Emerging Paradigms in Biosolids Management

Dr Bill Barber

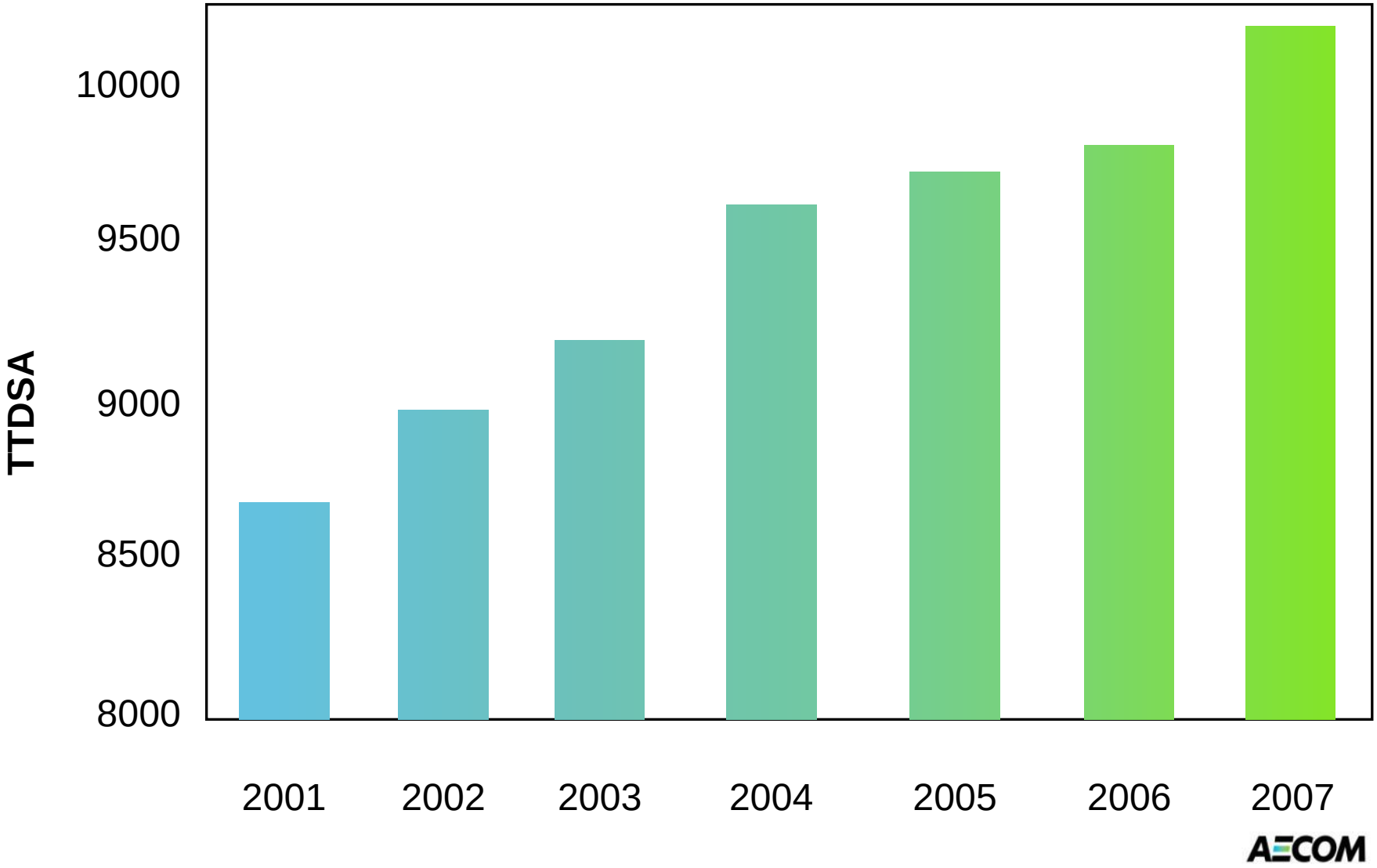
15th February 2013

AWA australian water association

Australian & New Zealand Biosolids Partnership

AECOM

Biosolids Production Trend in Europe

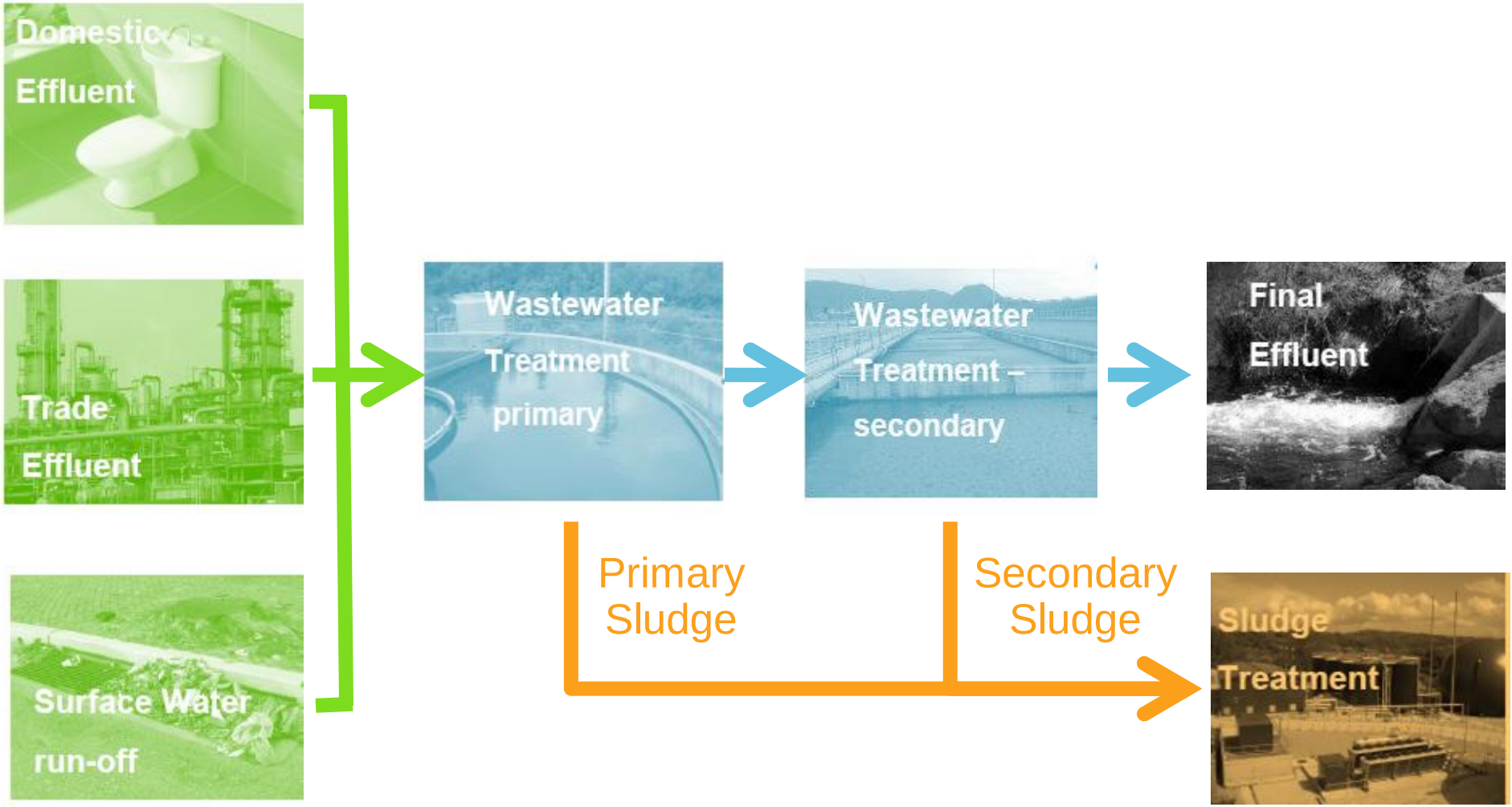


1) Increasingly Strict Environmental Regulation
Traditional wastewater treatment

