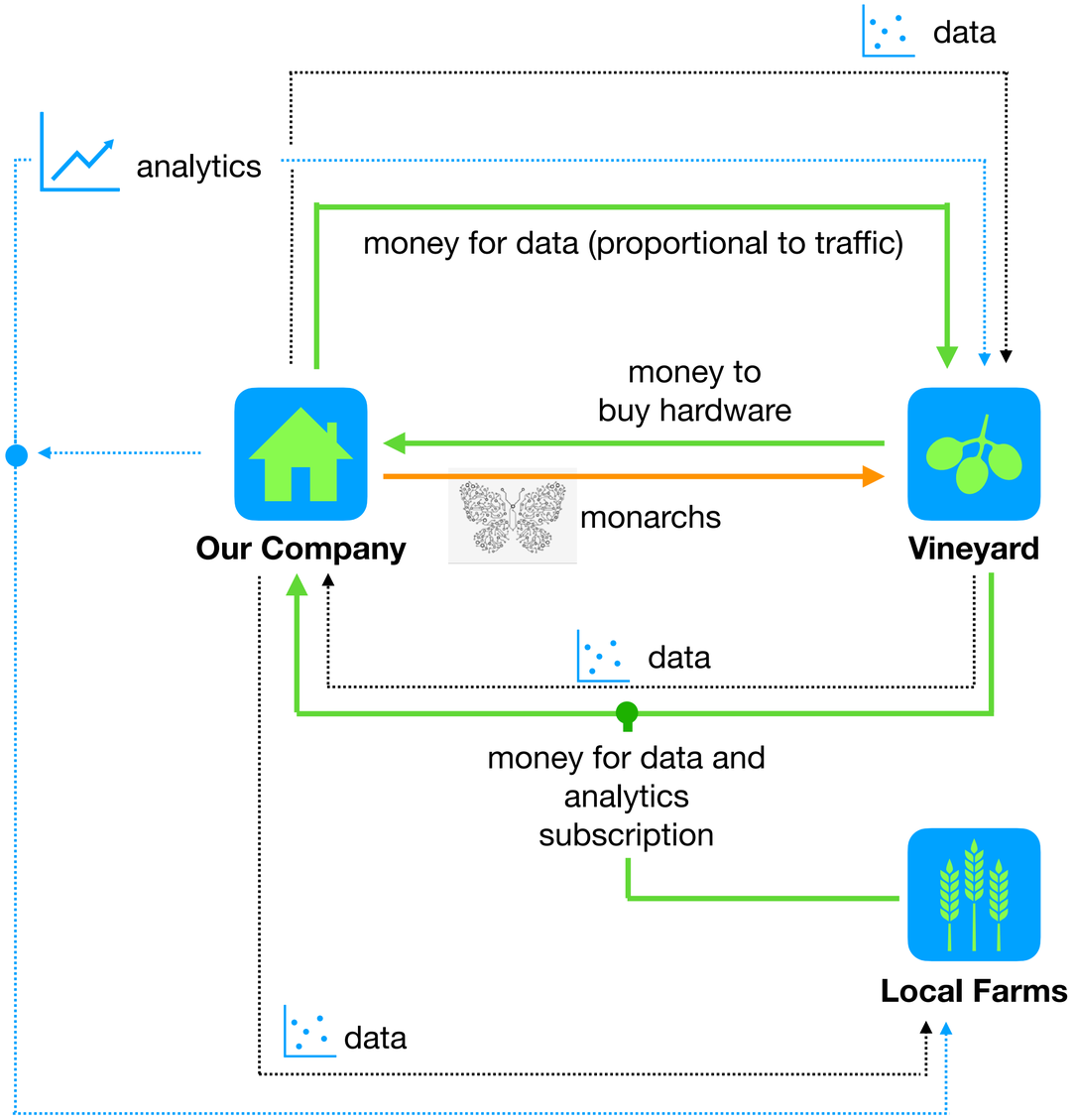


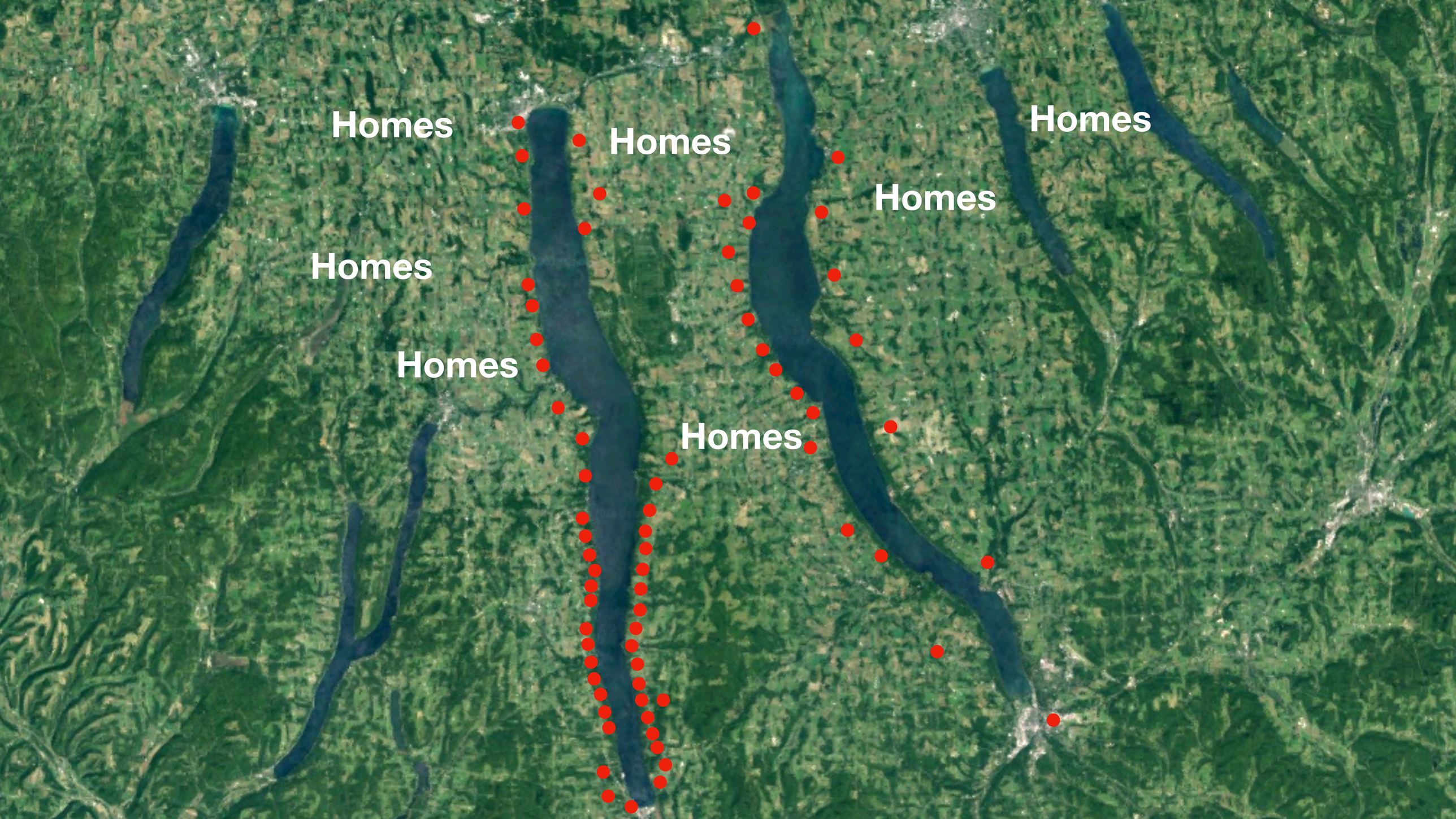



Farms
Farms
Farms
Farms
Farms
Farms
Farms

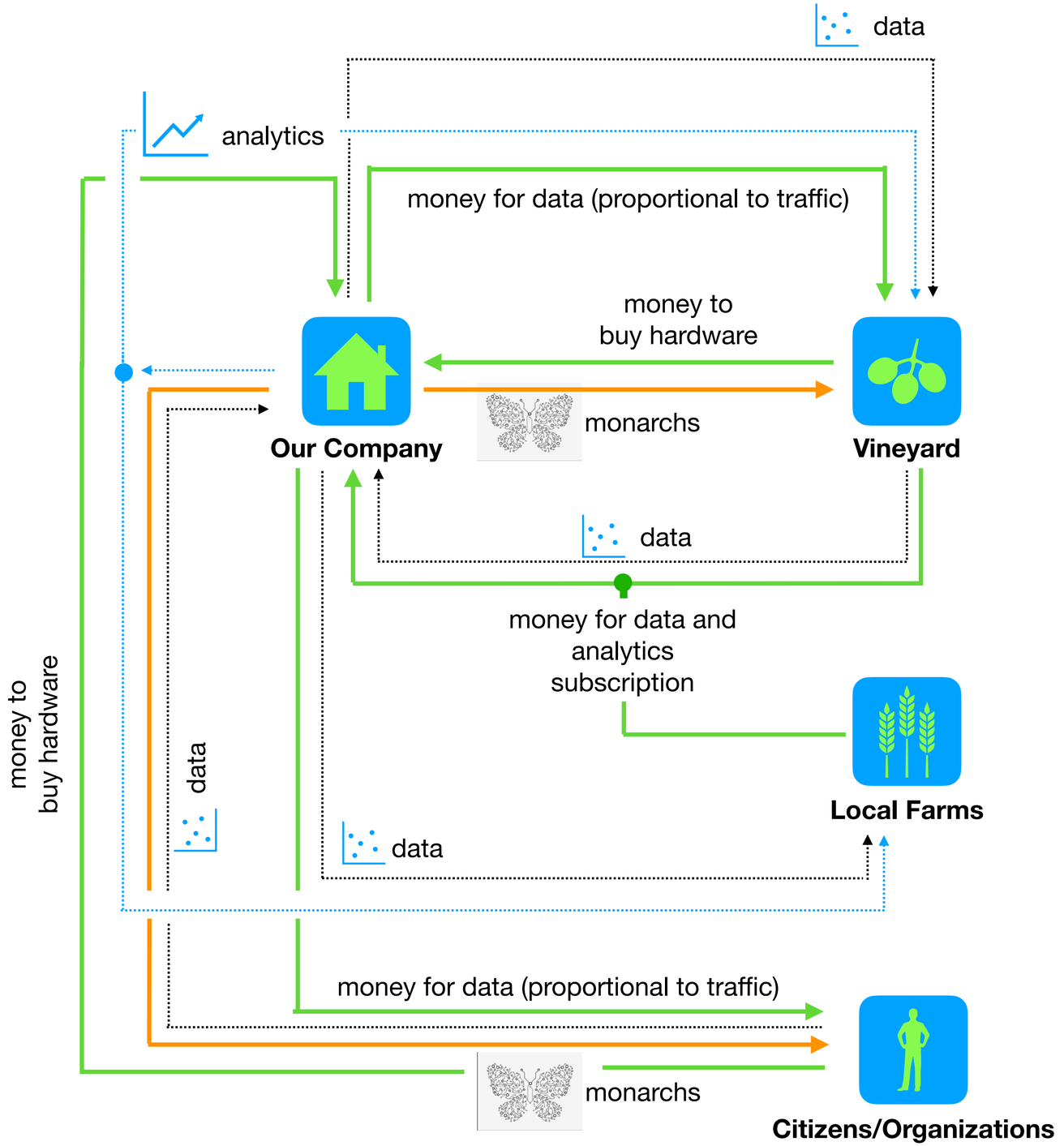
As more Monarchs are deployed, the collective dataset gains value to growers of lower profit/ acre crops that occupy land around and among the vineyards.

