

Waste-to-Energy: Cornerstone for Sustainable Cities

Green Trade Network Summit

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***In3 BioRenewables* & Renewable Energy Investor Forum**

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Agenda

- **Why Waste?**
- **Scope of the Problem/Opportunity**
- **Diversion vs. Conversion**
- **Garbage in ... Energy out: CIWMB
Survey of leading technologies**
- **Profile: Gill's Onions**
- **Biorefineries**
- **What now?**
- **Q & A**

Why Talk About Waste?



It's cheap, abundant, local

Mostly an afterthought

Nature constantly recycles

Reflects linear design

Take → Make → Waste inefficiency

Can be repurposed, redirected, **recovered**

Waste equals Food!

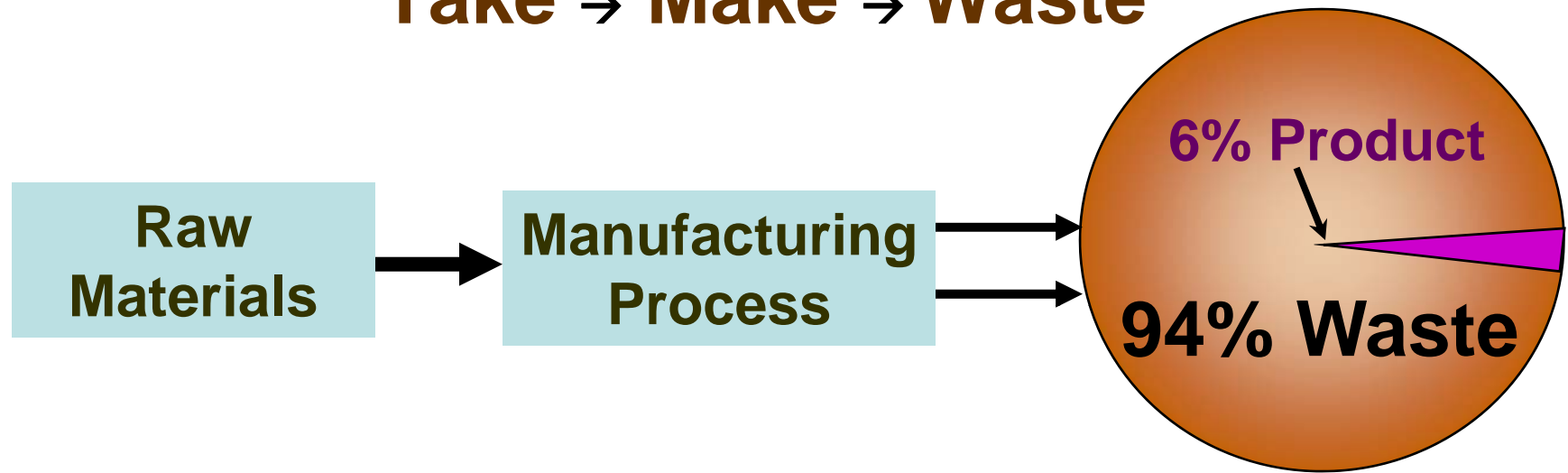




Not always ...

Linear US Industrial Processes

Take → Make → Waste



80% of products discarded after single use

99% of original materials used or contained in US

manufactured goods become waste within 6 weeks of sale

Waste is created faster than it can be reconstituted back into useful resources (such as soil nutrients or energy)

Why Use Waste for Energy?



Disrupt the Fossil Folly!

Breaks our dependency on centralized energy

Advantages of Converting W2E

Eliminates disposal costs for the producer

Can become a *profit center* via
(resource efficiency & productivity)

Commensurate reduction in **air pollutants**

Green jobs & marketing (bragging rights)

Feel-good factor; responsible, sustainable

Does W2E help municipalities reach diversion goals?

Why we waste waste

Because we can

Initial capital costs ... ROI can take *years*

Perception of risk:

Who will buy it?

At what price? (Energy “price shocks”)

It’s messy, often smelly, volatile/dangerous ...

More important things than *taking out the garbage*

Where DOES It Come From?