Primary
Sludge

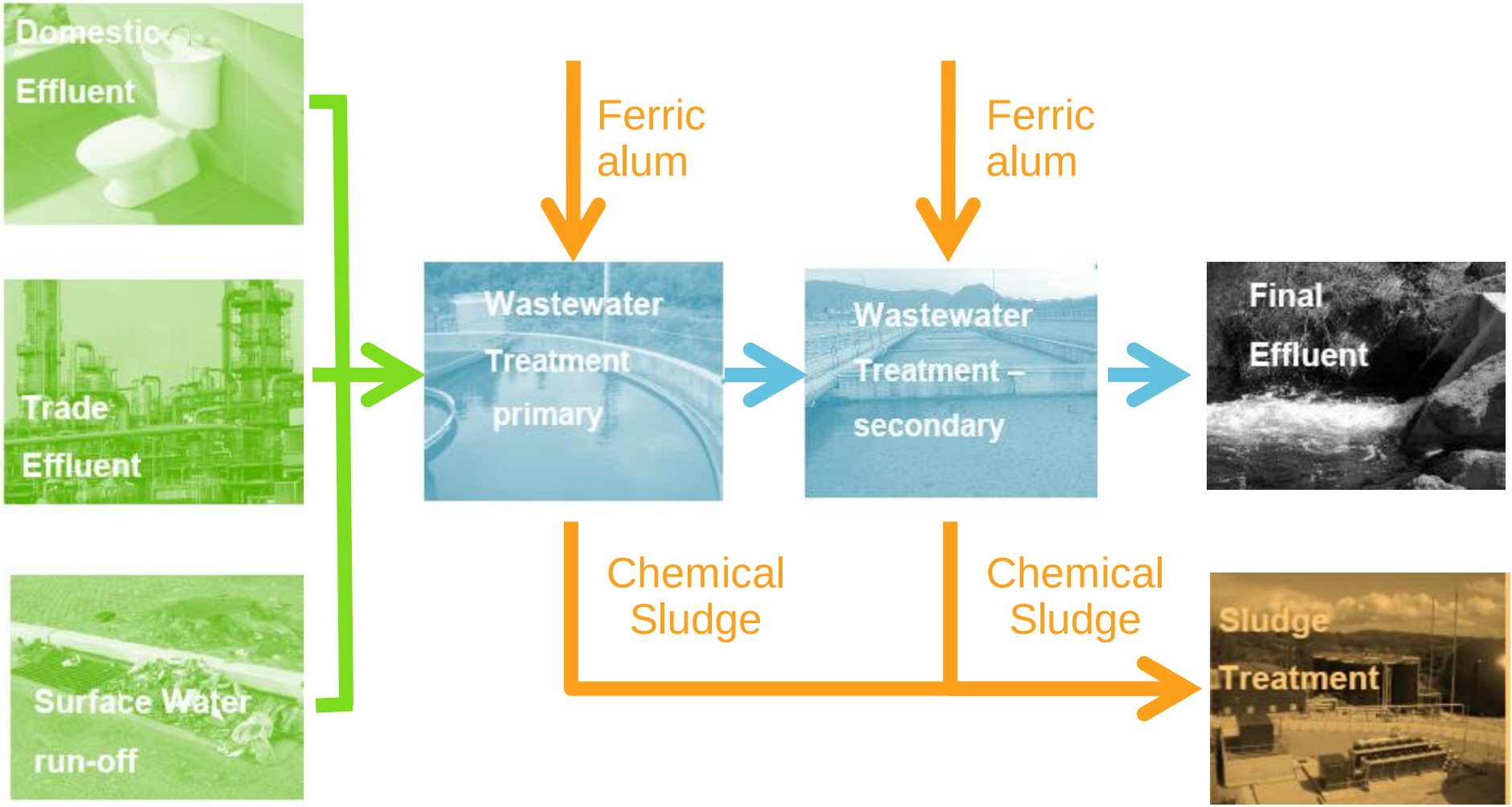
AECOM

Stricter wastewater standards – Secondary Treatment



AECOM

Nutrient removal – Chemical Dosing



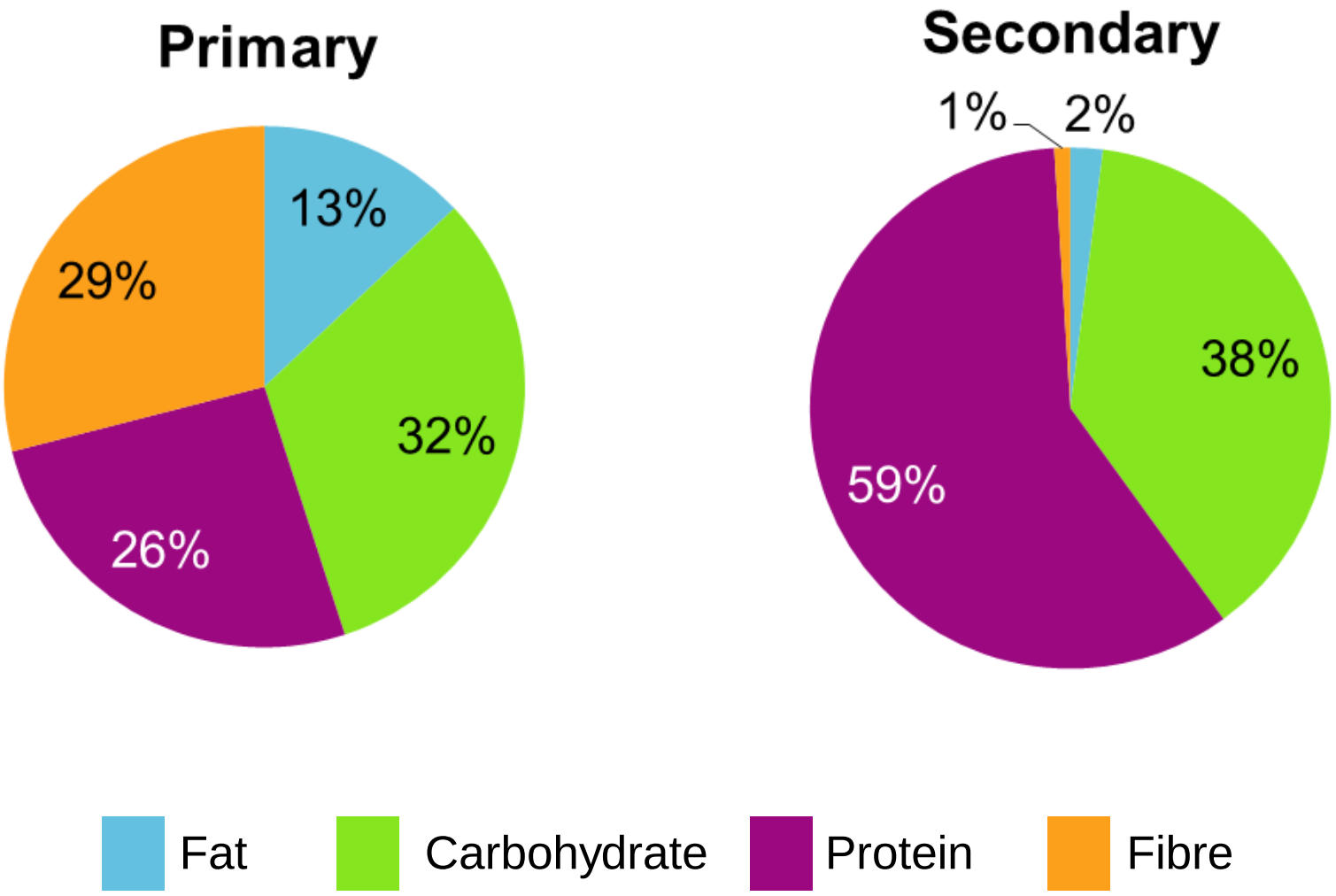
AECOM

Wastewater treatment fundamentally influences the quantity and type of sludge produced and consequently biosolids treatment potential