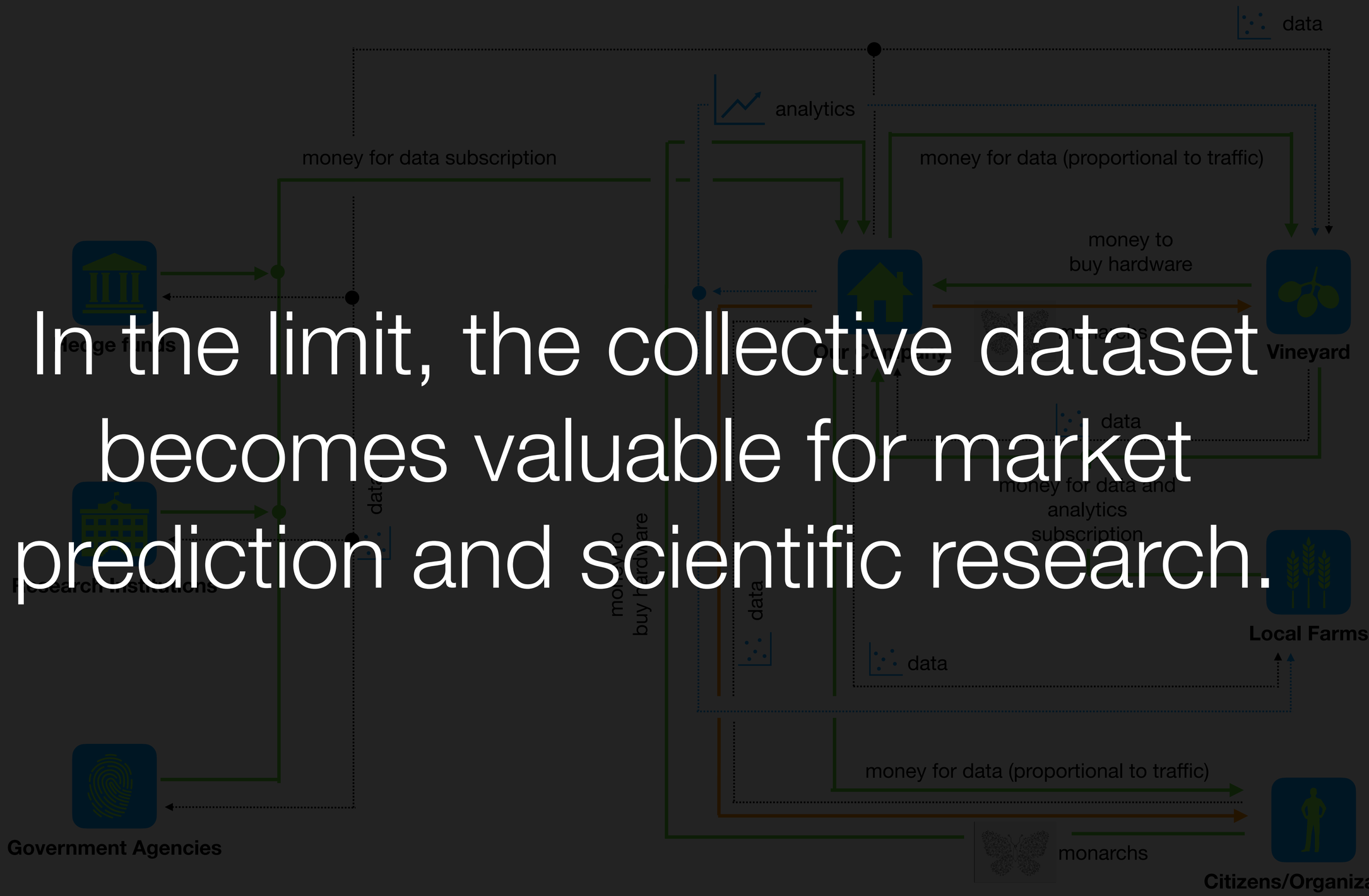
Hypothesis



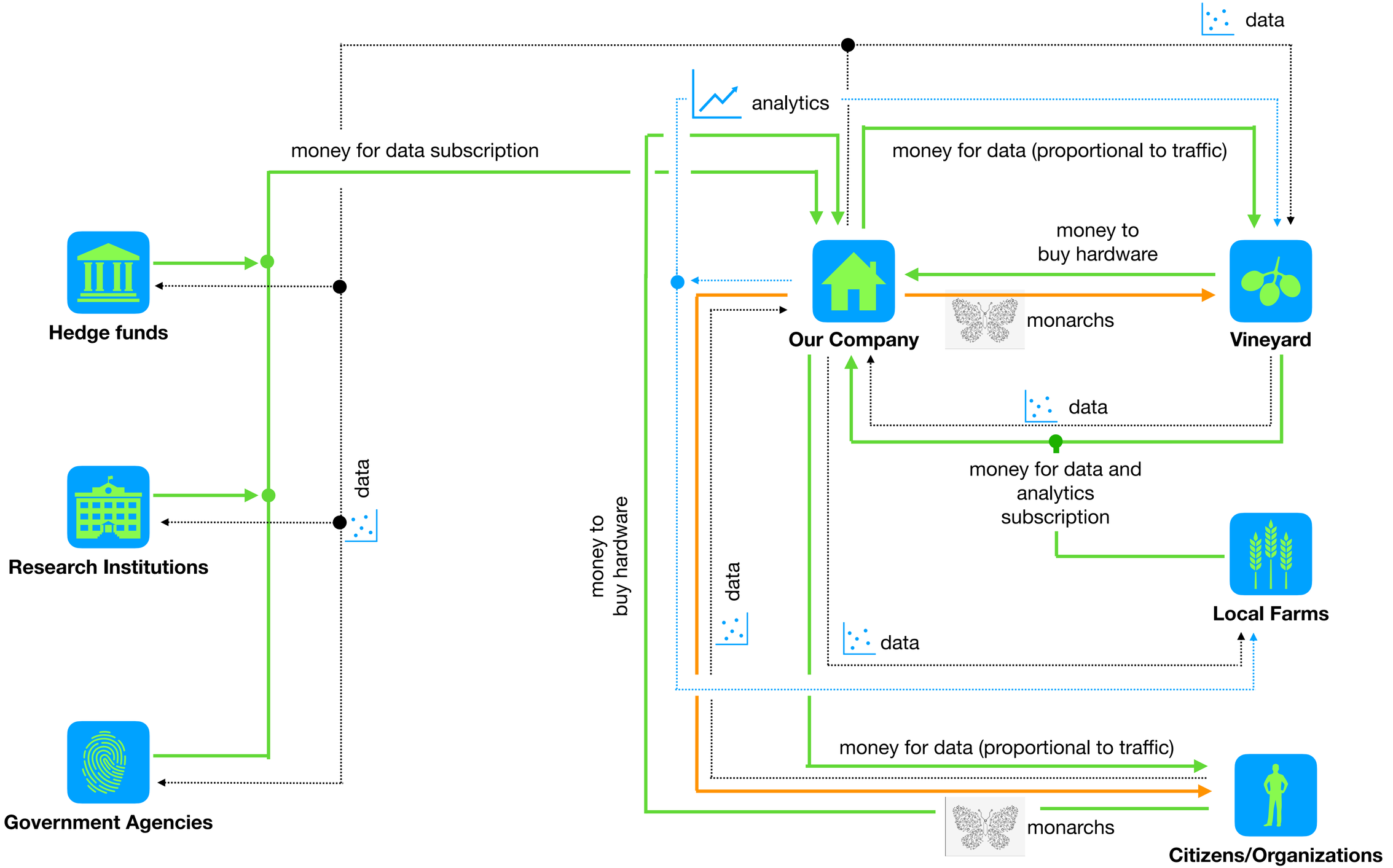

Homes
Homes
Homes
Homes
Homes
Homes
Homes

Anyone that buys hardware and contributes data to the collective dataset is reimbursed in proportion to the traffic on his or her data.





