Submission Guidelines

Outline for 5-Page White Paper Submissions for Data to Decision

1. **Introduction**

   a. Digital twins in urban planning can help break down data silos by creating a unified, integrated view of a city's infrastructure, systems, and operations. This allows for better decision-making, resource allocation, and improved public services by integrating data from various sources, such as GIS, IoT sensors, and BIM models. Data Silos in Urban Planning: Separate Departments: Different city departments (e.g., transportation, utilities, public works) often maintain data in their own systems, making it difficult to share information and coordinate actions. Conflicting Data: Data from different sources may be incomplete, inaccurate, or inconsistent, leading to unreliable decision-making. Limited Visibility: Decision-makers may have limited access to the full picture of how different systems interact, hindering their ability to address complex challenge

   b. Wings of Liberty is designed to help urban decision-makers visualize, simulate, and respond to safety incidents in real-time. It creates a semantic model of the city's physical infrastructure—such as roads, buildings, emergency services, and crowds—while integrating live data from surveillance systems, emergency response units, and IoT sensors (e.g., fire alarms, gunshot detectors, weather stations). This virtual replica enables city officials to simulate emergency scenarios, identify risks early, and coordinate real-time responses—improving public safety outcomes and community resilience with Microsoft Azure Digital Twins.

   FarmerNet is a Artificial Intelligence One of 137 companies chosen for a $15,000 grant with Microsoft AI for Earth for it's state-of-the-art remote estimation of carbon with computer vision models and satellite imagery data and Award winning Ethereum technology for carbon credit NFT marketplaces for decentralized verification and supply chain traceability with accurate ratings for Voluntary Carbon Markets (VCM) .

2. **Proposed Solution Details**

To ensure seamless integration and interoperability of real-time and historical data from multiple urban systems in a Microsoft Azure Digital Twins environment, the approach hinges on leveraging Azure's event-driven architecture, digital modeling language (DTDL), and data federation tools.

🔧 1. Modeling the Urban Environment in Azure Digital Twins

Azure Digital Twins uses the Digital Twins Definition Language (DTDL) to model entities like buildings, traffic signals, public transit, and utilities as graph-based twins with defined relationships.

- Define a unified schema using DTDL to represent:
  - Building, StreetLight, BusStop, AirQualitySensor, etc.
  - Relationships like locatedIn, connectedTo, poweredBy.

This model acts as the semantic foundation for harmonizing disparate datasets.

🔌 2. Real-Time Data Ingestion via Azure IoT Hub & Event Grid

- IoT Hub ingests real-time telemetry from sensors (air quality, smart meters, traffic cams).
- Use Azure Functions or Stream Analytics to transform and route events.
- Events are published to Event Grid, triggering updates to relevant digital twins.

Example:

```
{
 "busStopId": "BS-102",
 "timestamp": "2025-06-01T12:00:00Z",
 "passengerCount": 42,
 "temperature": 31.2
}
```

This data would be parsed and mapped to the BusStop twin's properties or telemetry stream.

🕰️ 3. Historical Data Storage and Replay

- Time Series Insights (TSI): Store telemetry for historical trend analysis.
- Azure Data Lake / Synapse Analytics: For large-scale, long-term storage and analytics.
- Historical data is linked via twin IDs and visualized through APIs or Power BI dashboards.

Usage:

- Compare past vs. current air quality.
- Replay a week of traffic data to simulate policy impacts.

🌐 4. Interoperability with External Systems (GIS, Transportation, Utilities)

- Use Azure Data Factory to integrate batch data from:
  - GIS systems (via GeoJSON/KML)
  - SCADA/utility backends
  - Transportation APIs (GTFS/GTFS-RT feeds)
- Convert external schemas into twin-compatible formats using:
  - Data mapping pipelines
  - Custom adapters
  - Microsoft Graph Connectors (for enterprise data)

🧠 5. Contextual Data Presentation

- Power BI with Azure Digital Twins connector: Visualizes live twin states alongside historical trends.