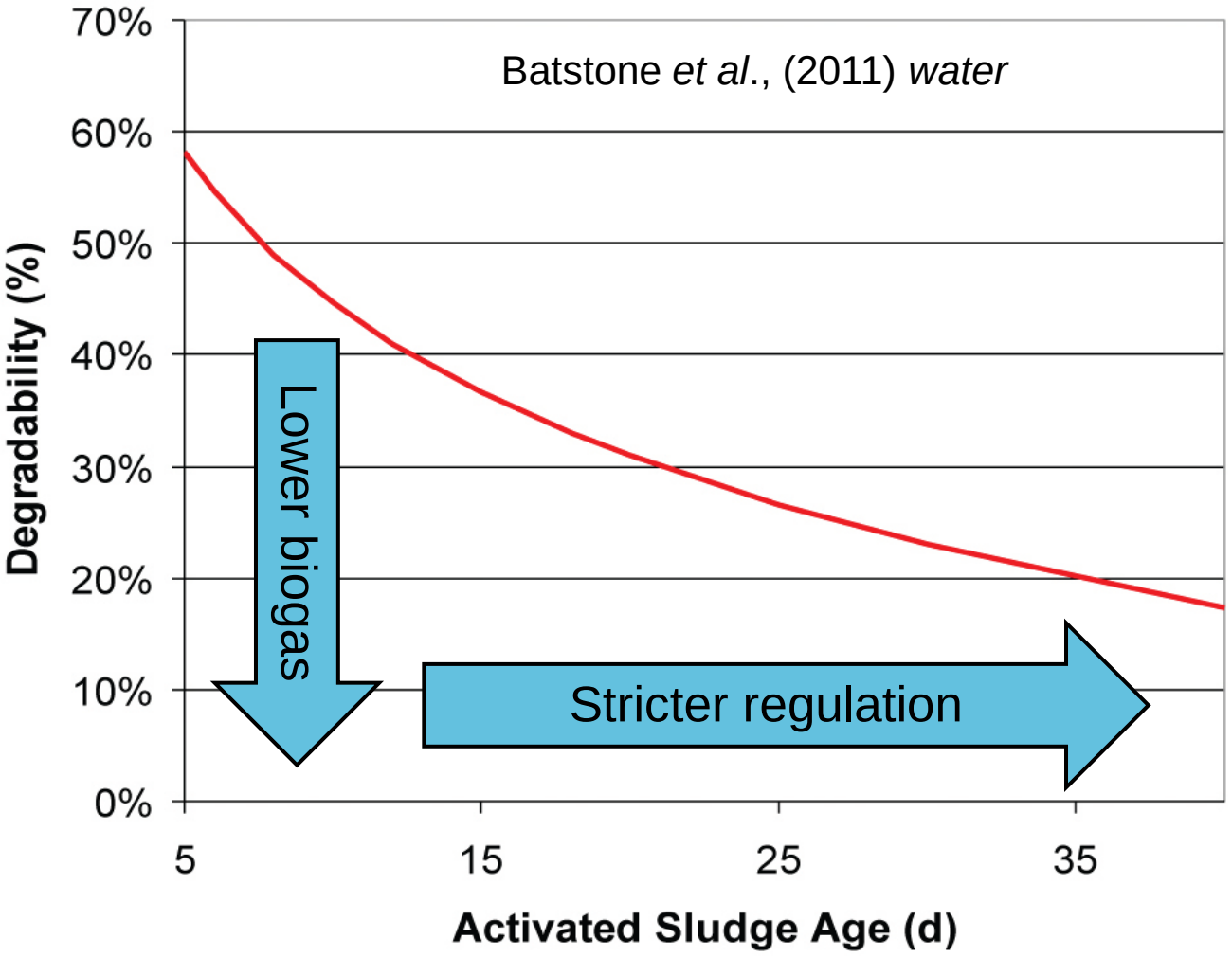
AECOM

Tightening standards also have other impacts

Tightening standards also have other impacts

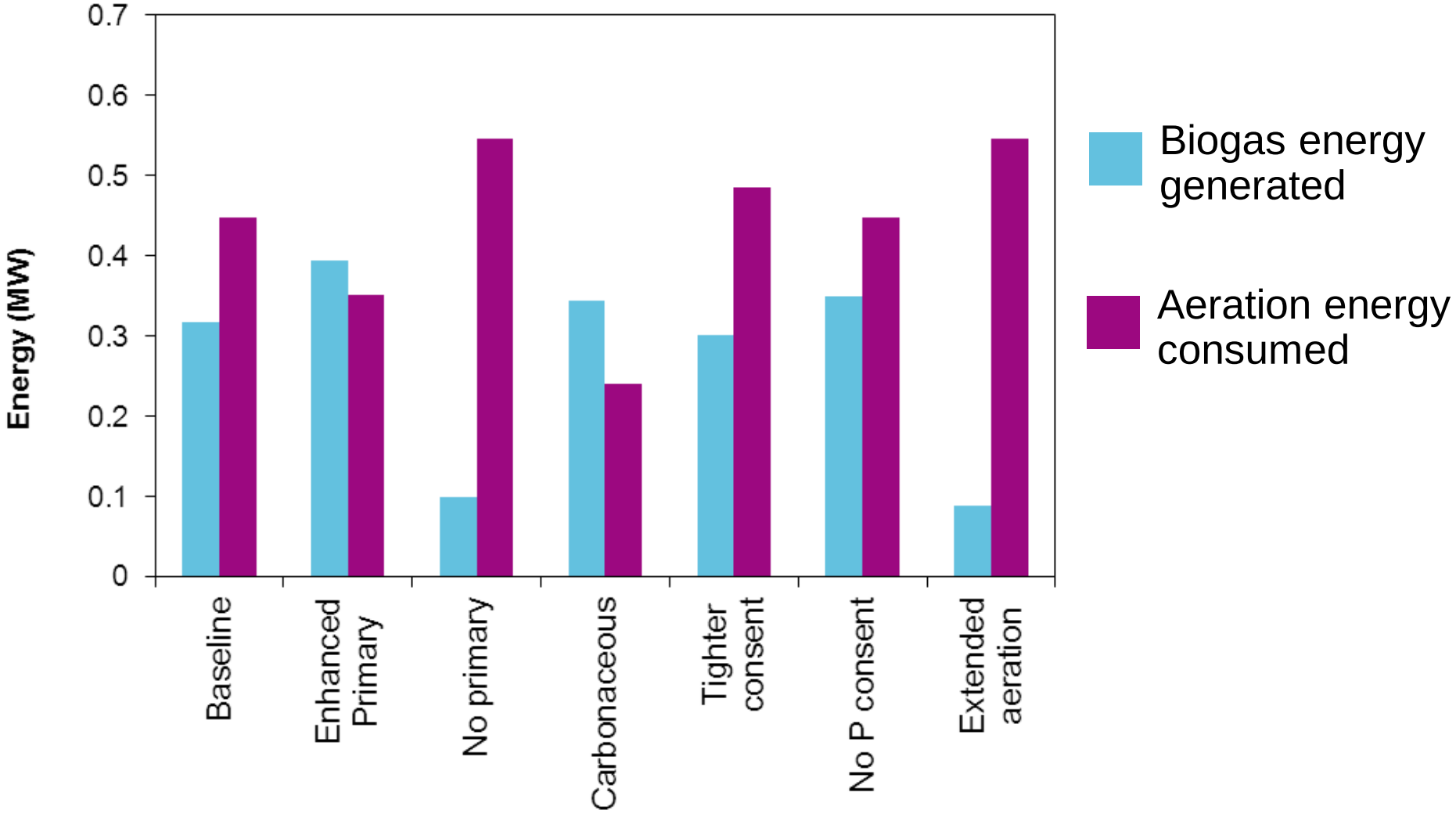


Tightening standards also have other impacts



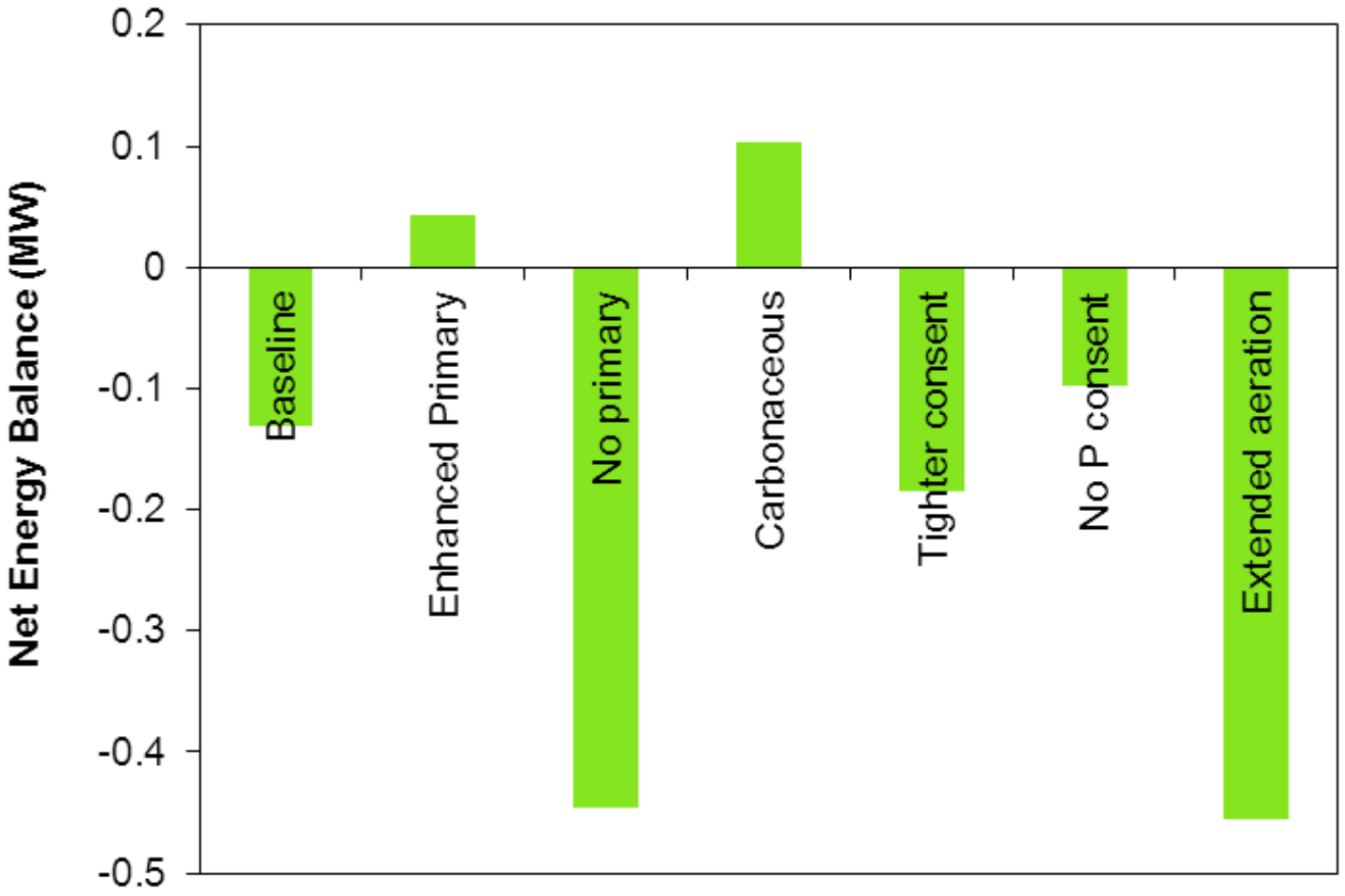
AECOM

Overall Energy Balance
between biogas and aeration requirements



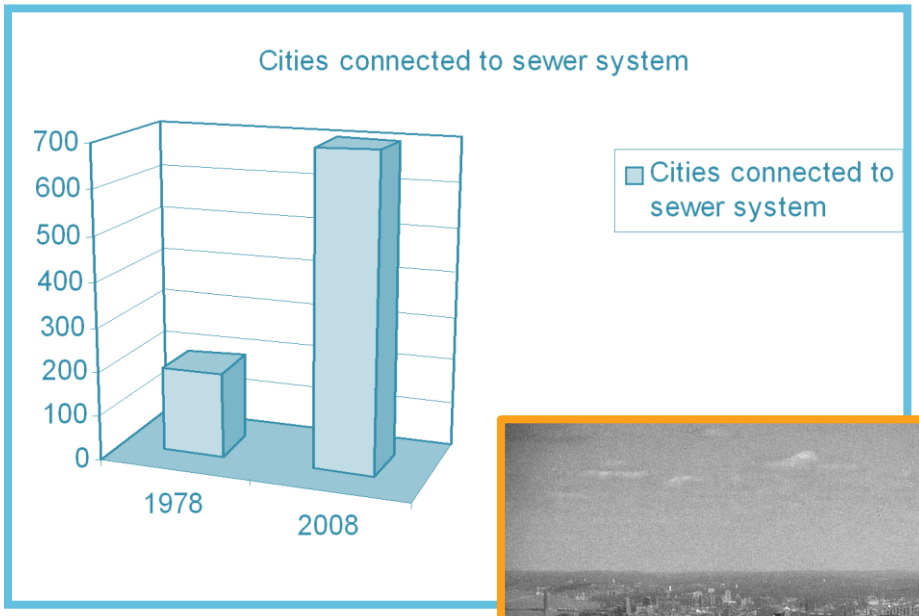
AECOM

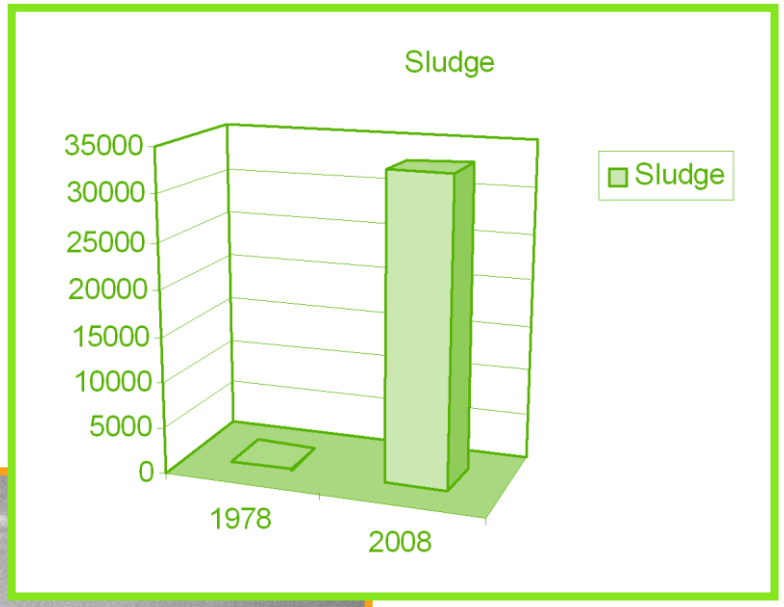
Overall Energy Balance
between biogas and aeration requirements