In the limit, the collective dataset becomes valuable for market prediction and scientific research.


data
analytics
money for data subscription
money for data (proportional to traffic)
money to
buy hardware
Hedge funds
Our Company
monarchs
Vineyard
data
data
money for data and
analytics
subscription
Research Institutions
money to
buy hardware
data
Local Farms
data
money for data (proportional to traffic)
Government Agencies
monarchs
Citizens/Organizations

The Business Model Canvas

Designed for: **Monarch**

Designed by: Hunter Adams

On:

Iteration:

Key Partners

- Cornell Extension Program (and other academic extension programs)
- New Zealand Winegrowers Research Centre

Key Activities

- Electronics prototyping
- Printed circuit board design
- Hardware installation and maintenance
- Software development

Key Resources

- IP over a critical aspect of the system
- Electronics prototyping facility
- Humans

Value Propositions

- Enable cool-climate vineyard managers to take preventative action agains wine-grape lost to frost.
- Decrease the number of fungicide sprays by 1-3 per season at cool-climate vineyards
- Reduce the probability of a bad growing season by enabling targeted maintenance for frost, fungus, and disease.

Customer Relationships

- Maintenance & updates
- Incentivize data sharing

Channels

- Direct sales
- Online sales

Customer Segments

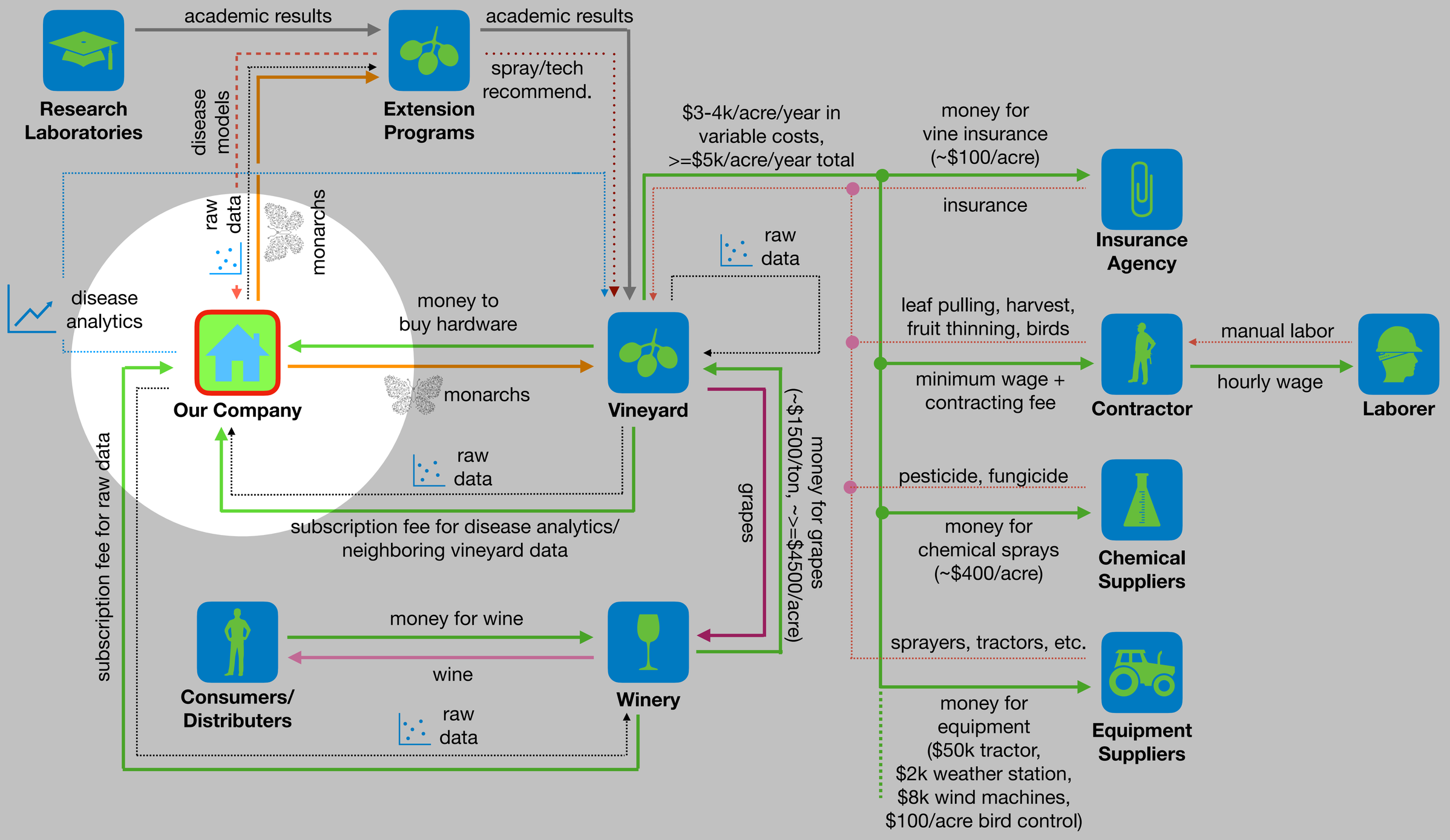
- Vineyard managers at cool-climate vineyards (end user).

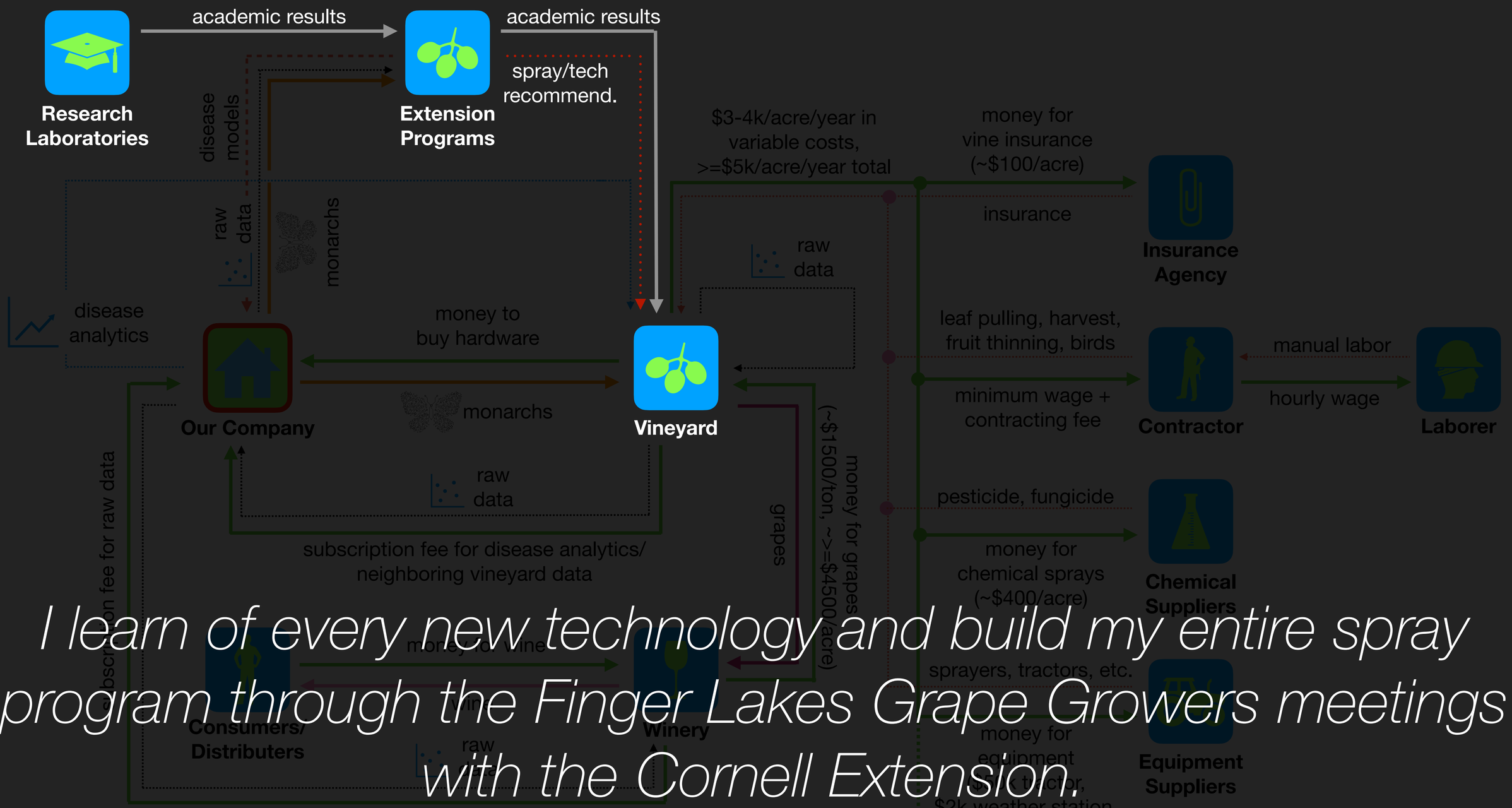
Cost Structure

- Printed circuit board fabrication and assembly
- Receiver station fabrication, assembly, and installation
- Building/facilities costs
- Human beings
- Cloud storage