INDUSTRY

HOUSEHOLDS

EVERYWHERE!

Common forms

- Municipal Solid Waste (MSW): human & pet
- Greenwaste – yard trimmings, etc.
- Construction / demolition wastes
- Kitchen / table scraps & other compostables
- Legally dumped industrial wastes
- Illegally dumped ...

Definition: BIOMASS

Any renewable, organic matter

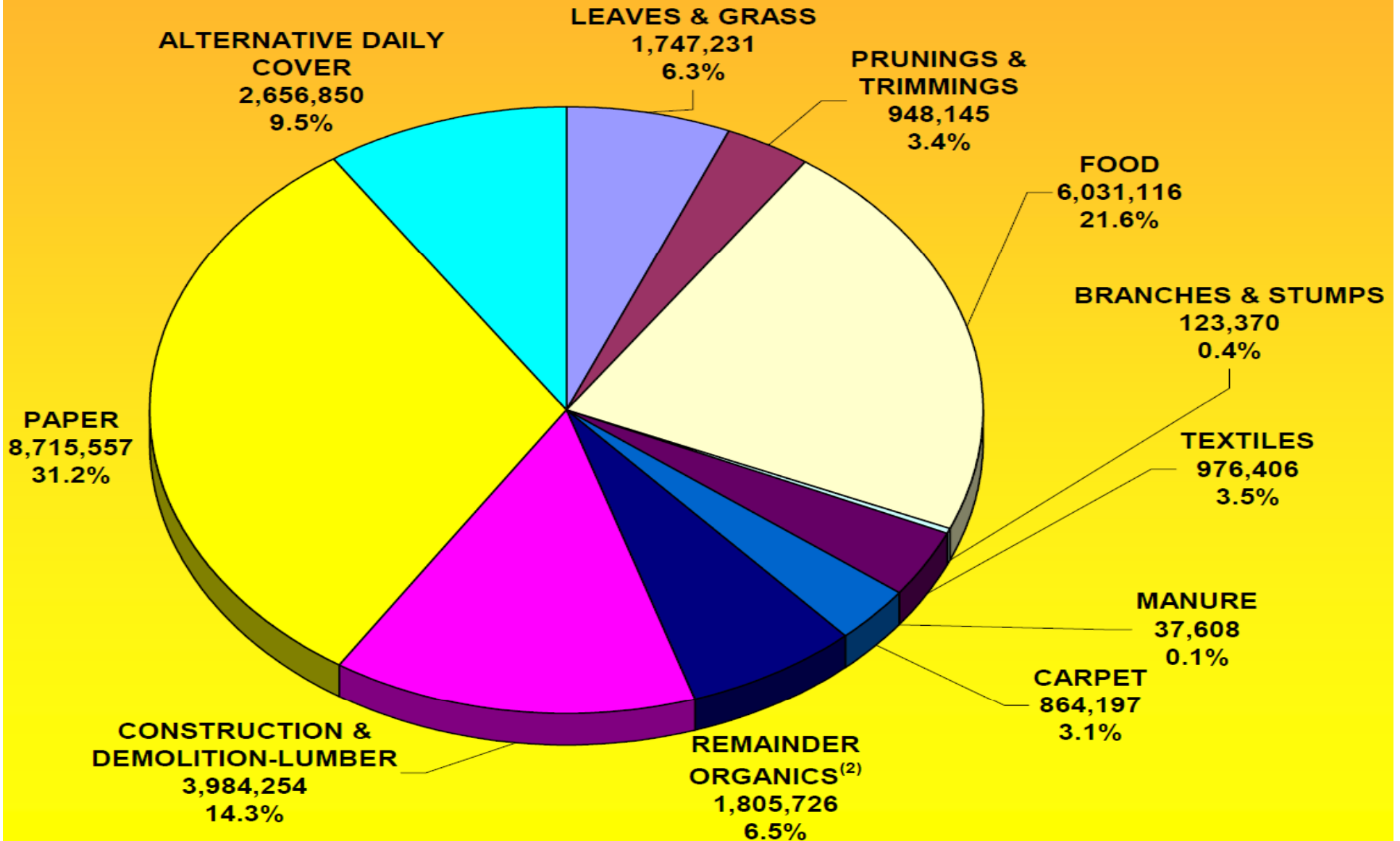


- Agricultural crops, aquatic plants
- Agriculture / aquaculture wastes & residues
- Wood, wood wastes & residues
- Animal wastes (manure, tallow)
- Restaurant & institutional food service waste (yellow grease)