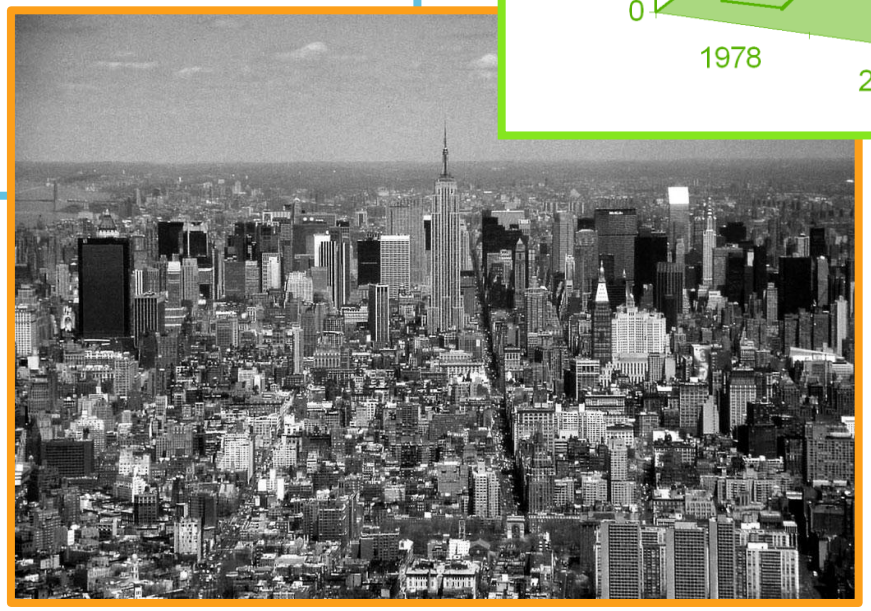


AECOM

2) Increasing and migrating populations

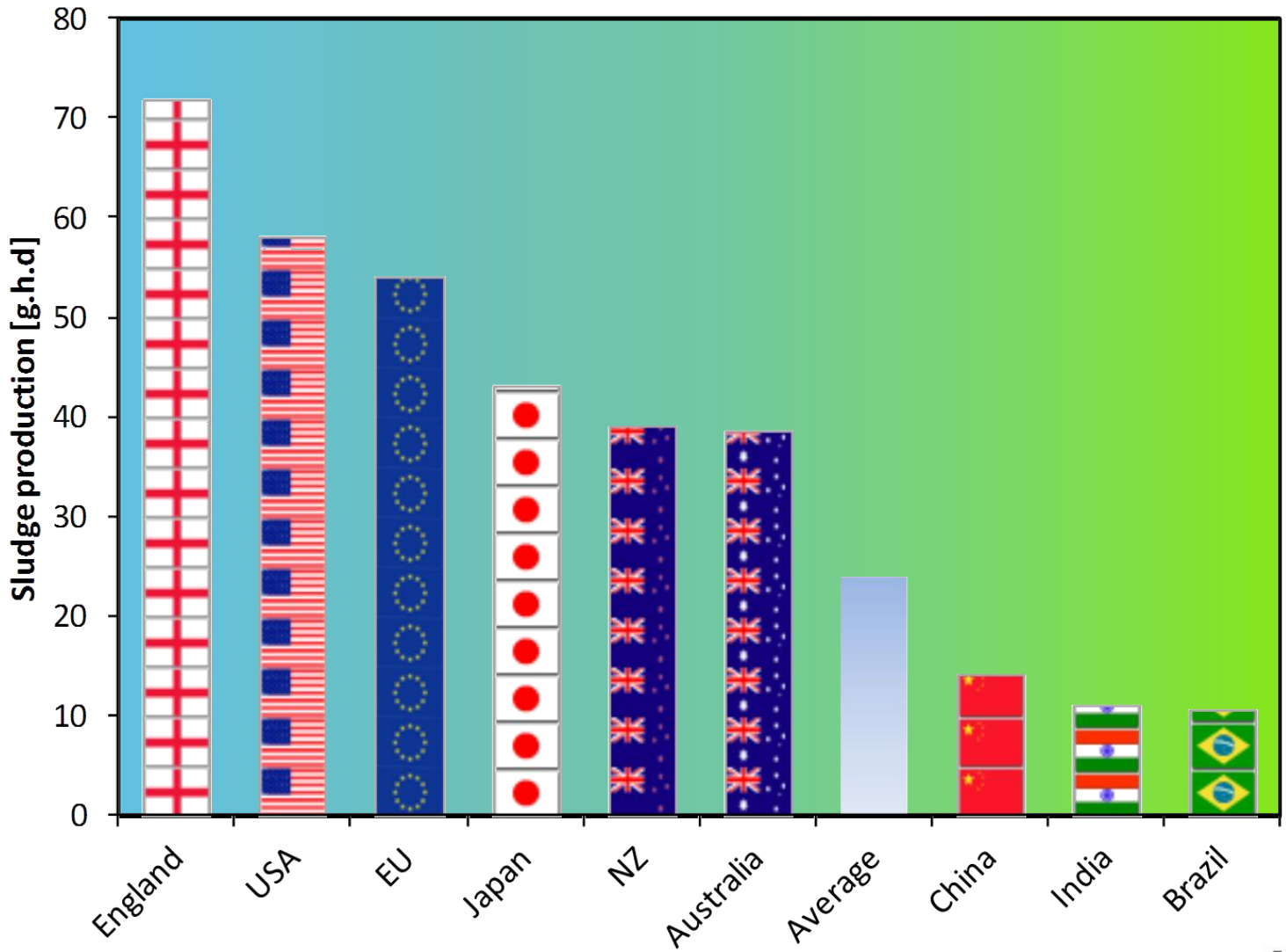






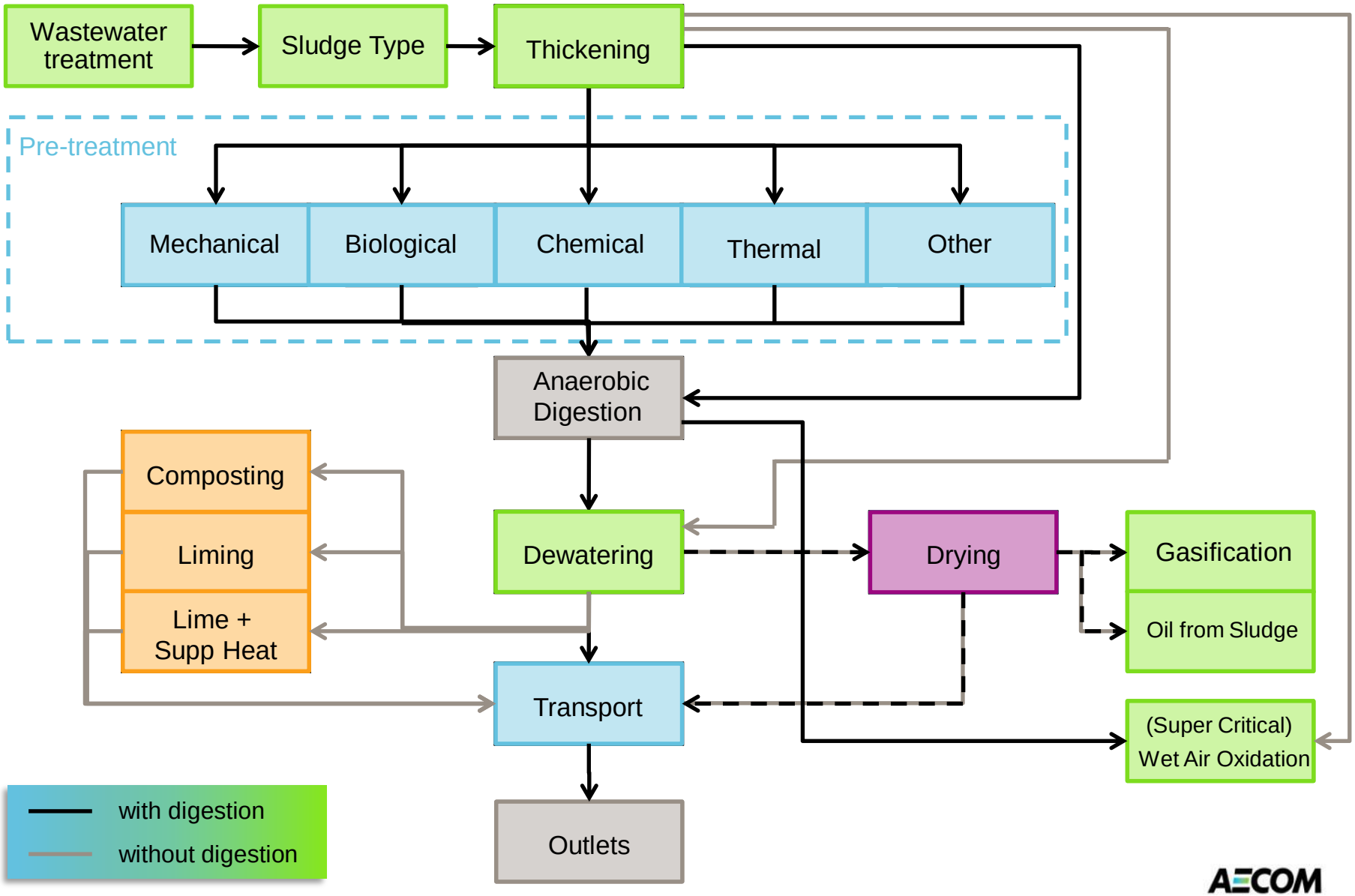
AECOM

World-wide Biosolids Production



AECOM

Sludge Processing



AECOM

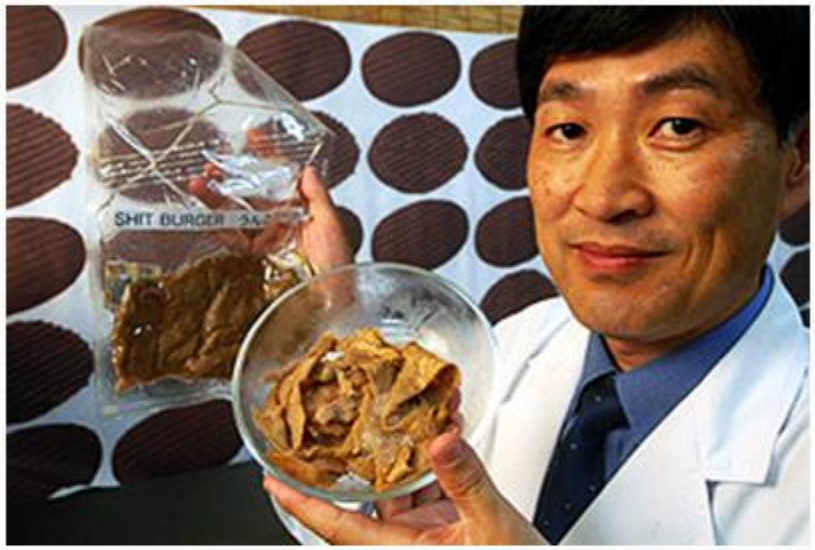
What else can you do with it?

POOP BURGER: Japanese Researcher Creates Artificial Meat From Human Feces

by Lori Zimmer, 08/16/11

filed under: News, Poo Power!, Recycled Materials

Like 34k



Some hardcore carnivores have a hard time finding meat alternatives such as soy protein or tofu burgers to be palatable. But non-meat eaters may lose their appetite along with their carnivorous friends over this one – a meat alternative made from HUMAN EXCREMENT. Yep, you heard me correctly — Japanese scientist Mitsuyuki Ikeda has developed a "burger" made from soya, steak sauce essence, and protein extracted from human feces. Hit the break for a video explaining the process!

Would you eat a turd burger?

- YES! WITH A SIDE OF FRIES PLEASE! — 1,237 VOTES
- NO WAY! MC DONALD'S IS BAD ENOUGH! — 8,106 VOTES
- NOT SURE, I'D HAVE TO SEE IT UP CLOSE FIRST. — 1,152 VOTES

Japan scientist synthesizes meat from human feces

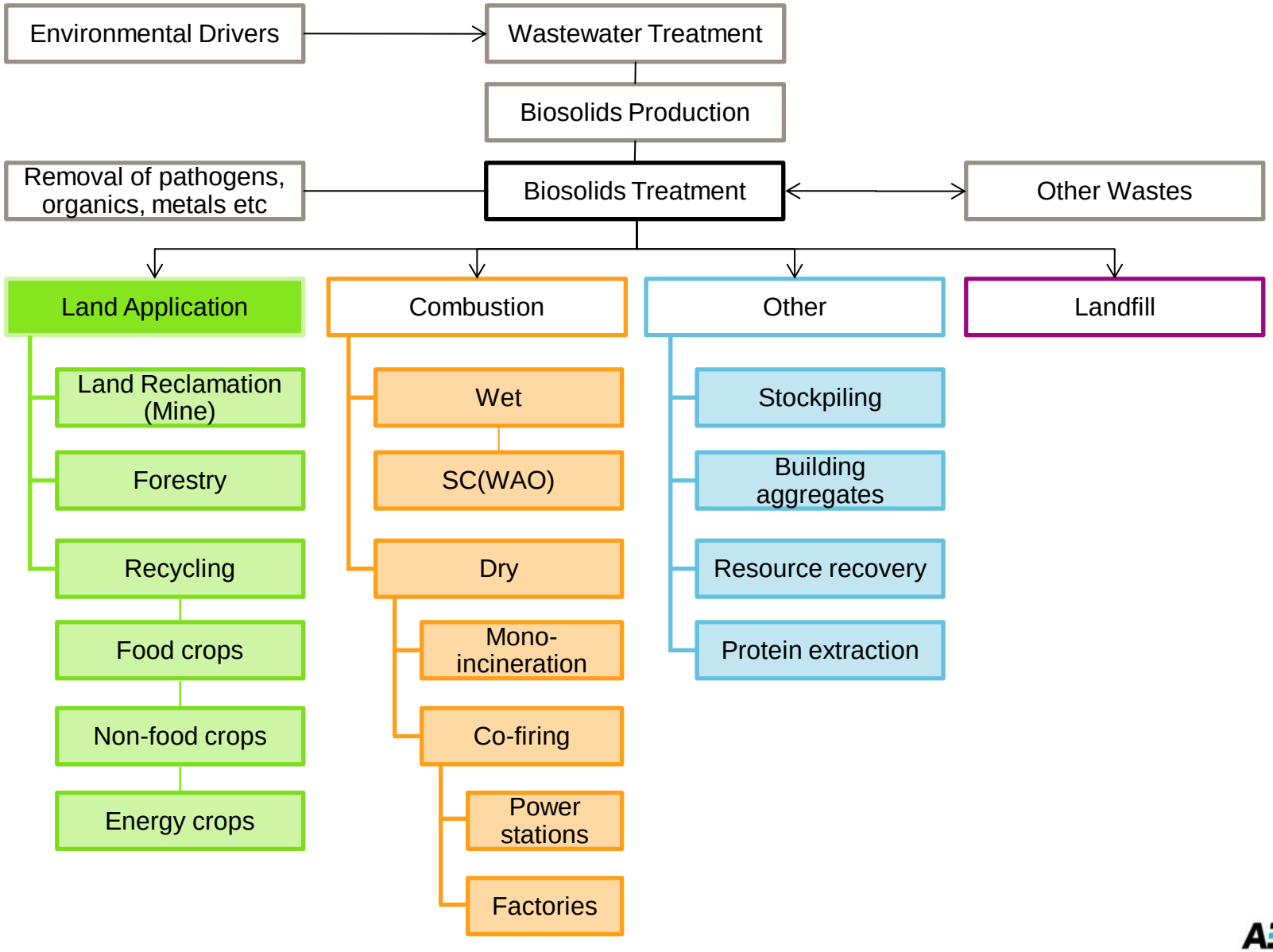
Story by Jeff Hughes
Japan scientist synthesizes meat from human feces

It's being called the "poop burger". Japanese scientists have found a way human feces.