Revenue Streams

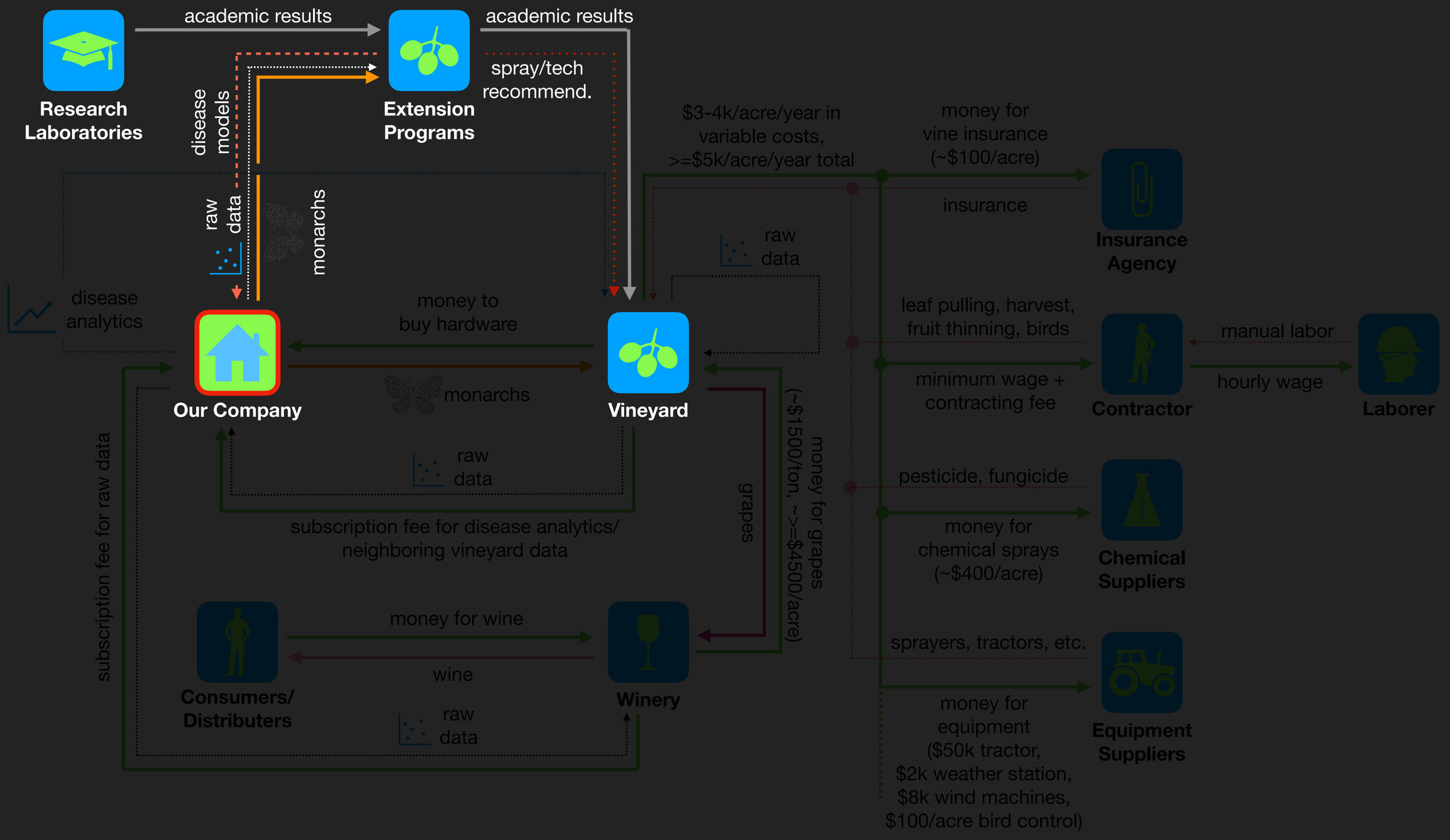
- Hardware sales (low margins to reduce barrier to entry)
- Data monetization through a subscription service - charged in dollars per acre (based on customer discovery preferences)
- Up-sell data analytics

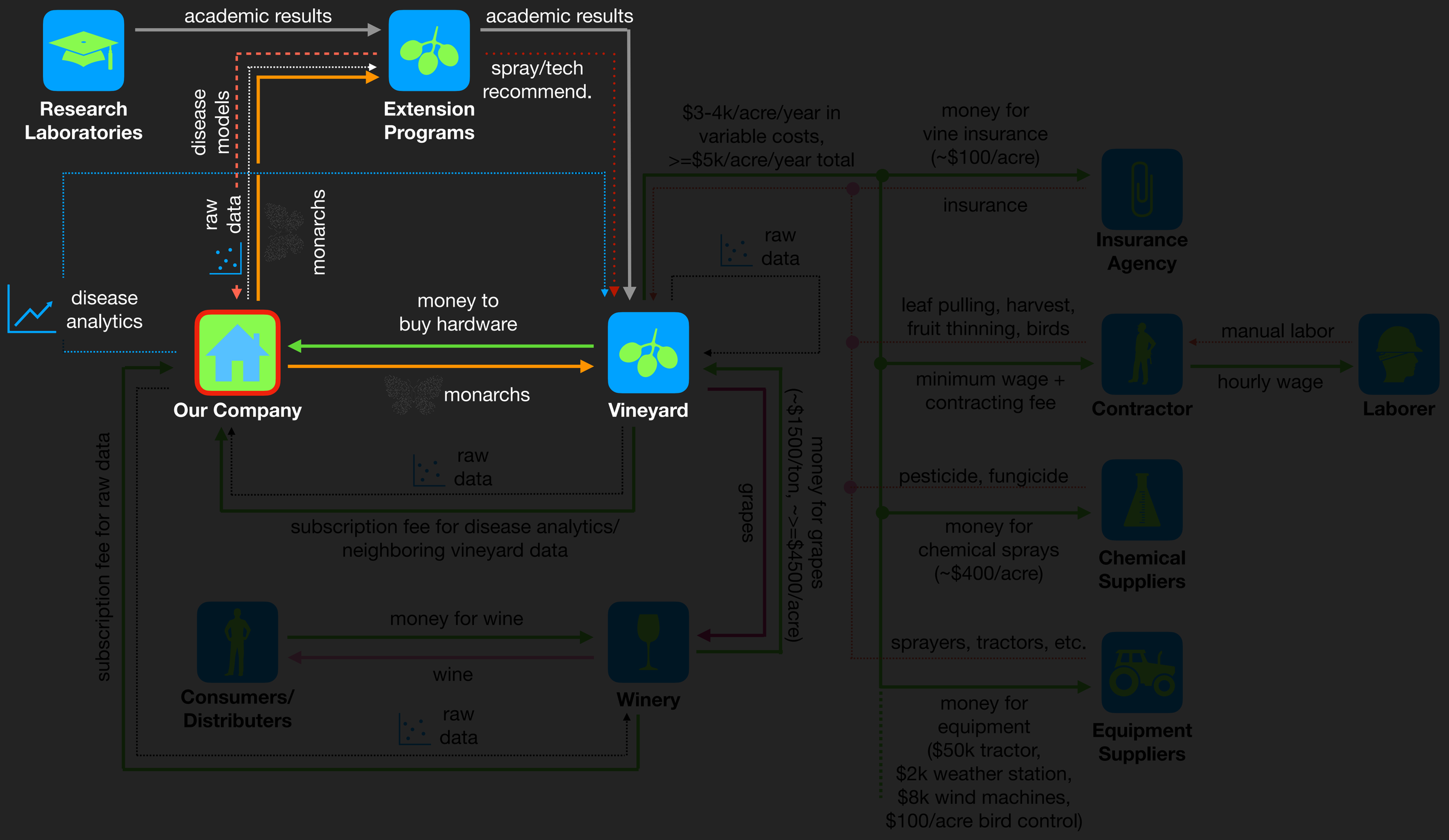

Research Laboratories
academic results
Extension Programs
academic results
spray/tech recommend.
disease models
raw data
monarchs
disease analytics
Our Company
money to buy hardware
monarchs
raw data
Vineyard
raw data
$3-4k/acre/year in variable costs, >=$5k/acre/year total
money for vine insurance (~$100/acre)
insurance
Insurance Agency
leaf pulling, harvest, fruit thinning, birds
minimum wage + contracting fee
Contractor
manual labor
hourly wage
Laborer
pesticide, fungicide
money for chemical sprays (~$400/acre)
Chemical Suppliers
sprayers, tractors, etc.
money for equipment ($50k tractor, $2k weather station, $8k wind machines, $100/acre bird control)
Equipment Suppliers
money for grapes (~$1500/ton, ~>=$4500/acre)
grapes
subscription fee for disease analytics/ neighboring vineyard data
subscription fee for raw data
money for wine
wine
Consumers/ Distributers
Winery
raw data



I learn of every new technology and build my entire spray program through the Finger Lakes Grape Growers meetings with the Cornell Extension.

Annie Bachman - Lakeshore Vineyard


Research Laboratories
academic results
Extension Programs
academic results
spray/tech recommend.
disease models
raw data
monarchs
$3-4k/acre/year in variable costs, >=$5k/acre/year total
money for vine insurance (~$100/acre)
insurance
Insurance Agency
raw data
disease analytics
money to buy hardware
Our Company
monarchs
Vineyard
leaf pulling, harvest, fruit thinning, birds
minimum wage + contracting fee
Contractor
manual labor
hourly wage
Laborer
raw data
subscription fee for disease analytics/ neighboring vineyard data
subscription fee for raw data
grapes
money for grapes (~$1500/ton, ~>=$4500/acre)
pesticide, fungicide
money for chemical sprays (~$400/acre)
Chemical Suppliers
money for wine
wine
Consumers/ Distributers
Winery
raw data
sprayers, tractors, etc.
money for equipment ($50k tractor, $2k weather station, $8k wind machines, $100/acre bird control)
Equipment Suppliers


Research Laboratories
academic results
Extension Programs
academic results
spray/tech recommend.
disease models
raw data
monarchs
disease analytics
Our Company
money to buy hardware
monarchs
Vineyard
raw data
$3-4k/acre/year in variable costs, >=$5k/acre/year total
money for vine insurance (~$100/acre)
insurance
Insurance Agency
leaf pulling, harvest, fruit thinning, birds
minimum wage + contracting fee
Contractor
manual labor
hourly wage
Laborer
pesticide, fungicide
money for chemical sprays (~$400/acre)
Chemical Suppliers
sprayers, tractors, etc.
money for equipment ($50k tractor, $2k weather station, $8k wind machines, $100/acre bird control)
Equipment Suppliers
raw data
subscription fee for disease analytics/ neighboring vineyard data
subscription fee for raw data
grapes
money for grapes (~$1500/ton, ~>=$4500/acre)
money for wine
wine
Consumers/ Distributers
Winery
raw data

The Business Model Canvas

Designed for: **Monarch**

Designed by: Hunter Adams

On:

Iteration:

Key Partners

- Cornell Extension Program (and other academic extension programs)
- New Zealand Winegrowers Research Centre

Key Activities

- Electronics prototyping
- Printed circuit board design
- Hardware installation and maintenance
- Software development

Key Resources

- IP over a critical aspect of the system
- Electronics prototyping facility
- Humans

Value Propositions

- Enable cool-climate vineyard managers to take preventative action agains wine-grape lost to frost.
- Decrease the number of fungicide sprays by 1-3 per season at cool-climate vineyards
- Reduce the probability of a bad growing season by enabling targeted maintenance for frost, fungus, and disease.