- Custom dashboards (React/Mapbox/Azure Maps):
    - Real-time overlays of traffic, pollution, occupancy
    - "What-if" scenario simulations (e.g., blackout, road closures)

🔁 6. Harmonization via Knowledge Graph Approach
Azure Digital Twins functions as a contextual layer, allowing:

- Cross-domain linking: e.g., a school's indoor air quality linked to nearby traffic congestion
- Unified queries using Azure Data Explorer (ADX) or GraphQL over twins
- Reasoning across domains using AI/ML in Azure Machine Learning

In the context of Microsoft Azure Digital Twins, enhancing real-time urban management and decision-making involves integrating AI-driven analytics, event-based processing, and simulation tools that leverage the live graph of interconnected digital entities. Below is a technical breakdown of tools and models that empower city leaders to make informed, proactive, and time-sensitive decisions:

🧠 1. Azure Machine Learning for Predictive & Prescriptive Analytics
Azure ML can be trained on historical and real-time data from digital twins to provide:

🔹 Predictive Models

- Traffic flow prediction (based on weather, events, historical congestion)
- Energy consumption forecasting (by district, building type, time of day)
- Public health anomaly detection (e.g., sudden rise in air pollutants)

🔹 Prescriptive Models

- Recommending dynamic rerouting in transportation networks
- Suggesting load balancing for energy grids
- Triggering automated HVAC adjustments for sustainability

Integration: Use Azure Functions or Logic Apps to trigger ML inferencing workflows as events flow through Event Grid from Digital Twins.

⚙️ 2. Azure Stream Analytics for Real-Time Event Processing
Real-time telemetry from urban systems is streamed into Azure Stream Analytics, where you can:

- Define SQL-like rules to detect anomalies or threshold breaches
- Output insights to dashboards, alerting systems, or update digital twins

→ This rule could trigger a heatwave alert for vulnerable populations or adjust smart shading systems in city zones.

🌐 3. Cognitive Services for Contextual Understanding

- Computer Vision: Analyze CCTV feeds for crowd density, traffic accidents
- Speech/Text Analytics: Analyze citizen helpline calls or social media for incident detection
  Language Understanding (LUIS): Help voice-enabled command centers understand natural language inputs

→ These can feed non-IoT insights into the Digital Twin graph (e.g., tagging a zone as "crowded" or "accident-prone").

🧠 4. Simulation & Scenario Modeling with Azure Synapse + ADT

Use Azure Synapse Analytics + Time Series Insights + the ADT graph to simulate urban scenarios:

- Evacuation routing during emergencies
- Infrastructure stress testing (e.g., power grid under heatwave)
- Public transport load balancing if a major road is closed

You can run "what-if" simulations and visualize the results on a map-based dashboard (e.g., Azure Maps or Power BI with Azure Digital Twins connector).

📊 5. Decision Dashboards with Real-Time Insights
Power BI + Azure Digital Twins

- Live twin telemetry
- ML prediction overlays
- Interactive filtering by zone, time, or system type

Custom React Dashboards with Azure Maps

- AI insights overlaid on geospatial layers (traffic, pollution, infrastructure)Real-time control triggers (e.g., reroute traffic, change light patterns)

🛠️ 6. Event-Driven Automation for Proactive Response
Use Azure Logic Apps or Durable Functions to define workflows that auto-respond to real-time conditions:

- Close digital signage in a flooded subway entrance
  Alert utility teams when pressure drops in water lines
- Notify emergency services when vision AI detects a vehicle collision

These systems turn AI-driven insights into automated, proactive actions.

🎯 GOAL:
Enable city leaders, planners, and public safety officials to interpret, interact with, and act upon data without needing technical expertise in IoT, machine learning, or programming.

🧩 1. Digital Twin Graph + Azure Maps = Intuitive Spatial Visualization
🧠 What Happens:
The Azure Digital Twins platform models the entire urban environment as a graph of entities and relationships—buildings, intersections, utilities, sensors, people, and more.
🗺️ Visualization Layer:

- Overlay the twin graph on Azure Maps or Power BI, showing:
    - Real-time heatmaps (e.g., noise, pollution, congestion)
    - Dynamic icons (e.g., malfunctioning sensors, water leak zones)
    - Geofenced alerts and color-coded zones (e.g., red for danger, green for resolved)

🧑‍💼 Benefit for Officials: They see city-wide patterns at a glance, with clickable regions that show details like status, ML-driven predictions, and action buttons.

