Xcel Energy 2016 Energy Efficiency Expo

GreenLean™ – A Practical Approach

100KFLOPS
per KWHr

IBM 650

3GFLOPS
per KWHr

Titan Cray XK7

Presented by: Samuel S. Gould

Potential for Eliminating Wastes

Results for 60 completed reviews

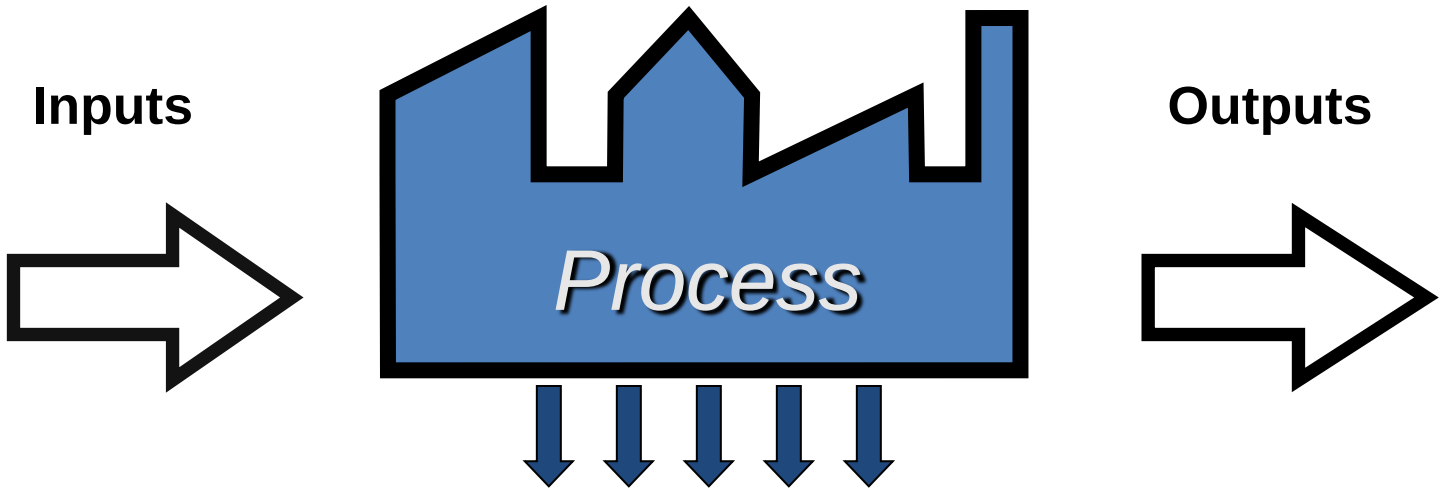
Total Potential Savings	**$35,126,750/yr**
Lean Opportunities	$23,682,524/yr
Clean Opportunities	$10,945,033/yr
Other Opportunities	$499,193/yr
One-Time Lean Opportunities	$19,829,477 **Roughly $250K**

Identifying Green Wastes

Results for 60 completed reviews

Energy Conservation	101,584,483 kWh
Water Conservation	35,320,965 gal
Water Pollution Reduction	19,477,288 lbs
Air Emissions Reduction	156,346 lbs
Solid Waste Reduction	3,471,901 lbs **Roughly 25 Tons**

Focusing on Eliminating Wastes



Capital

Labor

Materials

Wastes

Time

Energy

Water

Landfill

Etc.