Customer Relationships

- Maintenance & updates
- Incentivize data sharing

Channels

- Direct sales
- Online sales

Customer Segments

- Vineyard managers at cool-climate vineyards (end user).

Cost Structure

- Printed circuit board fabrication and assembly
- Receiver station fabrication, assembly, and installation
- Building/facilities costs
- Human beings
- Cloud storage

Revenue Streams

- Hardware sales (low margins to reduce barrier to entry)
- Data monetization through a subscription service - charged in dollars per acre (based on customer discovery preferences)
- Up-sell data analytics

The Business Model Canvas

Designed for: **Monarch**

Designed by: Hunter Adams

On:

Iteration:

Key Partners

- Cornell Extension Program (and other academic extension programs)
- New Zealand Winegrowers Research Centre

Key Activities

- Electronics prototyping
- Printed circuit board design
- Hardware installation and maintenance
- Software development

Key Resources

- IP over a critical aspect of the system
- Electronics prototyping facility
- Humans

Value Propositions

- Enable cool-climate vineyard managers to take preventative action agains wine-grape lost to frost.
- Decrease the number of fungicide sprays by 1-3 per season at cool-climate vineyards
- Reduce the probability of a bad growing season by enabling targeted maintenance for frost, fungus, and disease.

Customer Relationships

- Maintenance & updates
- Incentivize data sharing

Channels

- Direct sales
- Online sales

Customer Segments

- Vineyard managers at cool-climate vineyards (end user).

Cost Structure

- Printed circuit board fabrication and assembly
- Receiver station fabrication, assembly, and installation
- Building/facilities costs
- Human beings
- Cloud storage

Revenue Streams

- Hardware sales (low margins to reduce barrier to entry)
- Data monetization through a subscription service - charged in dollars per acre (based on customer discovery preferences)
- Up-sell data analytics

The Business Model Canvas

Designed for: **Monarch**

Designed by: Hunter Adams

On:

Iteration:

Technology has been disclosed to CTL, they are deciding whether or not it is protectable, and whether or not they would like to protect it.

Key Partners

- Cornell Extension (land-grant partner academic extension programs)
- New Zealand Winegrowers Research Centre

Key Activities

- Electronics prototyping
- Printed circuit board design
- Hardware installation and maintenance
- Software development

Value Propositions

- Enable cool-climate vineyard managers to take preventative action against wine-grape loss to frost
- Decrease the number of fungicide sprays by 1-3 per season at cool-climate vineyards
- Reduce the probability of a bad growing season by enabling targeted maintenance for frost, fungus, and disease.

Customer Relationships

- Maintenance & upgrades
- Incentivize data sharing

Customer Segments

- Vineyard management cool-climate vineyards (end user).

Key Resources

- IP over a critical aspect of the system
- Electronics prototyping facility
- Humans

Channels

- Direct sales
- Online sales

Cost Structure

- Printed circuit board fabrication and assembly
- Receiver station fabrication, assembly, and installation
- Building/facilities costs
- Human beings
- Cloud storage

Revenue Streams

- Hardware sales (low margins to reduce barrier to entry)
- Data monetization through a subscription service - charged in dollars per acre (based on customer discovery preferences)
- Up-sell data analytics

The Business Model Canvas

Designed for: **Monarch**

Designed by: Hunter Adams

On: Day Month Year

Iteration: No.

Key Partners

- Cornell Extension Program (and other academic extension programs)
- New Zealand Winegrowers Research Centre

Key Activities

- Electronics prototyping
- Printed circuit board design
- Hardware installation and maintenance
- Software development

Key Resources

- IP over a critical aspect of the system
- Electronics prototyping facility
- Humans

Value Propositions

- Enable cool-climate vineyard managers to take preventative action agains wine-grape lost to frost.
- Decrease the number of fungicide sprays by 1-3 per season at cool-climate vineyards
- Reduce the probability of a bad growing season by enabling targeted maintenance for frost, fungus, and disease.

Customer Relationships

- Maintenance & updates
- Incentivize data sharing

Channels

- Direct sales
- Online sales

Customer Segments

- Vineyard managers at cool-climate vineyards (end user).

Cost Structure

- Printed circuit board fabrication and assembly
- Receiver station fabrication, assembly, and installation
- Building/facilities costs
- Human beings
- Cloud storage

Revenue Streams

- Hardware sales (low margins to reduce barrier to entry)
- Data monetization through a subscription service - charged in dollars per acre (based on customer discovery preferences)
- Up-sell data analytics

Co-Development of vineyard-specific Monarch with the Cornell Extension, technology demonstration in research and commercial vineyards

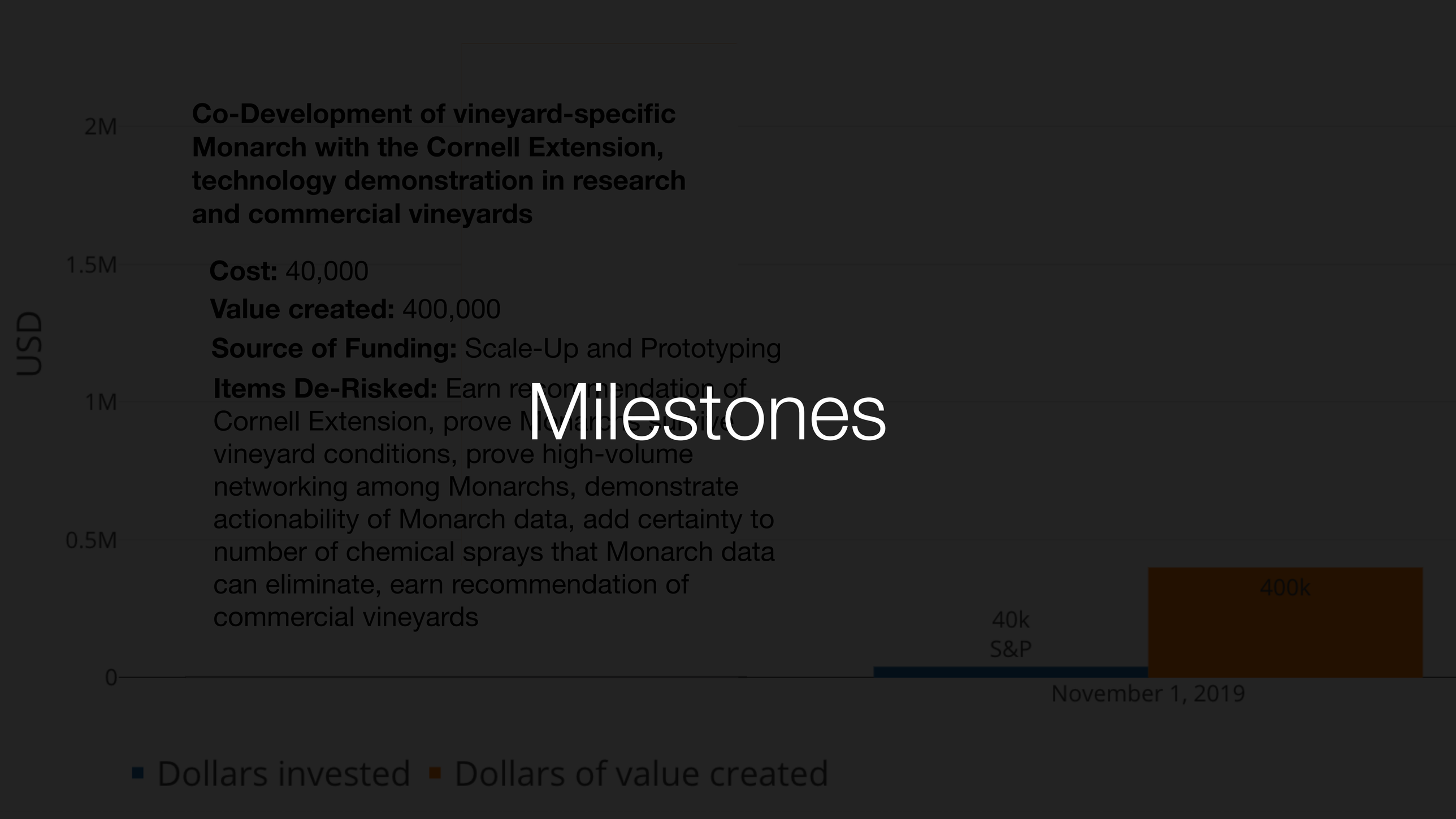
Cost: 40,000

Value created: 400,000

Source of Funding: Scale-Up and Prototyping

Items De-Risked: Earn recommendation of Cornell Extension, prove Monarchs thrive in vineyard conditions, prove high-volume networking among Monarchs, demonstrate actionability of Monarch data, add certainty to number of chemical sprays that Monarch data can eliminate, earn recommendation of commercial vineyards