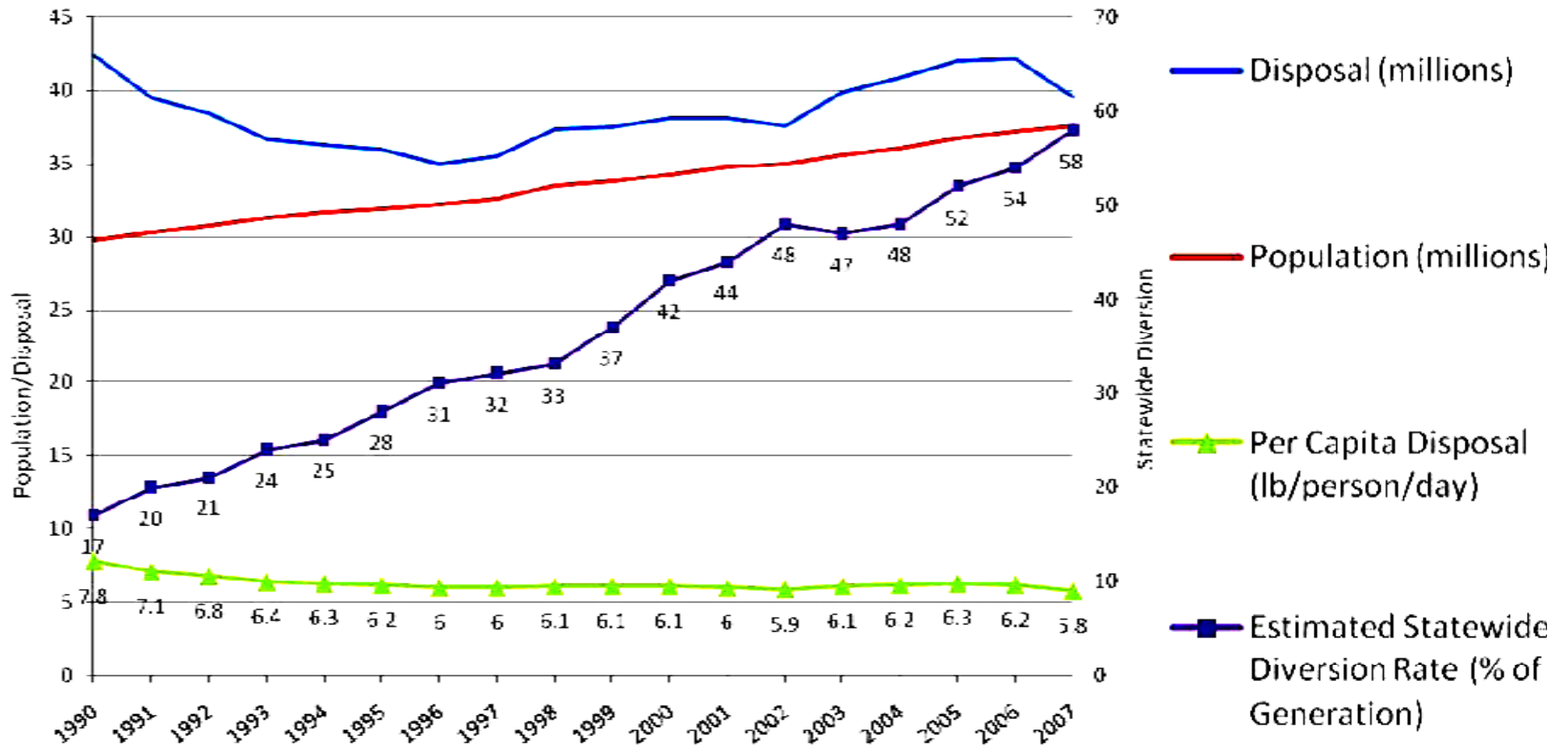
... Energy Out



California Organics Disposed (28,000,000 tons per year; CIWMB)