Value Added

Products

Services

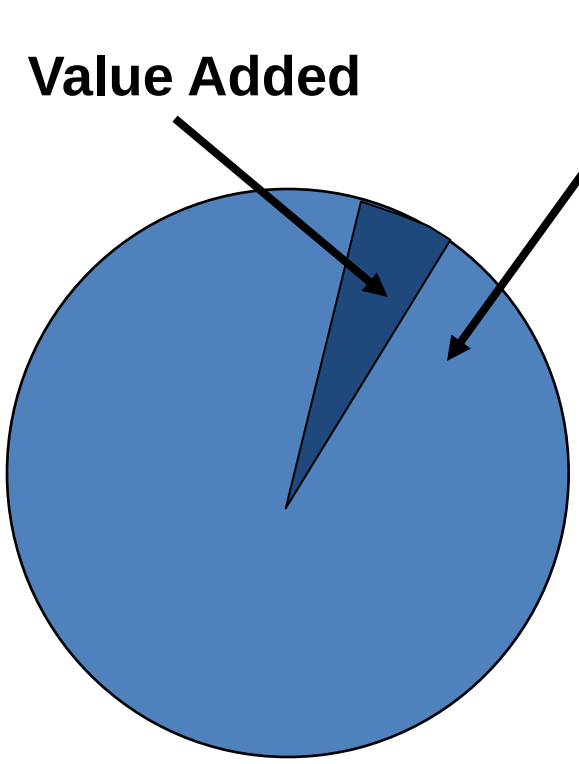
Defining Lean

Lean has been defined in many different ways.

“Lean is about People, Simplicity, Flow, Visibility, Partnerships, Integrity, and True Value, as perceived by the customer.”

‘SME Speaks’
November 2003

Identification of Green Wastes



- Overproduction
- Waiting
- Transportation
- NVA Processing
- Excess Inventory
- Defects
- Excess Motion
- Underutilized People

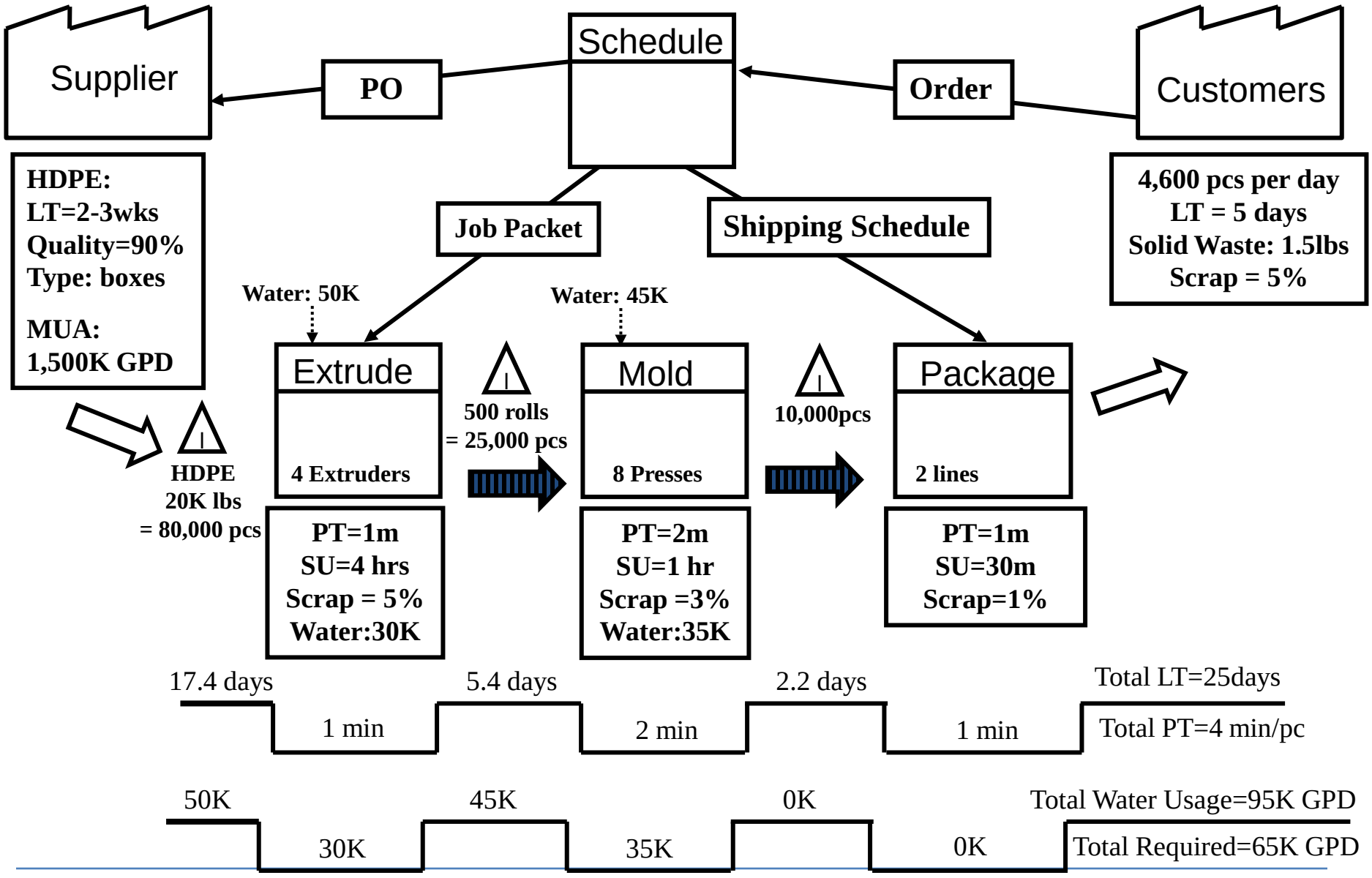
- Energy
- Water
- Material
- Packaging
- Emission
- Landfill (Burn)
- Discharge
- Imbalance

