Start-Up Thinking
How Systems Thinking Helps Entrepreneurial Ventures Start, Grow, and Mature

Redefining Rural Refrigeration

Sorin Grama
+1 415 847 9017
sorin@promethean-power.com
November 28, 2011

©Copyright 2011, Promethean Power Systems, Inc.
Agenda

- System Evolution – a story
- Frame-by-frame analysis
- Startup thinking
The Inspiration
Milk Collection Process
Milk Collection – Racing Against Time

**Hour 1**
- Limited Milk Supply
  (No access to remote dairy farmers)

**Hour 2**
- Village Collector
  - Racing Against Time

**Hour 3**
- Truck Driver
  - High Transportation Cost
    (Multiple Trips)

**Hour 4**
- Dairy Processor
  - Lower Quality
    (High Bacteria Count)

Bacterial Growth over time →
Milk Chiller Architecture – Top Level
Standard Milk Chiller Architecture

- Grid
- Electrical Power
- Condenser
- Compressor
- Cooling Power
- Stainless Steel Silo
- Agitator
- Milk

©Copyright 2011, Promethean Power Systems, Inc.
Rural Milk Chiller Architecture

Unreliable Power

 Diesel Generator

 Grid

Electrical Power

 Condenser

 Compressor

 Cooling Power

 Stainless Steel Silo

 Agitator

 Milk

©Copyright 2011, Promethean Power Systems, Inc.
Rural Milk Chiller

©Copyright 2011, Promethean Power Systems, Inc.
Prior Knowledge – Solar
Rural Milk Chiller Architecture

Solar

Electrical Power

Condenser

Compressor

Cooling Power

Stainless Steel Silo

Agitator
Gen1 Installation – March 2010

©Copyright 2011, Promethean Power Systems, Inc.
Promethean’s Milk Chiller Architecture
Generation 1

Solar

Electrical Power

Ice

Thermal Energy Storage Unit

Rapid Chiller
SS Silo
Agitator

Cooling Power

©Copyright 2011, Promethean Power Systems, Inc.
Promethean’s Milk Chiller Architecture
Generation 2

Unreliable Power
- Grid

Solar

Electrical Power
- Condenser
- Compressor

Cooling Power
- Thermal Energy Storage Unit

Cooling Power
- Rapid Chiller
  - SS Silo
  - Agitator

©Copyright 2011, Promethean Power Systems, Inc.
Gen 2 Installation – March 2011

©Copyright 2011, Promethean Power Systems, Inc.
Promethean’s Milk Chiller Architecture
Generation 2

Solar
Unreliable Power
Grid

Electrical Power

Condenser
Compressor

Cooling Power

Thermal Energy Storage Unit

Cooling Power

Rapid Chiller
SS Silo
Agitator

©Copyright 2011, Promethean Power Systems, Inc.
Promethean’s Milk Chiller Architecture
Generation 2.5

- Diesel Generator
- Condenser
- Rapid Chiller
- Electrical Power
- Compressor
- Cooling Power
- Grid
Gen 2.5
Promethean’s Milk Chiller Architecture
Generation 1

Solar

Electrical Power

Thermal Energy Storage Unit

Ice

Rapid Chiller
SS Silo
Agitator

Cooling Power

©Copyright 2011, Promethean Power Systems, Inc.
Promethean’s Milk Chiller Architecture
Generation 2
Promethean’s Milk Chiller Architecture
Generation 3

4-5 Hours of Grid

Electrical Power

Condenser
Compressor

Cooling Power

Thermal Energy Storage Unit

Cooling Power

Rapid Chiller
SS Silo
Agitator

Cooling Power

©Copyright 2011, Promethean Power Systems, Inc.
System Evolution

Operating Cost

Capital Cost

Gen 1 Ice

Gen 2.5 RMC

Gen 3 TSS

Gen 2 Solar

©Copyright 2011, Promethean Power Systems, Inc.
Start-up Thinking

1. Beware the Voice of the Customer
2. Funding as system input & project milestone
3. Optimize for minimal set of viable features
4. Pivoting is essential; system boundaries are flexible
5. Stay focused on the problem, not the solution
The Problem We’re Solving

Current Solution: Diesel Generator
The Problem We’re Solving

Unreliable Electricity in Villages = Low Milk Quality + High Transportation Cost
Our Solution – Cool Milk with 5 Hours of Grid

Rapidly cools milk from 34 °C to 4 °C

Thermal Energy Battery
• 5 hours to charge
• Can cool 500L milk

Rapid Milk Chiller
• Rapidly cools milk from 34 °C to 4 °C

©Copyright 2011, Promethean Power Systems, Inc.
Further Reading

Case Study: Can Solar Power Pay?


©Copyright 2011, Promethean Power Systems, Inc.
Summary – Promethean Power

- Developing innovative solutions for cold chain supply
- First application – milk cooling
  - Fruits & vegetables, vaccines, vending machines
- Portfolio of patent-pending technologies
  - Thermal Energy Storage
- Received purchase orders from Indian dairies
- Raising Series B funding & hiring in India
Start-Up Thinking
How Systems Thinking Helps Entrepreneurial Ventures Start, Grow, and Mature

Redefining Rural Refrigeration

Sorin Grama
+1 415 847 9017
sorin@promethean-power.com
November 28, 2011

©Copyright 2011, Promethean Power Systems, Inc.