Somehow this feels like a Vonnegut plotline: population boom equals food waste matter. Absurd yes, but Japanese scientists have actually discover feces.

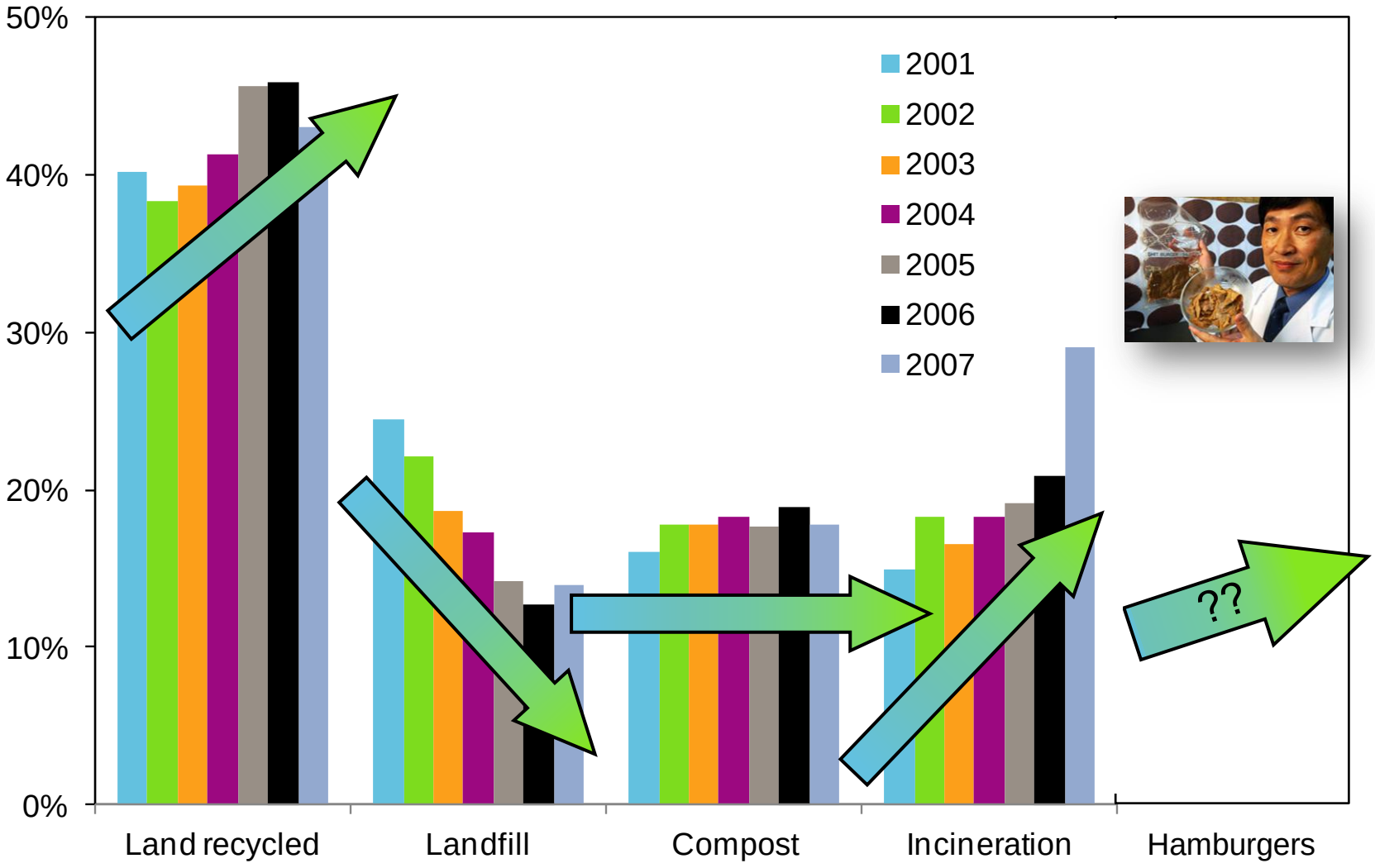
Mitsuyuki Ikeda, a researcher from the Okayama Laboratory, has develope excrement. Tokyo Sewage approached the scientist because of an overab explore the possible uses of the sewage and Ikeda found that the mud co bacteria

Biosolids Outlets



AECOM

European Biosolids Outlets



AECOM

Human sewage used for cereals

by ANTHONY PHILLIPS

Toxic Sewage Sludge in Your Food

December 17 2009 | 54,285 views | + Add to Favorites

Cereal: could it have b

[rhsPanel]

Supermarket shop
Britain using huma

Sainsbury's admitte
is cheaper than the

Human Waste Used by 200 Million Farmers, Study Says

Tasha Eichenseher in Stockholm, Sweden
for National Geographic News
August 21, 2008

Sludge Happens

Recycling sewage into fertilizer might be making us sick. Why doesn't the EPA give a crap?

—By ***Josh Harkinson*** | May/June 2009

The treated sewage, known as sludge, is being used on crops including

Did Sewage Sludge Lace the White House Veggie Garden With Lead?

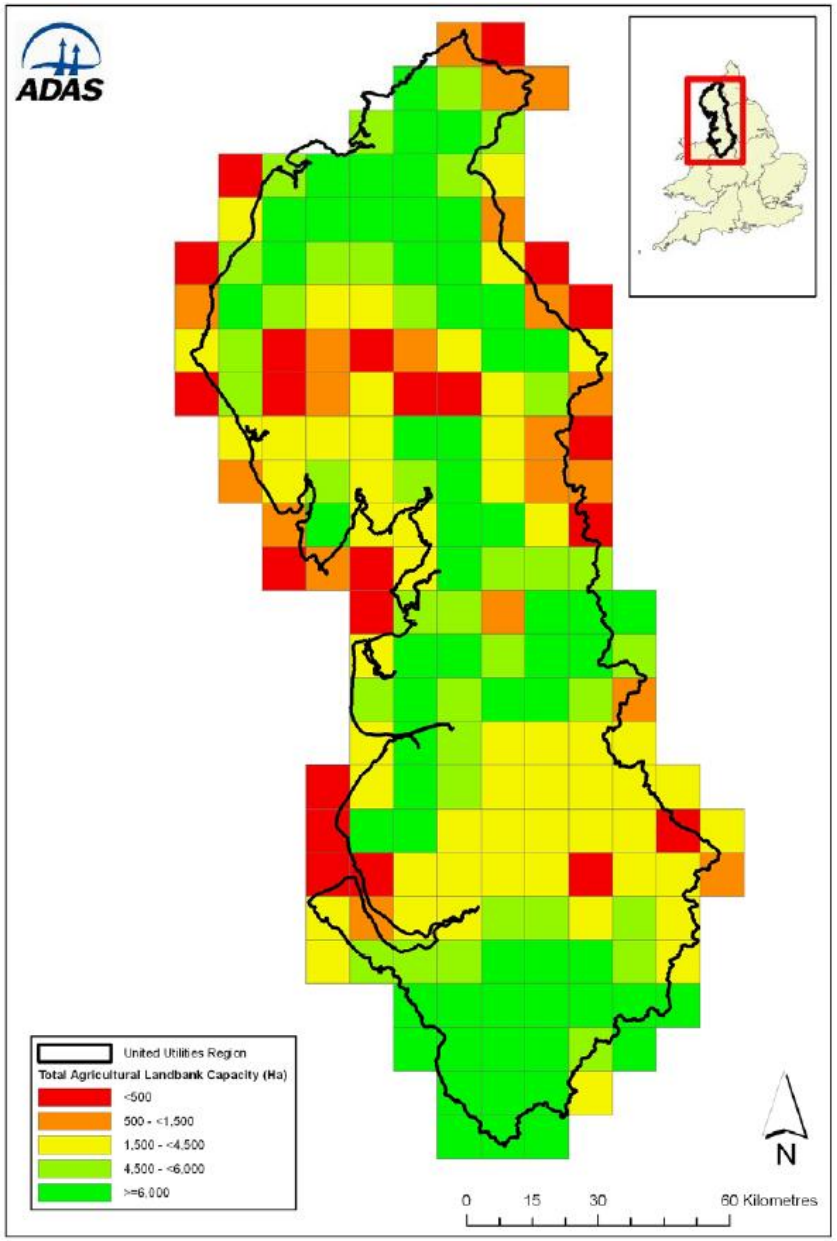
—By ***Josh Harkinson*** | Wed Jun. 17, 2009 9:25 PM PDT

Although its use has been allowed by law since 1998, sludge has until recently been used by only small pockets of the farming industry.