🧠 2. Power BI + Azure Digital Twins Connector = Executive Dashboards
Features:

- Low-code interface with drag-and-drop visual tools
- Real-time dashboards connected to ADT graph and telemetry
- Embedded AI Insights (e.g., forecasting cards, anomaly detection visual cues)

🧑‍💼 Use Case: A city health officer monitors asthma-related emergency calls and sees predictive surges in specific neighborhoods due to rising particulate matter—without needing to know SQL or data science.

🤖 3. Conversational Interfaces with Azure OpenAI + ADT

🧑‍💼 Benefit: Officials don't need to explore dashboards—they can talk to the data.

🎥 4. Mixed Reality + 3D Visualization (HoloLens, Unity, Babylon.js)
Advanced UX:

- Full 3D models of city infrastructure mapped to the twin graph
- Real-time sensor overlays in AR/VR (e.g., water pressure, traffic)
- Scenario playback: "What happened in the flood zone 10 minutes ago?"

Microsoft Tools:

- Azure Remote Rendering for high-fidelity city models
- Babylon.js + Azure Digital Twins SDK for browser-based 3D views

🧑‍💼 Example: Urban planners walk through a virtual reconstruction of traffic flow before and after a new bike lane proposal.

🛠️ 5. Personalized Alerting & Role-Based Dashboards

- Role-based access control (RBAC) filters what each official sees
- Mayors get high-level KPI visualizations
- Fire chiefs get incident heatmaps and resource locations
- Utility heads get system diagnostics

When using Microsoft Azure Digital Twins in smart urban environments, ensuring data privacy, security, and transparency is a top priority—especially as cities handle sensitive information across IoT, transportation, utilities, and citizen data.

🔐 1. Granular Access Control with Azure Role-Based Access Control (RBAC)

- Use RBAC to assign fine-grained permissions to specific users or systems.
- Twin-level and property-level access:

    - Example: A utility provider can access electrical grid twins but not residential HVAC twins.

- Supports Active Directory integration for user identity verification.

✅ Privacy Benefit: Only authorized stakeholders access specific slices of the twin graph.

🧩 2. Data Partitioning and Isolation with Digital Twin Models & Instances

- Segregate sensitive vs. public data in your twin graph structure.
    - Example: Health-related environmental twins are separated from public traffic flow models.
- Implement virtual network isolation using Azure Private Link to restrict exposure.

✅ Security Benefit: Limits attack surfaces and enforces clear data boundaries.

🔍 3. Data Lineage and Transparency via Twin Graph Querying

- Use the ADT graph and Digital Twin Definition Language (DTDL) to track:
    - Source of data (sensor ID, timestamp, device location)
    - History of interactions (e.g., who accessed or modified twin state)

✅ Transparency Benefit: City leaders and citizens can see where data came from and how it was used.

🧠 4. Privacy-Preserving Analytics Using Azure Confidential Computing + Edge AI

- Deploy AI models at the Edge (IoT Edge, Edge runtime) to process sensitive data locally before sharing aggregated or anonymized results.
    - Example: Smart cameras compute foot traffic patterns without uploading raw footage.
- Use Azure Confidential VMs or Enclaves for sensitive data processing in memory-encrypted environments.

✅ Privacy Innovation: Reduces central exposure of raw, identifiable data.