Milestones



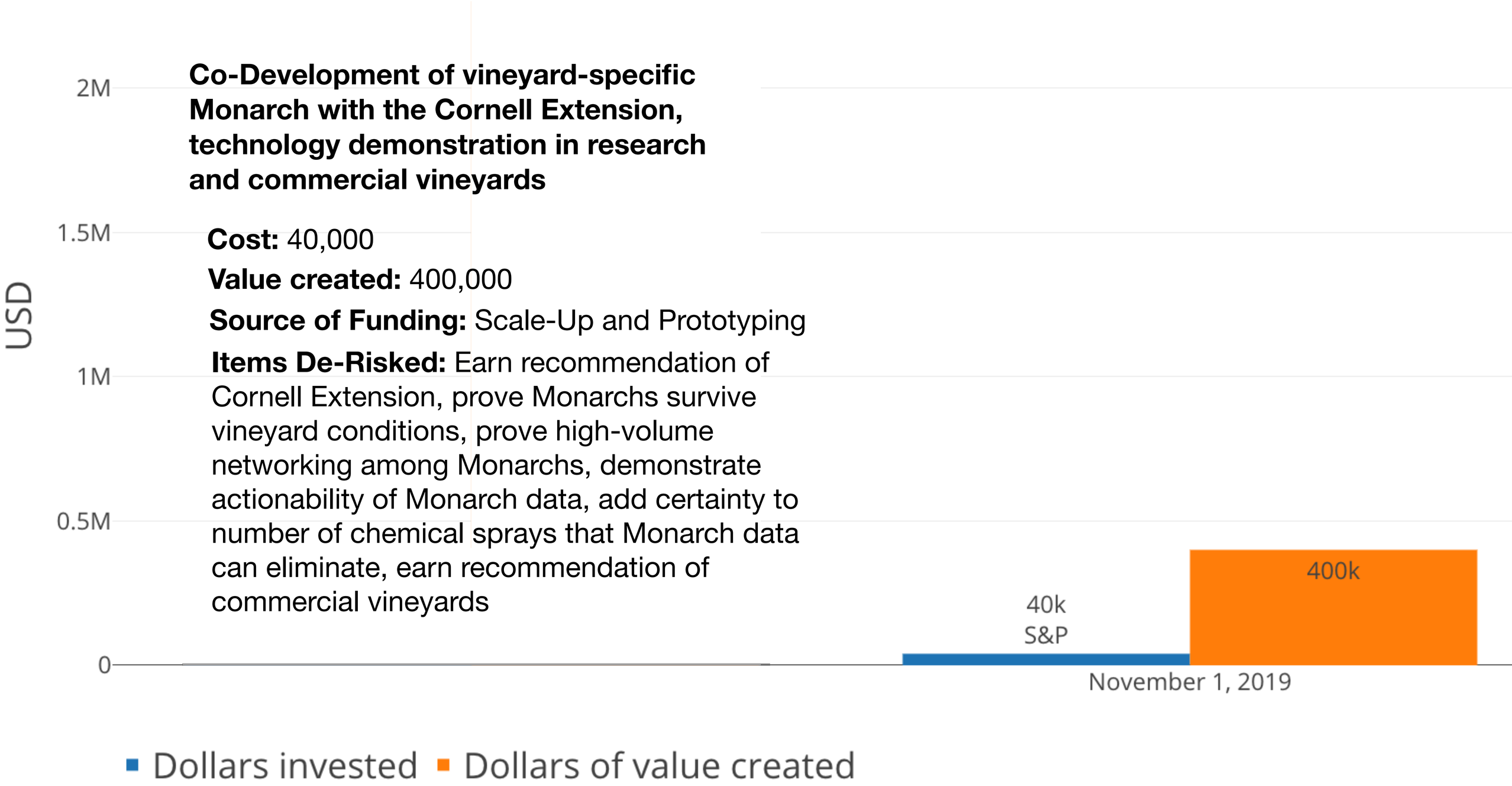
Co-Development of vineyard-specific Monarch with the Cornell Extension, technology demonstration in research and commercial vineyards

Cost: 40,000

Value created: 400,000

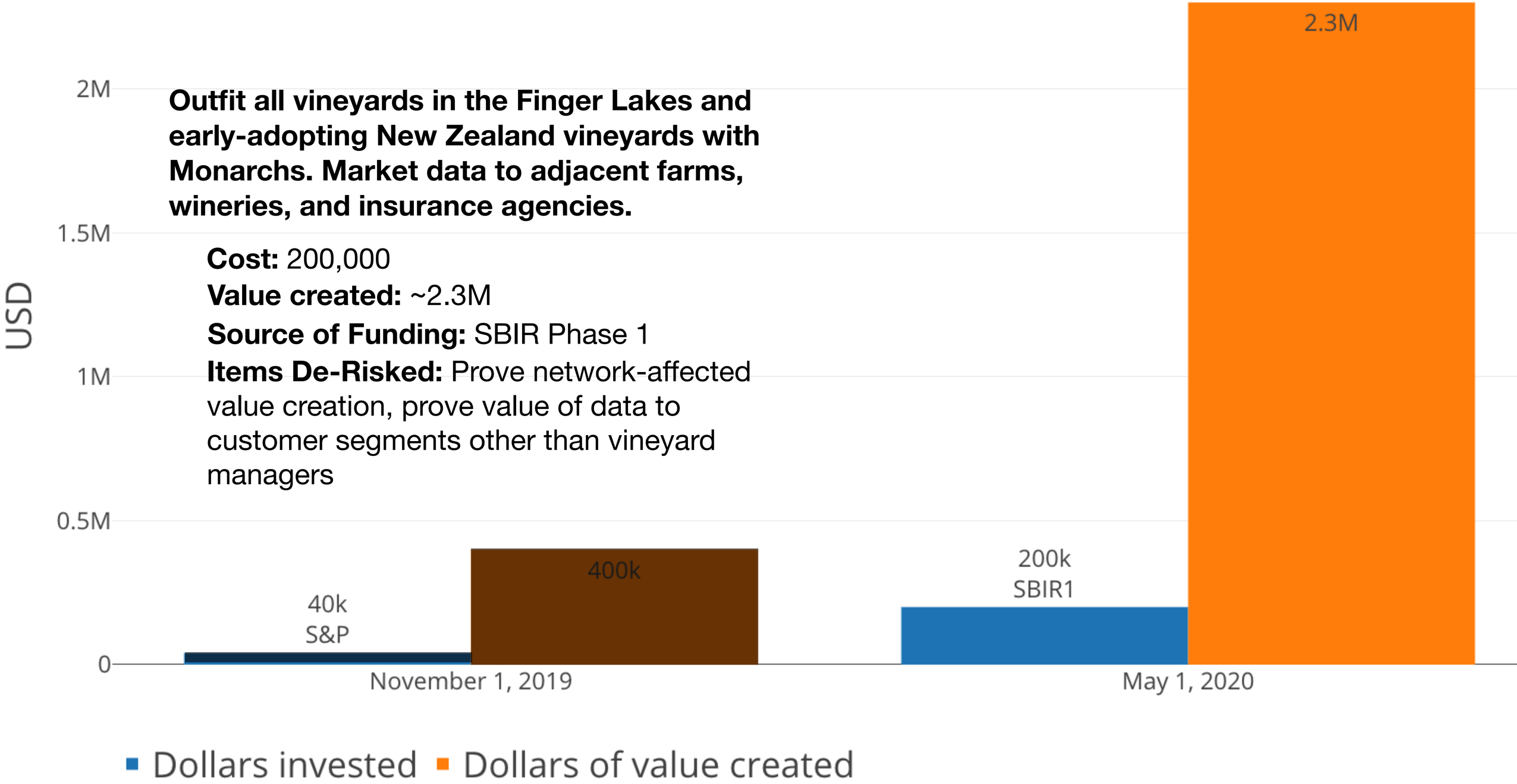
Source of Funding: Scale-Up and Prototyping

Items De-Risked: Earn recommendation of Cornell Extension, prove Monarchs survive vineyard conditions, prove high-volume networking among Monarchs, demonstrate actionability of Monarch data, add certainty to number of chemical sprays that Monarch data can eliminate, earn recommendation of commercial vineyards



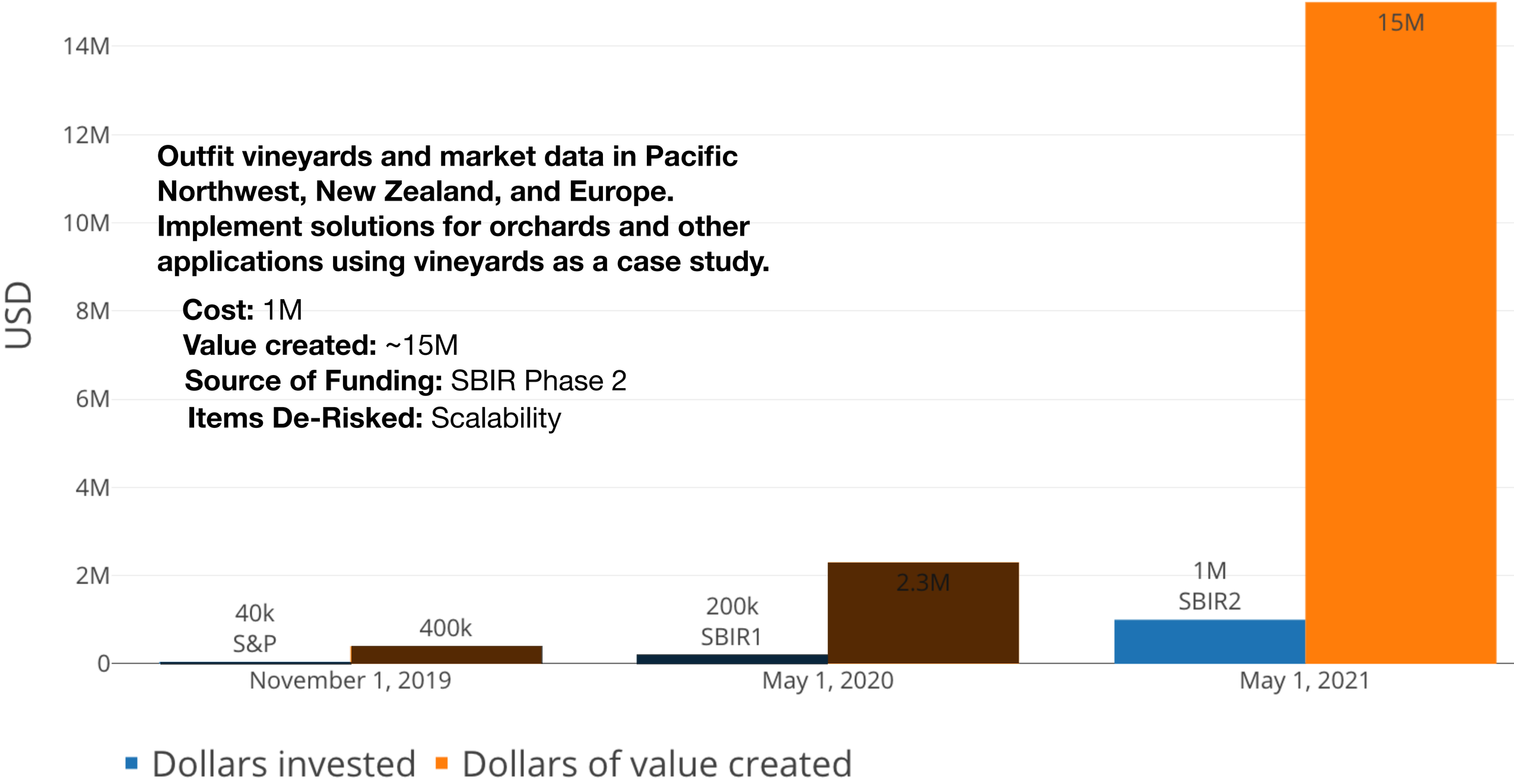
Outfit all vineyards in the Finger Lakes and early-adopting New Zealand vineyards with Monarchs. Market data to adjacent farms, wineries, and insurance agencies.