Disposal vs. Landfill Diversion (CIWMB)



Diversions and Conversions

Energy from Waste Recovery

Diversions

- Composting
- Chipping/Grinding for Mulch
- Reuse/Recover
- Recycling

Conversions

- **Thermal:** incineration, gasification, pyrolysis
- **Non-thermal:** anaerobic digestion, fermentation
- **Physiochemical:** synthetic crude oil or biodiesel

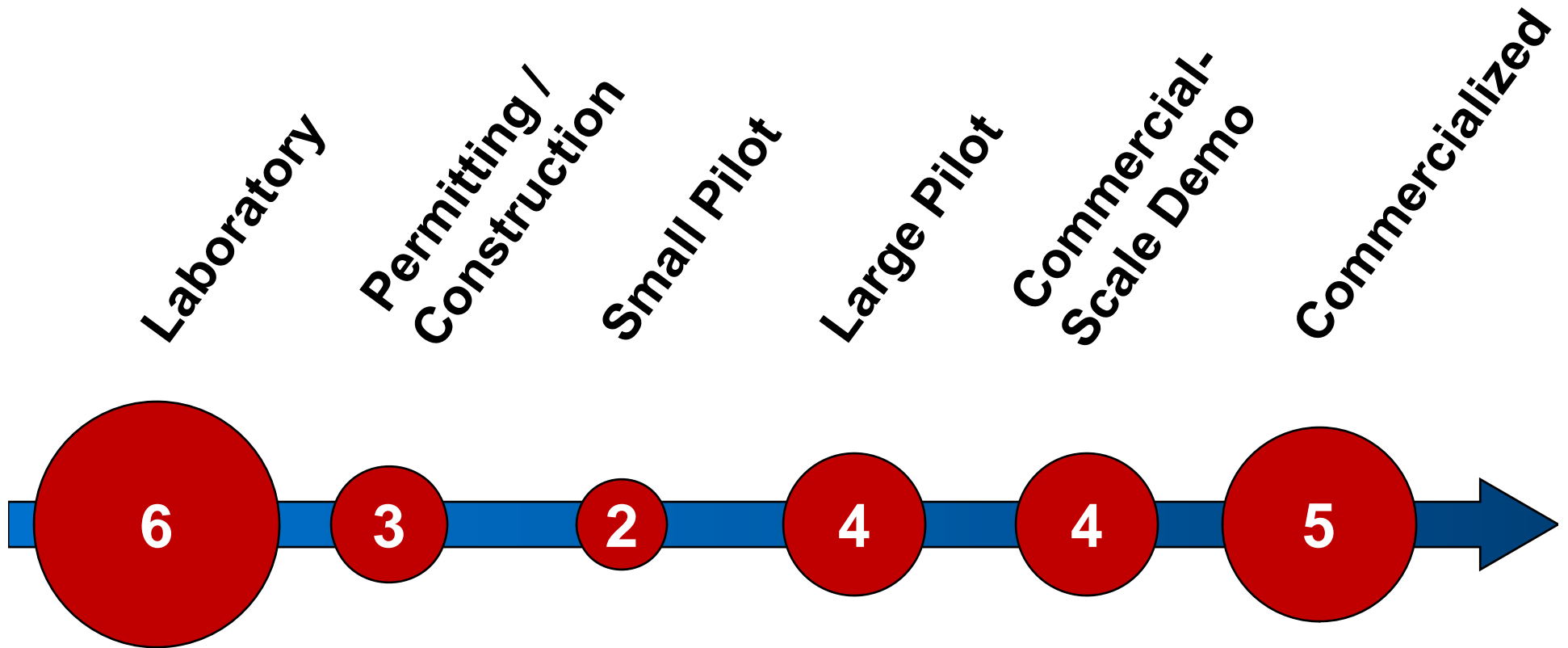
Municipal Solid Waste to Energy Survey 2009