🔒 5. Encryption In Transit and At Rest

- All data flowing into or out of Azure Digital Twins is protected using TLS 1.2+
- Stored telemetry, models, and twin data are encrypted using Azure-managed keys or customer-managed keys (CMKs)

✅ Security Foundation: Meets compliance standards (ISO 27001, SOC 2, GDPR)

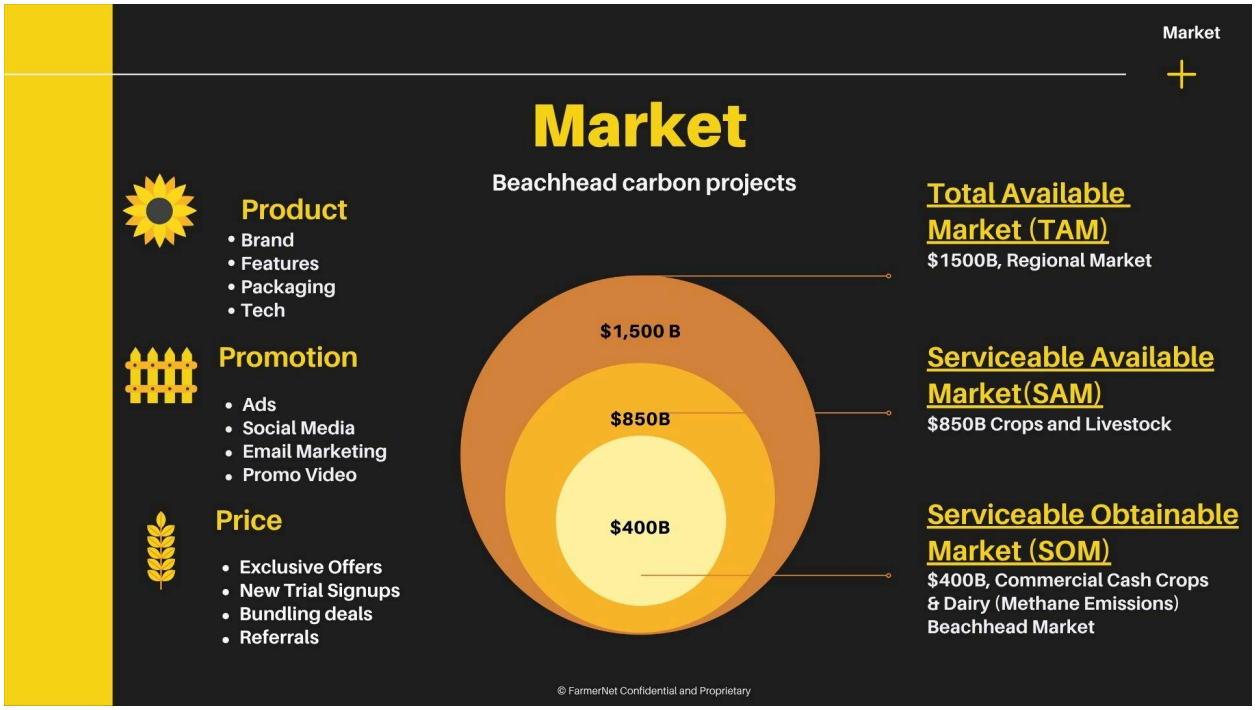
---

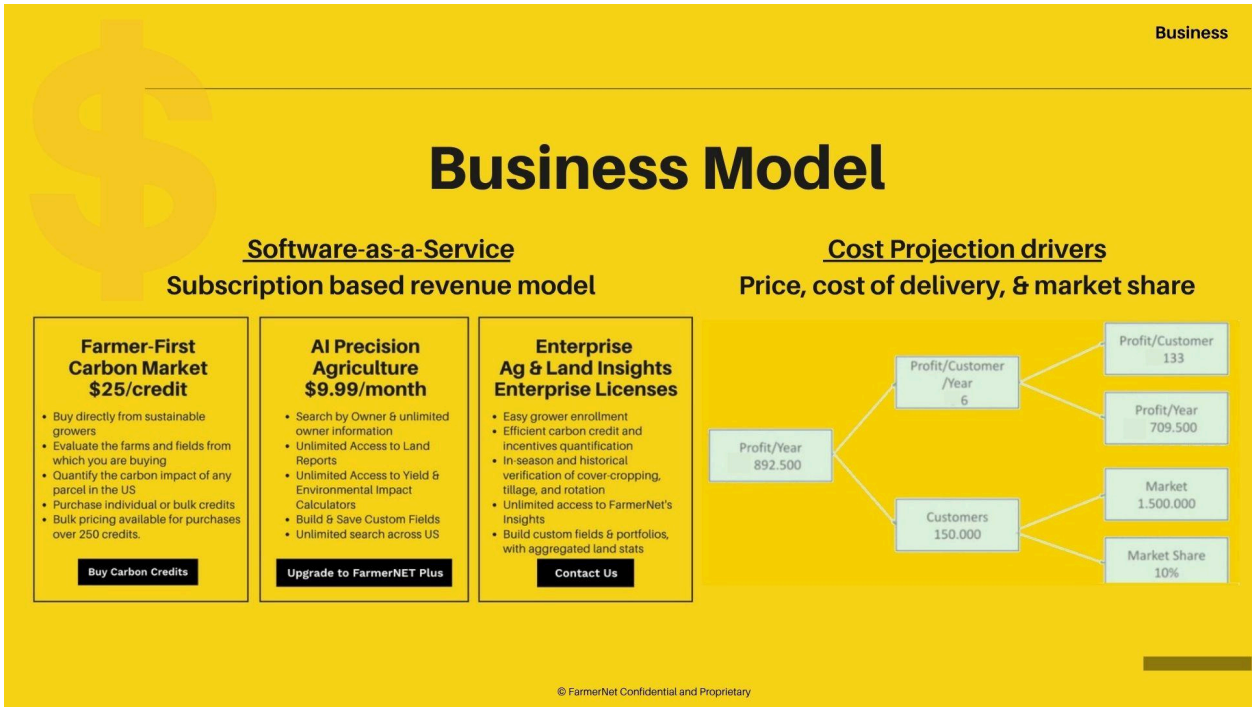
3. **Potential Impact**

   Faster Response Times: Real-time situational awareness and geospatial alerts enable quicker mobilization of emergency services. Reduced Casualties and Property Damage: Predictive maintenance and hazard detection reduce incident occurrence and improve preparedness. Cross-Agency Coordination: Unified data layer supports joint operations between fire, police, healthcare, and public works. Data-Driven Planning: Insights support pre-emptive strategies for festivals, traffic reroutes, protests, or extreme weather.

4. **Team Experience and Capabilities**

5. **Expected Outcomes**


Market
Market
Beachhead carbon projects
Product
• Brand
• Features
• Packaging
• Tech
Promotion
• Ads
• Social Media
• Email Marketing
• Promo Video
Price
• Exclusive Offers
• New Trial Signups
• Bundling deals
• Referrals
$1,500 B
$850B
$400B
Total Available Market (TAM)
$1500B, Regional Market
Serviceable Available Market(SAM)
$850B Crops and Livestock