All biosolids used in agriculture meet 'strict quality assurance levels' and

AECOM

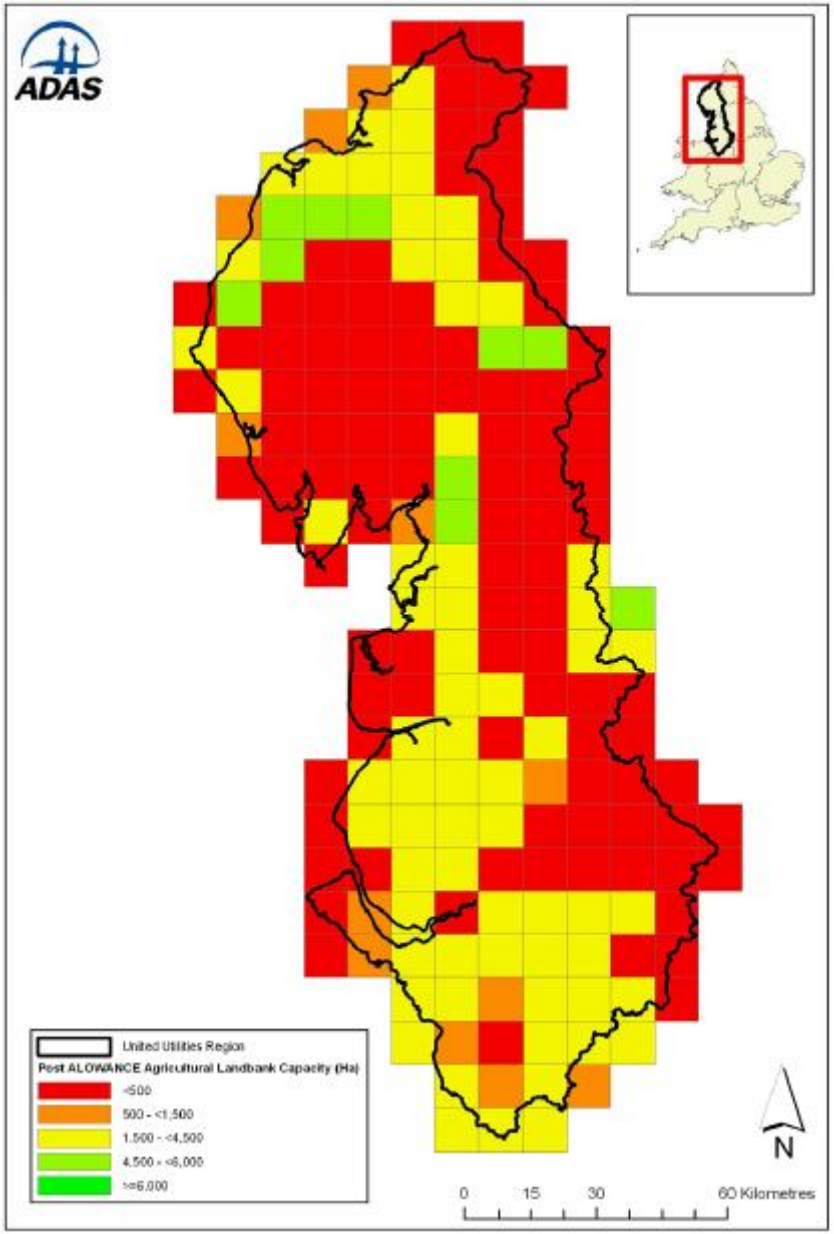
Land availability for biosolids use



- ESA
- SSSI
- National Parks
- Organically Managed Land
- Topography
- Water Courses
- NVZ
- PVZ
- Competition
- Supermarket pressures