Typically 95% of resources (time, material, capital) are non-value added

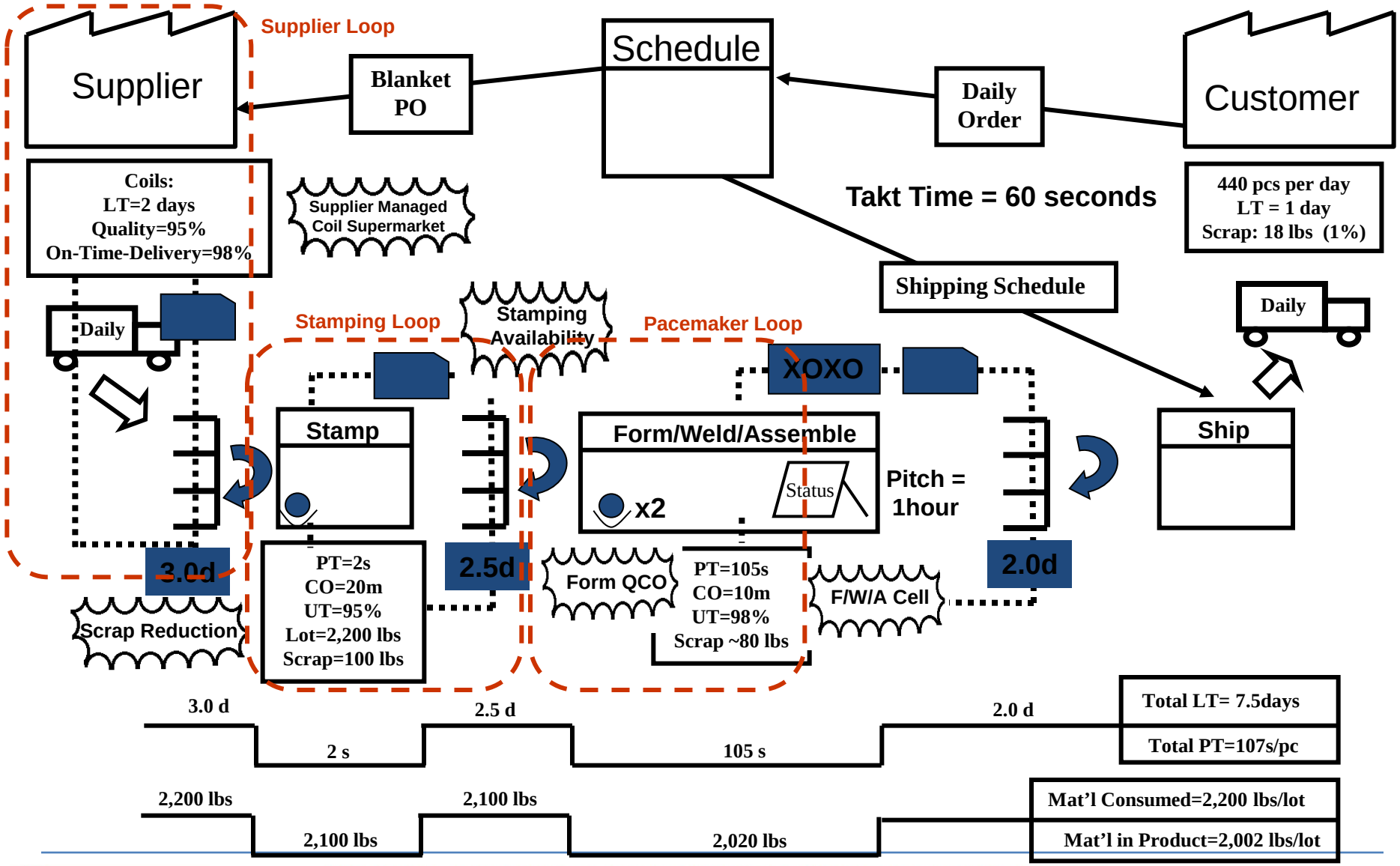
Preparing for a gVSM Event

- Collect data prior to the event
  - Time (process, lead, “set-up”)
  - Quality (scrap, rework)
  - Equipment reliability (downtime)
  - Materials Use
  - Energy Use
  - Water Use
  - Air Emissions
  - Hazardous Waste Generation
  - Chemical Use
  - Solid Waste Generation
  - Wastewater Discharges

Green Value Stream Map



Achieving the Future State – Identifying "Loops"



GreenVSM Steering Committee

- Adopt new summary measures for future state
  - Projected total lead time and total process time
  - Targets for First Pass Yield (FPY), First Time Quality (FTQ)