Serviceable Obtainable Market (SOM)
$400B, Commercial Cash Crops & Dairy (Methane Emissions) Beachhead Market
© FarmerNet Confidential and Proprietary


Business
Business Model
Software-as-a-Service
Subscription based revenue model
Farmer-First Carbon Market $25/credit
• Buy directly from sustainable growers
• Evaluate the farms and fields from which you are buying
• Quantify the carbon impact of any parcel in the US
• Purchase individual or bulk credits
• Bulk pricing available for purchases over 250 credits.
Buy Carbon Credits
AI Precision Agriculture $9.99/month
• Search by Owner & unlimited owner information
• Unlimited Access to Land Reports
• Unlimited Access to Yield & Environmental Impact Calculators
• Build & Save Custom Fields
• Unlimited search across US
Upgrade to FarmerNET Plus
Enterprise Ag & Land Insights Enterprise Licenses
• Easy grower enrollment
• Efficient carbon credit and incentives quantification
• In-season and historical verification of cover-cropping, tillage, and rotation
• Unlimited access to FarmerNet's insights
• Build custom fields & portfolios, with aggregated land stats
Contact Us
Cost Projection drivers
Price, cost of delivery, & market share
Profit/Year 892.500
Profit/Customer /Year 6
Customers 150.000
Profit/Customer 133
Profit/Year 709.500
Market 1.500.000
Market Share 10%
© FarmerNet Confidential and Proprietary