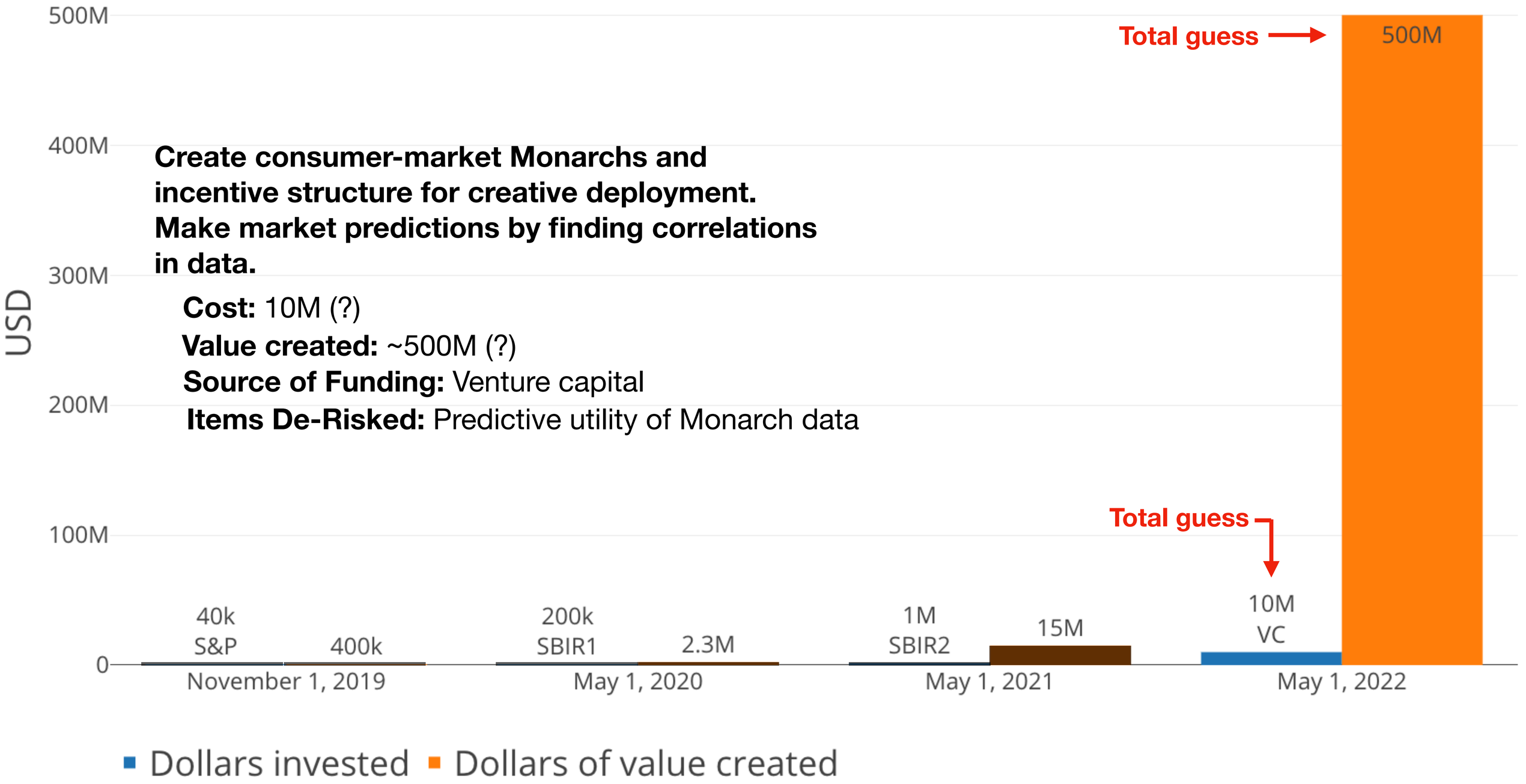
Cost: 200,000
Value created: ~2.3M
Source of Funding: SBIR Phase 1
Items De-Risked: Prove network-affected value creation, prove value of data to customer segments other than vineyard managers



Outfit vineyards and market data in Pacific Northwest, New Zealand, and Europe. Implement solutions for orchards and other applications using vineyards as a case study.

Cost: 1M
Value created: ~15M
Source of Funding: SBIR Phase 2
Items De-Risked: Scalability




500M
400M
300M
200M
100M
0
USD
Total guess
500M
Create consumer-market Monarchs and incentive structure for creative deployment. Make market predictions by finding correlations in data.
Cost: 10M (?)
Value created: ~500M (?)
Source of Funding: Venture capital
Items De-Risked: Predictive utility of Monarch data
Total guess
40k S&P
400k
200k SBIR1
2.3M
1M SBIR2
15M
10M VC
November 1, 2019
May 1, 2020
May 1, 2021
May 1, 2022
Dollars invested
Dollars of value created

Customer discovery in Marlborough and Hawke's Bay, New Zealand

Sept. 1 - Sept. 8, 2018

Co-development of vineyard-specific Monarch with the Cornell Extension

Sept. 2018 - Jan. 2019

Development of advanced, internet-connected receiver

Sept. 2018 - Aug. 2019

✓ *Dairy calf demonstration*

Research-vineyard technology demonstration with minimum-viable receiver

Aug. 2019 - Oct. 2019

Development of minimum viable user interface for data presentation and analytics

Aug. 2019 - Oct. 2019

✓ *Graduation - Jan. 2020*

USDA SBIR Application

Oct. 2019

Commercial testing and value-proving with local vineyards

Nov. 2019 - Nov. 2020

Commercial deployment of Monarchs

March. 2020 -

Blue Origin suborbital launch - 2020

Marketing of vineyard data to wineries, insurance agencies, agricultural consulting firms, and staple-crop farmers via subscription

Vineyard kickbacks from subscriptions for providing data

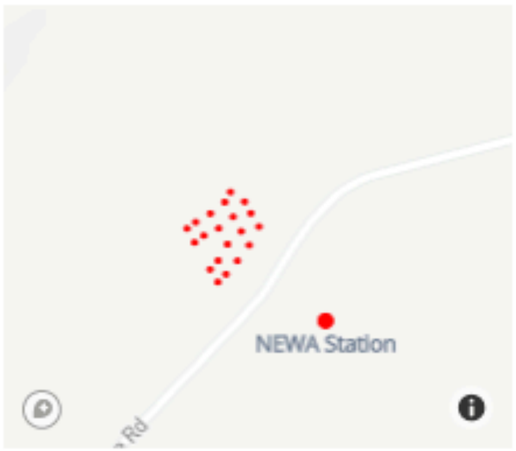
Development of consumer-market Monarch/receiver kits for distribution on Sparkfun