- Survey of conversion technologies for municipal solid waste (MSW) to energy
- Motivation:
 - Many CA jurisdictions concerned with landfill capacity and difficulty of new sites
 - Los Angeles, Santa Barbara, Sacramento, San Jose, Santa Cruz, and others
- 23 responses from 83 survey requests

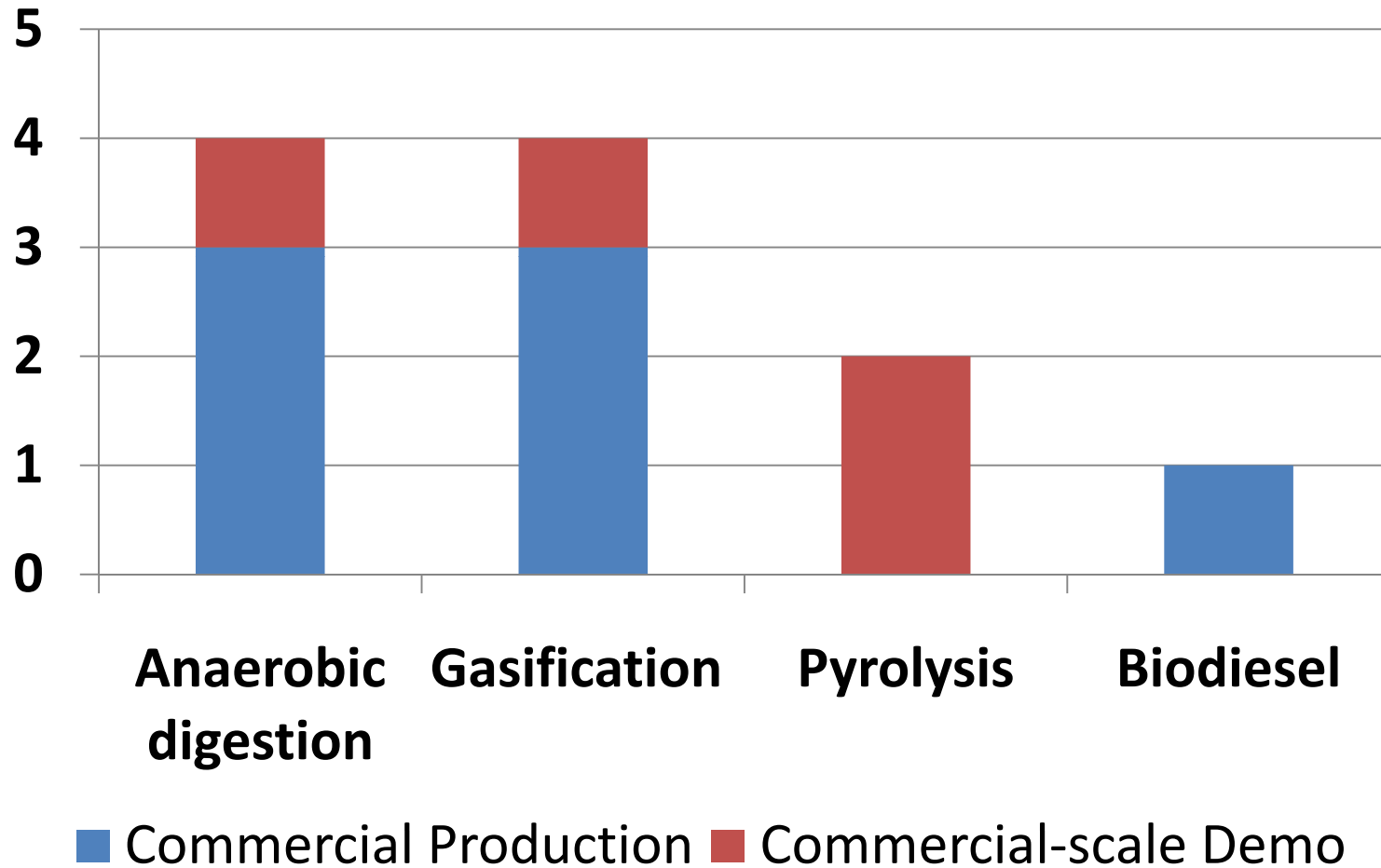
WTE Conversion Technologies

Technology	Responses
Thermal	21
Gasification	2
Pyrolysis	8
Autoclaving	1
Biochemical	10
Anaerobic Digestion	6
AD/Composting	1
Fermentation	3
Physicochemical	1
Biodiesel	1