  - Targets for solid waste reduction, hazardous waste reduction
  - Targets for emission reductions
  - Targets for energy consumption reduction
- Roadblock removal during implementation
  - Resource constraints
  - Political issues
  - Technical barriers

Do the targets meet the business objectives defined prior to the event?

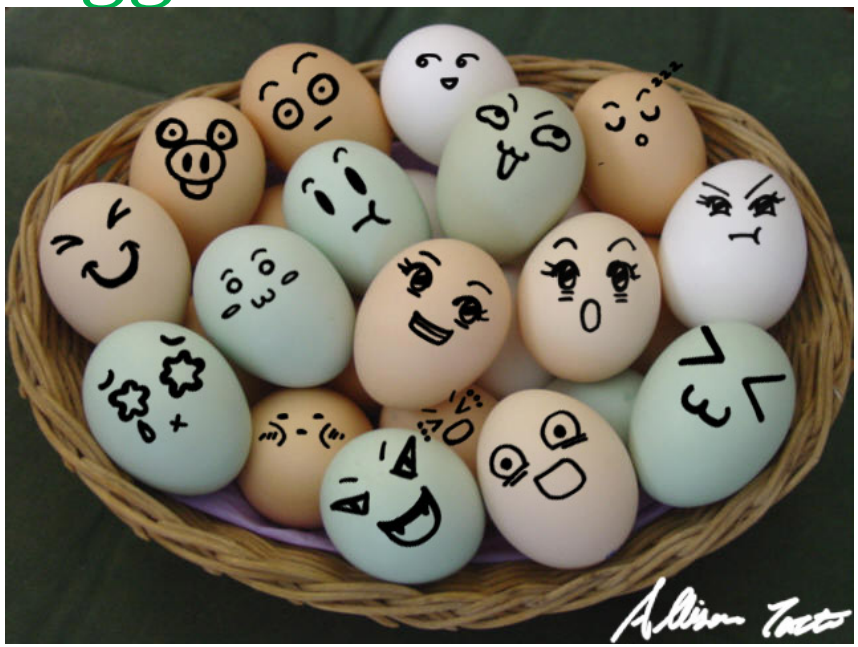
Strategically evaluate materials and tactically handle with 8-Rs

1. Refuse to accept
2. Reduce the amount
3. Reuse in plant
4. Repair to extend life
5. Recycle into product
6. Recover for upcycle
7. Replenish or balance
8. Rethink use of all resources

A3: Strategic Target is to reduce Electrical Energy by > 50% for processed eggs.