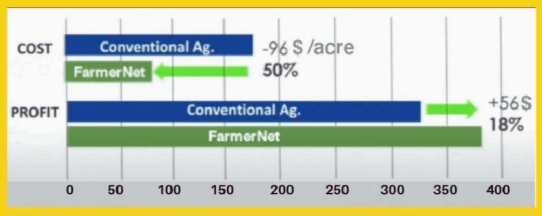
Competitive Analysis

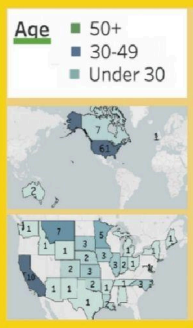
FarmerNet's Advantages

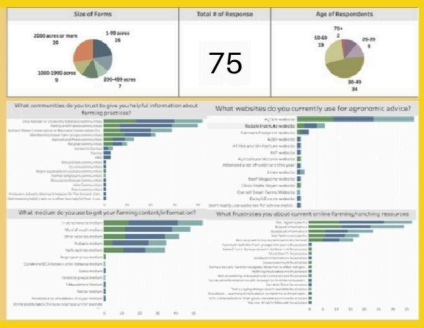
- Highly scalable and modular technology
- Provisional patents and white paper
- Low cost installation, operations, and maintenance
- Sustainable and environmentally friendly

Customer Value Proposition

Reduces average measurement, reporting, and verification (MRV) software cost 50% cheaper with 18% greater profitability using AI POWERED TECHNOLOGY