Facility Development Stage



Commercial Activity



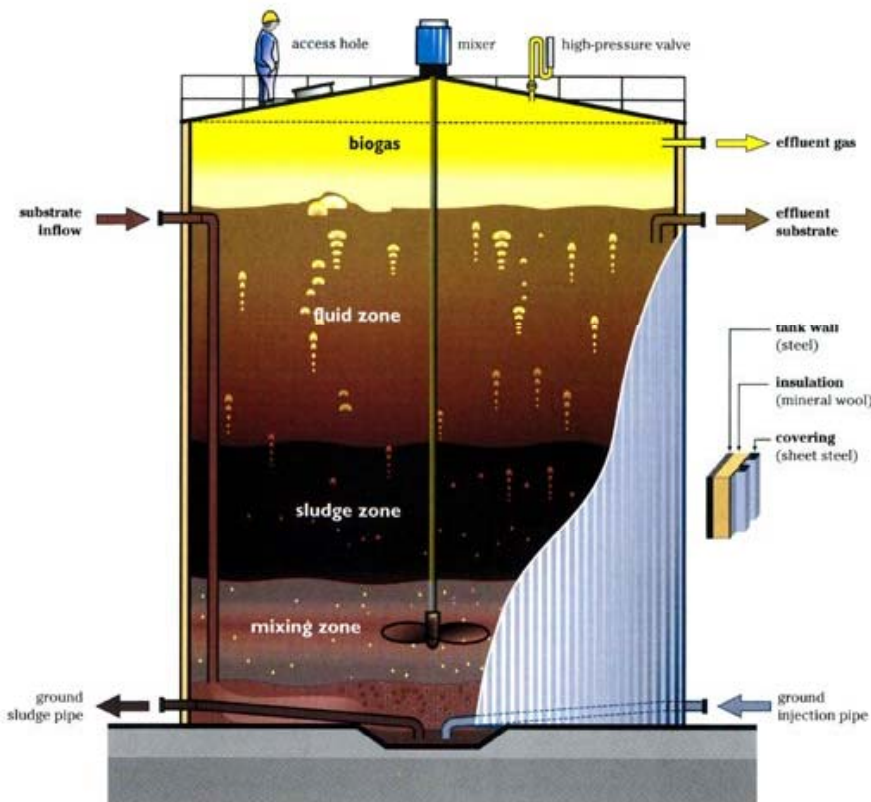
Thermal (thermochemical)

- Higher temperatures and conversion rates
- Emissions concerns
- A continuum of processes
 - **Pyrolysis**: Thermal decomposition in a primarily non-reactive environment
 - **Gasification** – Decomposition in a chemically reactive environment
 - **Autoclaving** – Separation of compounds through combinations of heat and pressure

Biochemical Conversion

Anaerobic Digestion, Composting, Fermentation

- Relatively low temperatures & lower reaction rates
- High selectivity for products
- Higher **moisture** feedstocks
- Not applicable to *non*-biodegradables (such as conventional plastics)



**Cellulosic biohols –
waste, weeds, or wine –
may get us out of this pickle**

Proven Method: Gasification Anaerobic Digestion



METHANE – affordable renewable energy
(burned to generate heat & electricity)

COMPOST – returns nutrients to soil

Physicochemical Conversion

Biodiesel liquid fuels

- Near-ambient temperatures and pressures
- Synthesis – both physical & chemical
- Primarily used to transform fresh or used vegetable oils, animal fats, greases, tallow, and other feedstocks





**The biofuels industry is
expanding
faster than it is maturing**

W2E FutureTech



BioEnergy
New Energy
Pond Scum Energy



Forms:

Cleaner-burning gases

Electricity co-generation
from methane gas

Liquid Biofuels

Storage in fuel cells

Advantages:

Replaces dirtier fuels

Commensurate
reduction in GHG

Elim. hauling costs

Available when needed

Energy Beets

Mendota Beet Coop & UC Davis



- ✓ Turning beets into methane & electricity
- ✓ WISE Solutions increase simple sugars



WiseSolutions.net
sugarbeet.ucdavis.edu



In³
BioRenewables



- Onion Juice goes to anaerobic digester to produce CH₄ (methane)
- CH₄ burned cleanly to power 600 kilowatt fuel cells -- enough to run 460 homes



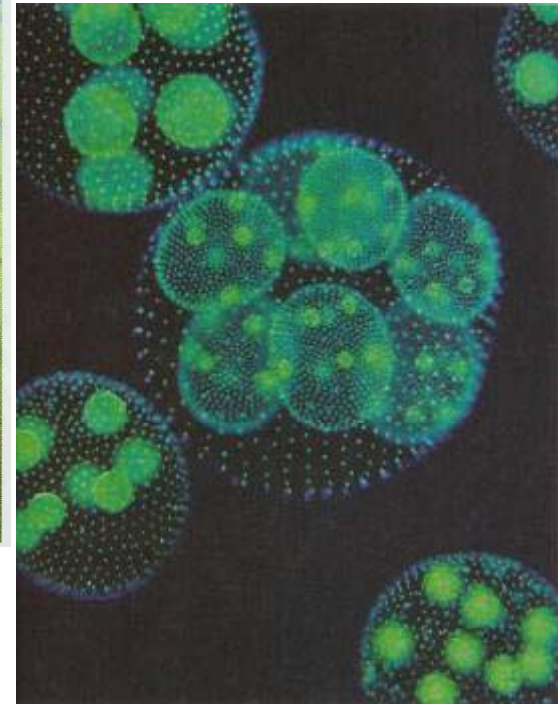
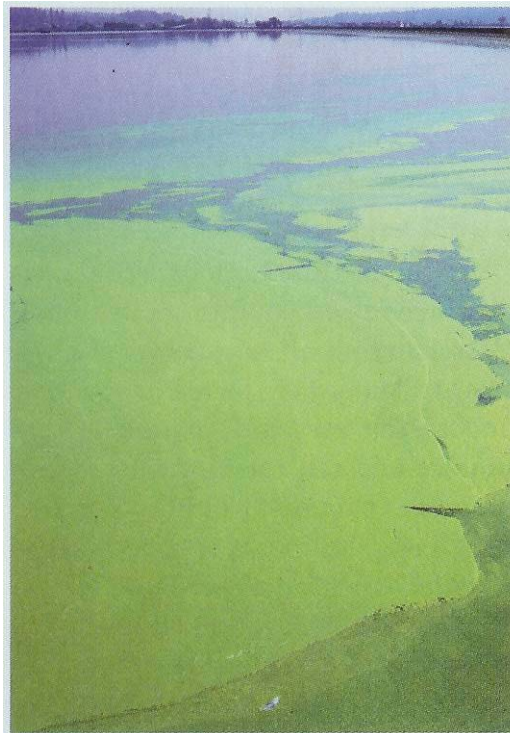


Why they did it

- Saves \$700,000 / year in electricity
- Reduces 225,000 lbs solid waste per day
 - **Saves additional \$400,000 disposal costs**
- Break-even within 6 years
- *Elim 30K tons CO2-equivalence per year*