Problem: Reduce egg processing energy consumption by > 50%

Actual Situation:	>260Kj
Desired Situation:	<130Kj
Gap from Std:	>130 Kj
Extent of Problem:	> 1year
Rationale for Solving:	Profitable



Target/Goal: Reduce electrical power usage by >50 by Easter season

Root Cause: Using excessive electrical power before and after excessive amount water is brought to a rapid boil.

How much energy is required to bring water to boil for eggs?

The more water, the more energy it takes. The colder the water, the more energy it takes.

Let say the water is at room temperature, or 20 °C. First, the water must be heated to 100 °C, which takes energy. The amount of energy is given by the specific heat of water, which is 4.186 Joule/gram °C.

That means that requires 4.186 Joules of energy to heat 1 gram of water by 1 °C. So if you have 100 grams of water at 20 °C, you have to add this much energy:

100 grams * (100 °C - 20 °C) * 4.186 J/g °C = 33488 J = **33.488 kJ**

Once the water is at 100 °C, still more energy must be added. This is given by the heat of vaporization, which for water is 40.7 kJ / mol or 2261 Joules per gram.

So, in the example, once the 100 grams of water is at 100 °C, this amount of energy must be added to boil it:

100 g * 2261 Joules/gram = 226100 Joules = **226.1 kJ**

Q = 33.5kJ + 226.1kJ = 259.6 kJ

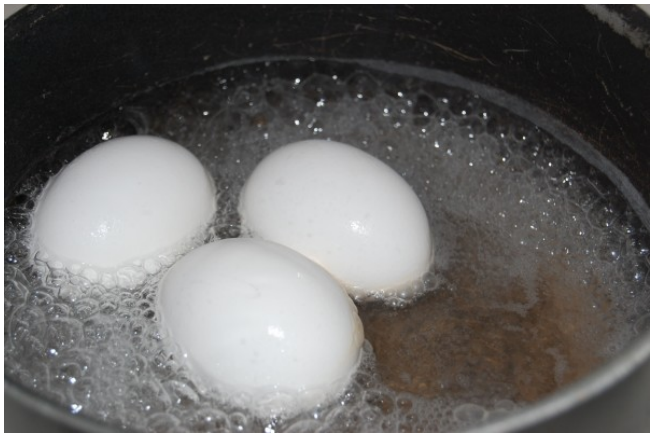
It takes 12.9% to heat the water and

It takes 87.1% to boil the water

What would a green lean process look like for producing hard boiled eggs?

Things that we kind of know:

- ✓ The more water, the more energy it takes to heat the water.
- ✓ The colder the water, the more energy it takes.
- ✓ When salt is added to water, the boiling point of the water rises.
- ✓ **It takes 12.9% to heat the water to a simmer and an additional 87.1% to bring the water to a boil.**
- ✓ The shell has a higher coefficient of expansion than the protein.
- ✓ The process of protein denaturation is exothermic (releasing <60J).
- ✓ The ceramic encasing of electrical elements retains energy once heated.



How would one test an egg to determine how hard it is?

What would a green lean process look like for producing hard boiled eggs?