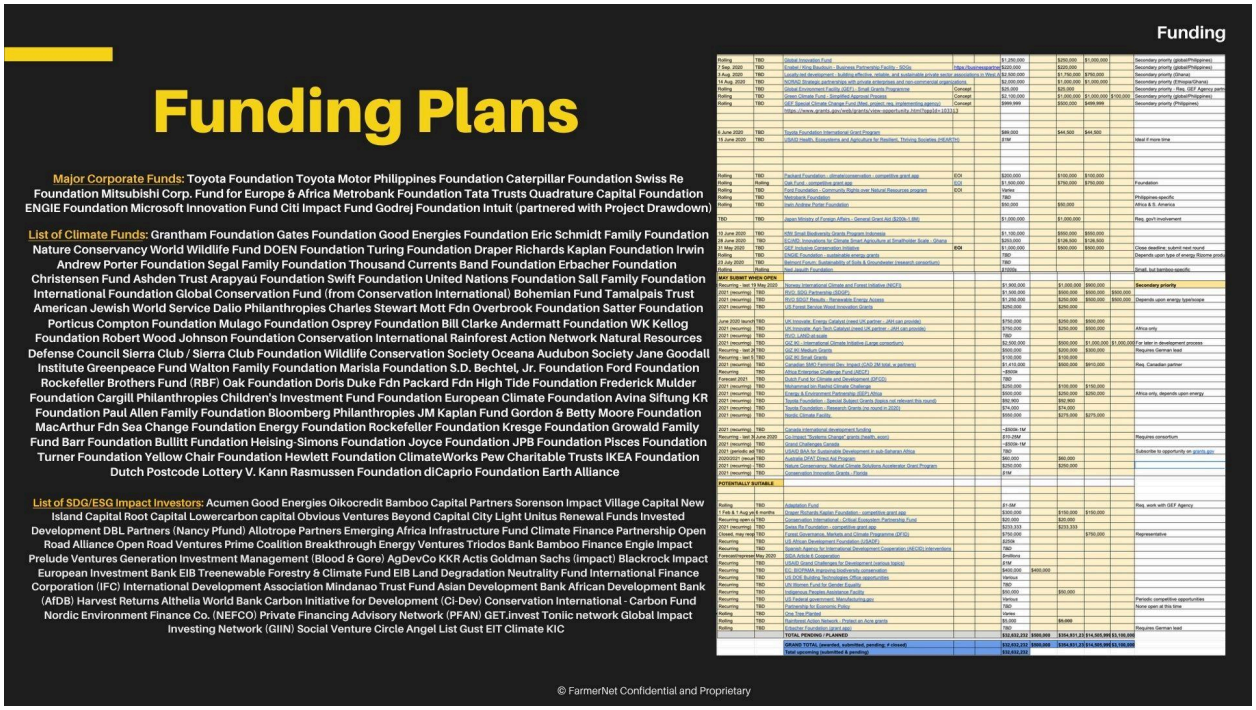


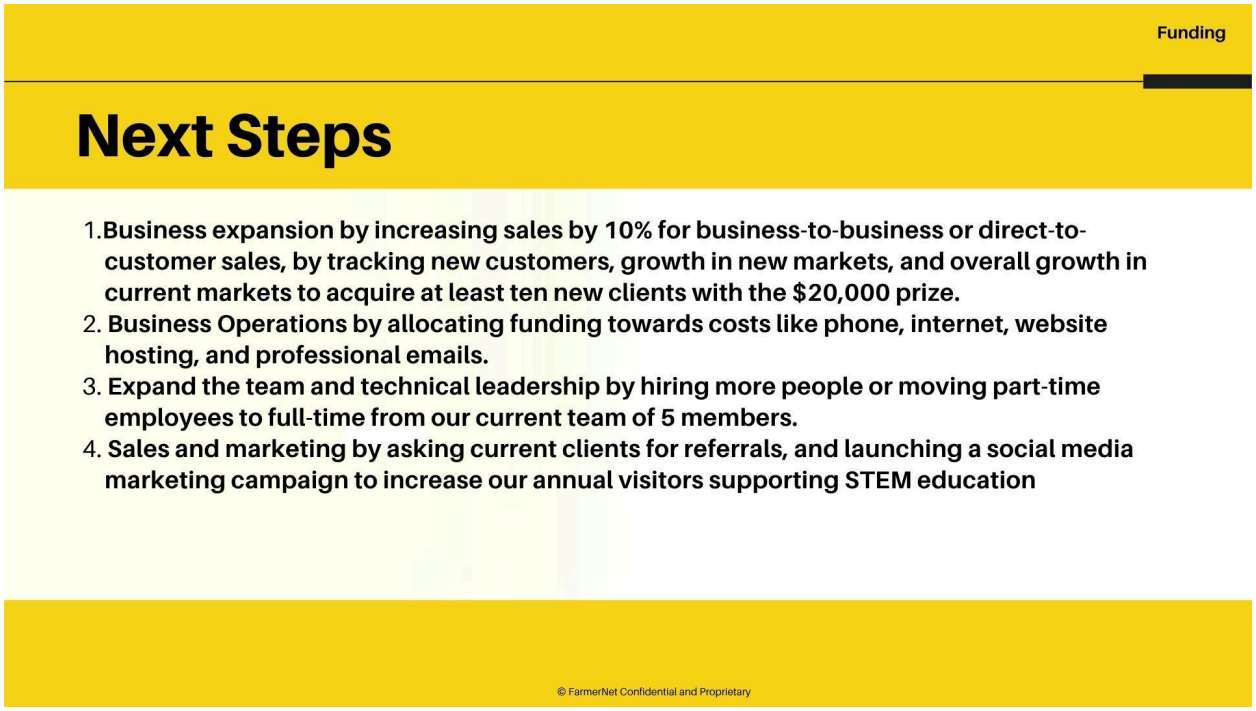




Mean total crop production is projected to decline by 18% under 2 °C of global warming https://www.pnas.org/content/115/26/6644

⋆Customer Discovery Interviews





6. **Conclusion**

a. Our solution uses **Azure Digital Twins** integrated with **real-time IoT data** to create a live, interactive model of city infrastructure—starting with smart bus stops. By connecting **Azure IoT Hub**, **Event Grid**, and **Azure Functions**, sensor data like air quality and temperature is instantly visualized and updated in the digital twin.This architecture enables **real-time monitoring, predictive insights**, and **scalable integration** across smart city systems. Its strength lies in **low-latency data flow, cloud-native scalability, and visual clarity**, empowering cities to make data-driven decisions for public services and sustainability