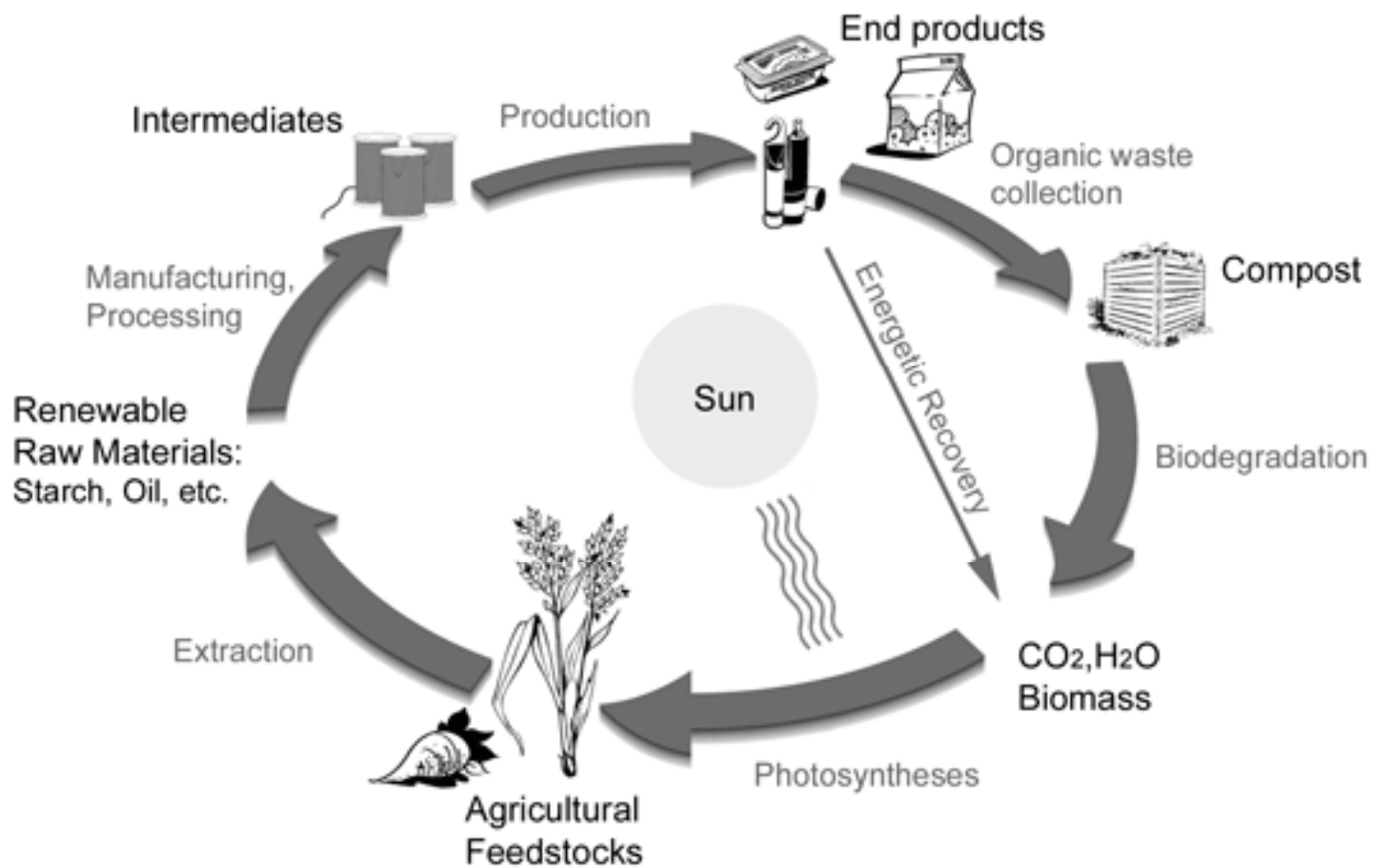
“It was first a business decision to solve a waste problem.” – Steve Gill

Pond Scum Economics: The race is on!



Algae Farming in New Zealand

Industrial Biorefining



Success Keys in BioRenewables

- ✓ **All ag waste / biomass = opportunity**
- ✓ **Radical innovation ... get disruptive!**
- ✓ **“Biorefinery” yield multiple \$ streams**

What We Do



In³
BioRenewables

Inspire
Innovate
Invest

Investing in radically innovative BioRenewable technologies
Bioplastics & green chemistry business development since 1996

Services:

- Workshops and seminars
- Market, competitive & risk analysis
- Deal structure and presentation coaching
- Commercialization and technology transfer / licensing
- Management consulting, team facilitation, project management

More at www.in3inc.com/about.html

Renewable Energy Investor Forum



Questions?

What will you do on Monday morning?

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