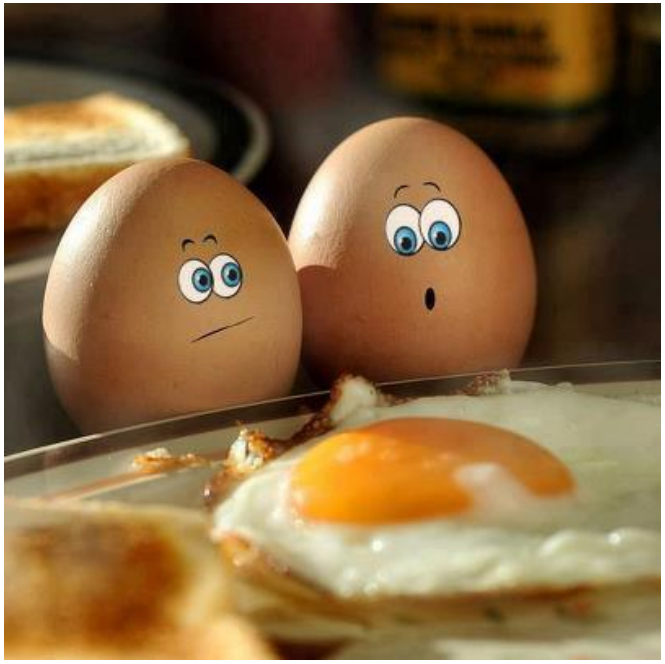
An energy efficient way would be to put the egg in very little water in a closed container and add heat to the approach of boiling (simmering).

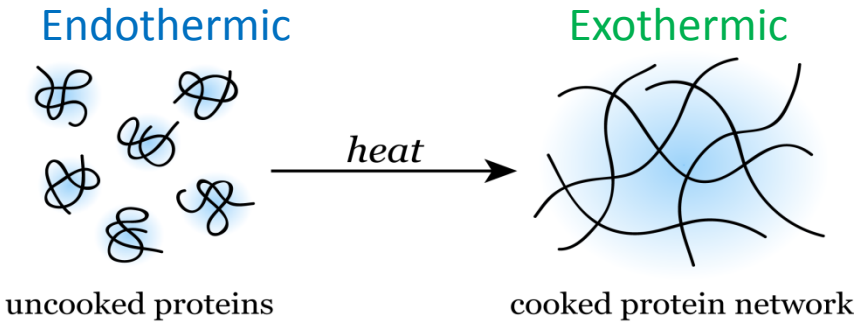
Turn off the heat and leave with lid on for 3-10 minutes to achieve soft vs hard results.

Use cold water to cool eggs first to freeze the state of hardness desired.

A quick hot water bath is used to expand the shell prior to cracking or shelling is helpful.

Resultant: significant reduction of energy and water usage.





What would the next step be for further reducing the green profile?

Gas Flame: 40% of the flame energy consumed by the gas stove top goes to directly heating the eggs.

Heater Elements: 74% of the electricity consumed by the stove top is used to actually the heat eggs.

Induction Coils:84% of the electricity consumed by an induction stove top goes directly toward heating food.

(Source: US DOE)

The green energy profile will improve significantly but will it be worth pursuing?

What if the gas energy subsidy remains at the 50% level in your consumption market?

What about water usage?

What about the egg shell waste stream?

Recommended Reading

- ***Green Intentions: Creating a Green Value Stream to Compete and Win*, by Brett Wills**
- ***Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage*, by Daniel Esty and Andrew Winston**
- ***The Green to Gold Business Playbook: How to Implement Sustainability Practices for Bottom-Line Results in Every Business Function*, by Daniel C. Esty and P.J. Simmons**
- ***Sustainable Value: How World's Leading Companies are Doing Well by Doing Good*, by Chris Laszlo**
- ***Learning to See*, by Mike Rother & John Shook**

Achieving the Green Future State

Engagement Model at Enterprise Minnesota

- Business Discussion, Walkthrough, and Business Planning
- Selection of VSM Scope, Team, Data Needs, Event Date
- Set Up 2-3 Days for the Event with Team
- 30-60-90 Monitoring of Achieving the Future State

MEP Lean Websites

www.enterpriseminnesota.org

www.nist.gov/mep

www.greeneconomypost.com/green-supply-chain-studies-7580.htm