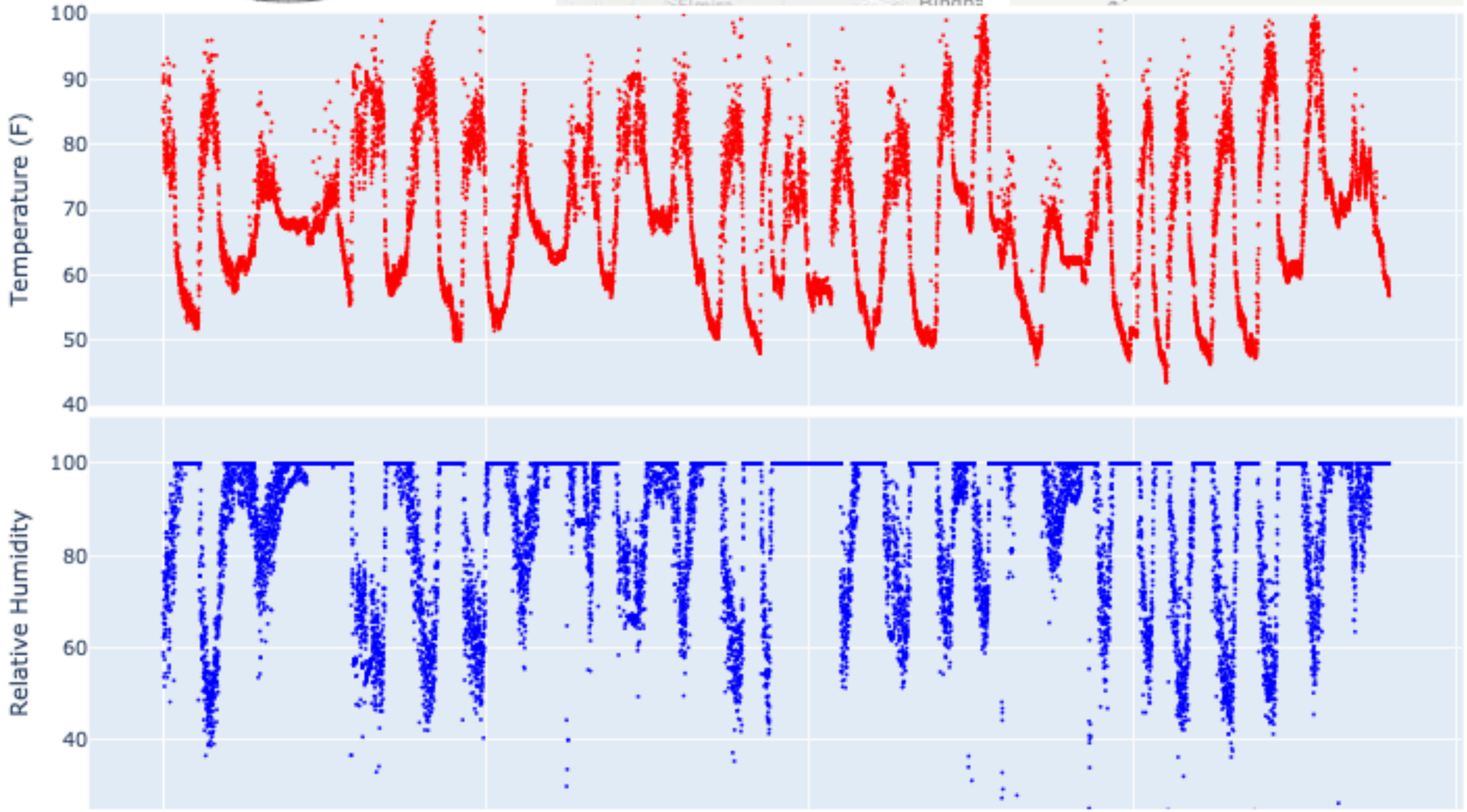
Development of other application-specific Monarchs using vineyards as case study

Realtime-market of kickbacks for data contribution based on data traffic

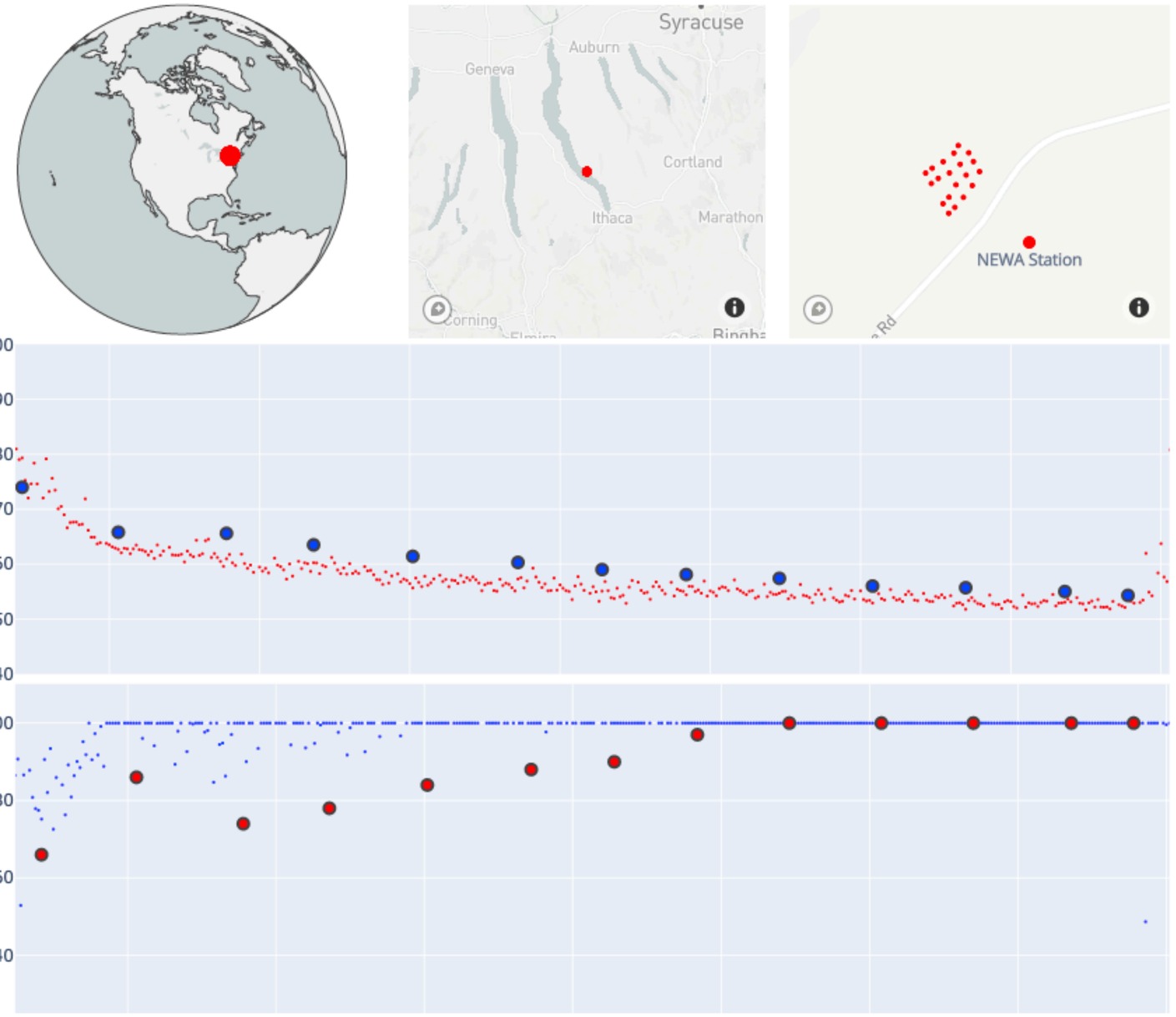
Global network of Monarchs providing realtime data for scientific research and market prediction.

Datasets





5 weeks of data from Cornell research vineyard in Lansing, NY



Night of 8/25 - 8/26/2019

Monarchs measure cooler, more humid air within the leaf canopies than the conventional weather station measures outside the leaf canopies.

I also put them on cows.

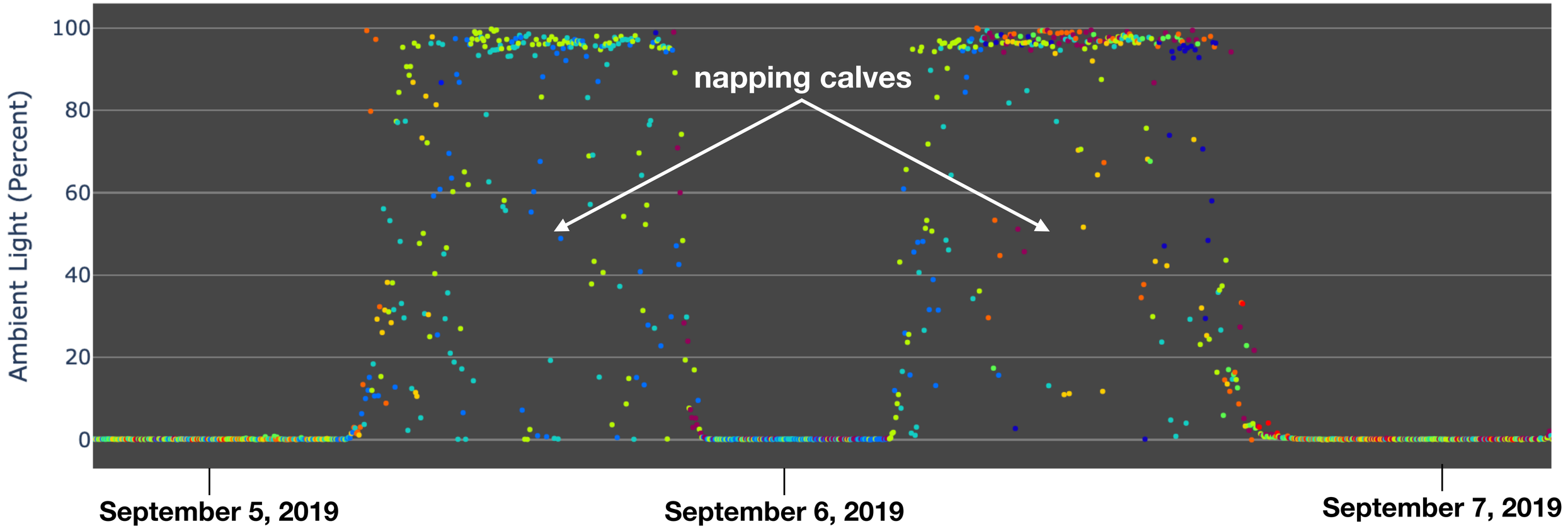
Sunnyside Farms, Scipio Center, NY


38669


003 209 855 531
38684


Altelix

September 4-23, 2019



Monarchs identify napping calves.

Team

Hunter Adams

PhD candidate in aerospace engineering at Cornell University, focused on low-power electronic systems, online state estimation, and multi-agent systems.

Mason Peck

Associate professor of mechanical and aerospace engineering at Cornell University, former CTO of NASA.

With thanks to

Justine Vanden Heuvel

Professor of viticulture, Cornell University

Dan Olmstead

NEWA Coordinator, Cornell University Extension

Will Kerner

Research Program Manager, New Zealand Winegrowers Research Center

and the teaching team.