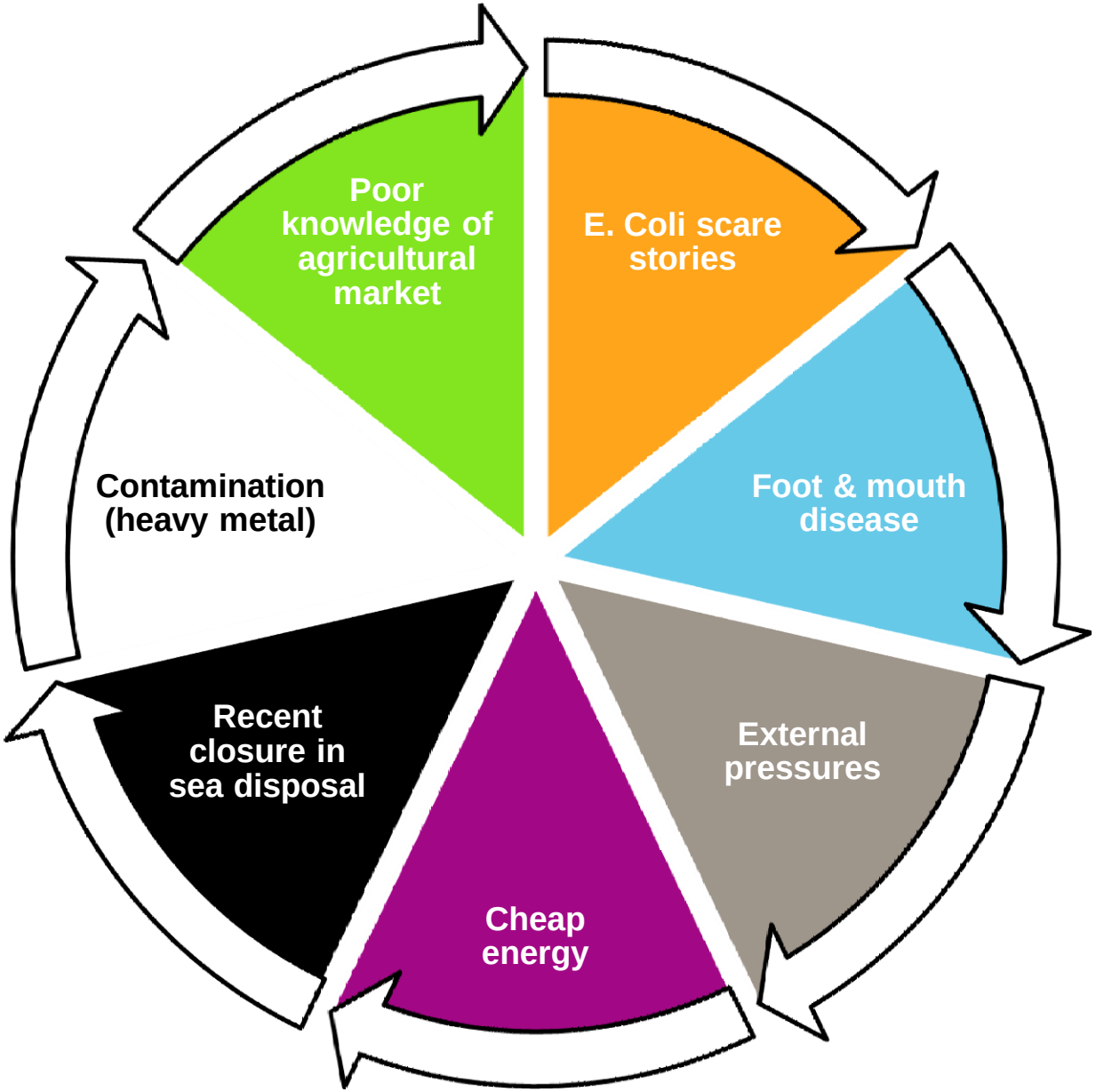
AECOM

Land availability for biosolids use



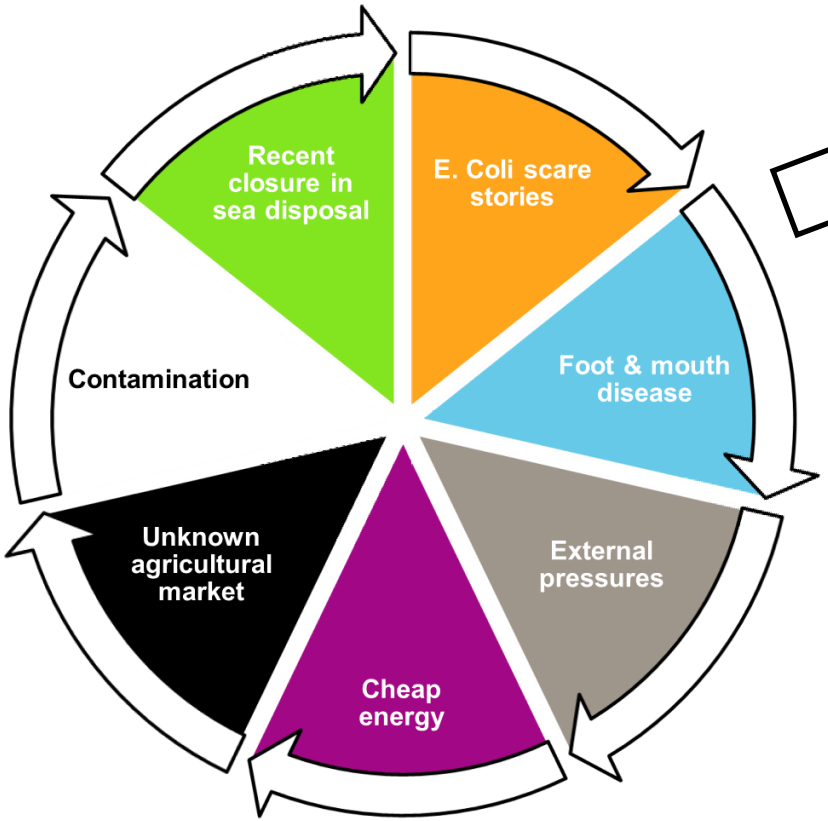
AECOM

Biosolids in Europe in 2000



AECOM

Biosolids in Europe in 2000



Solutions with ***LOW*** reliance on land application

Thermal Drying

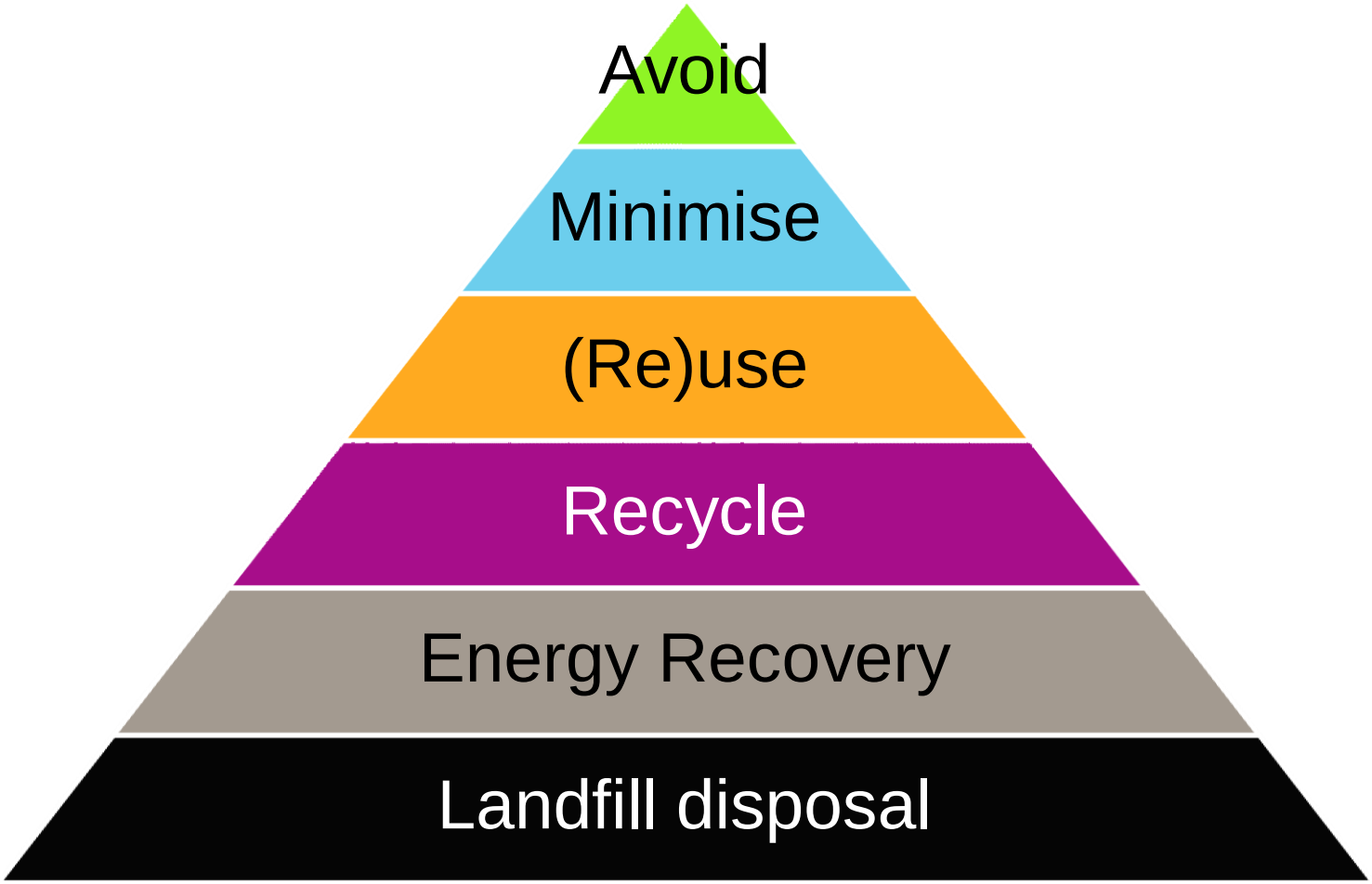
Incineration

Liming (intermediate measure)

Landfill

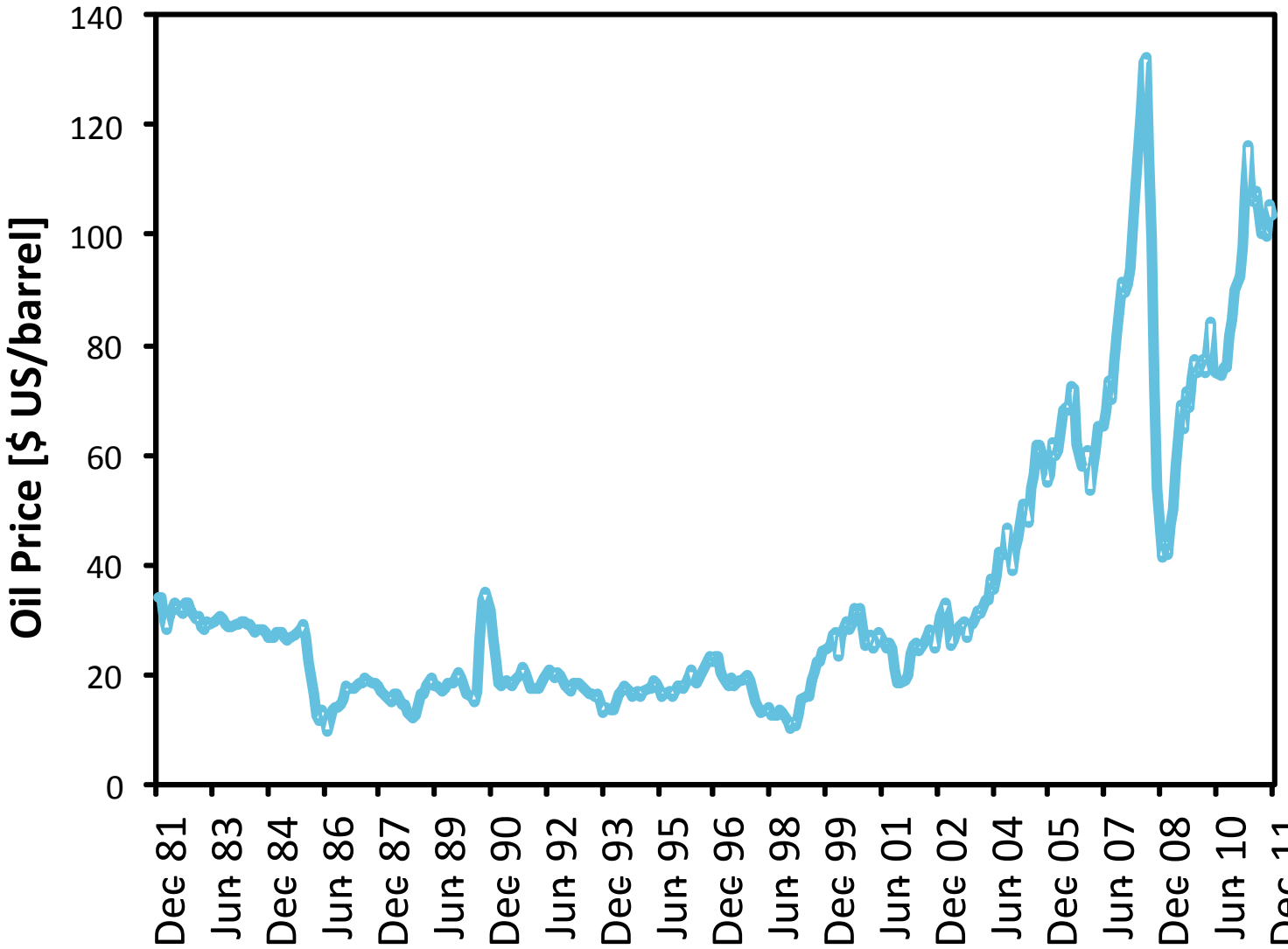
AECOM

Since 2001 – A Biosolids Odyssey



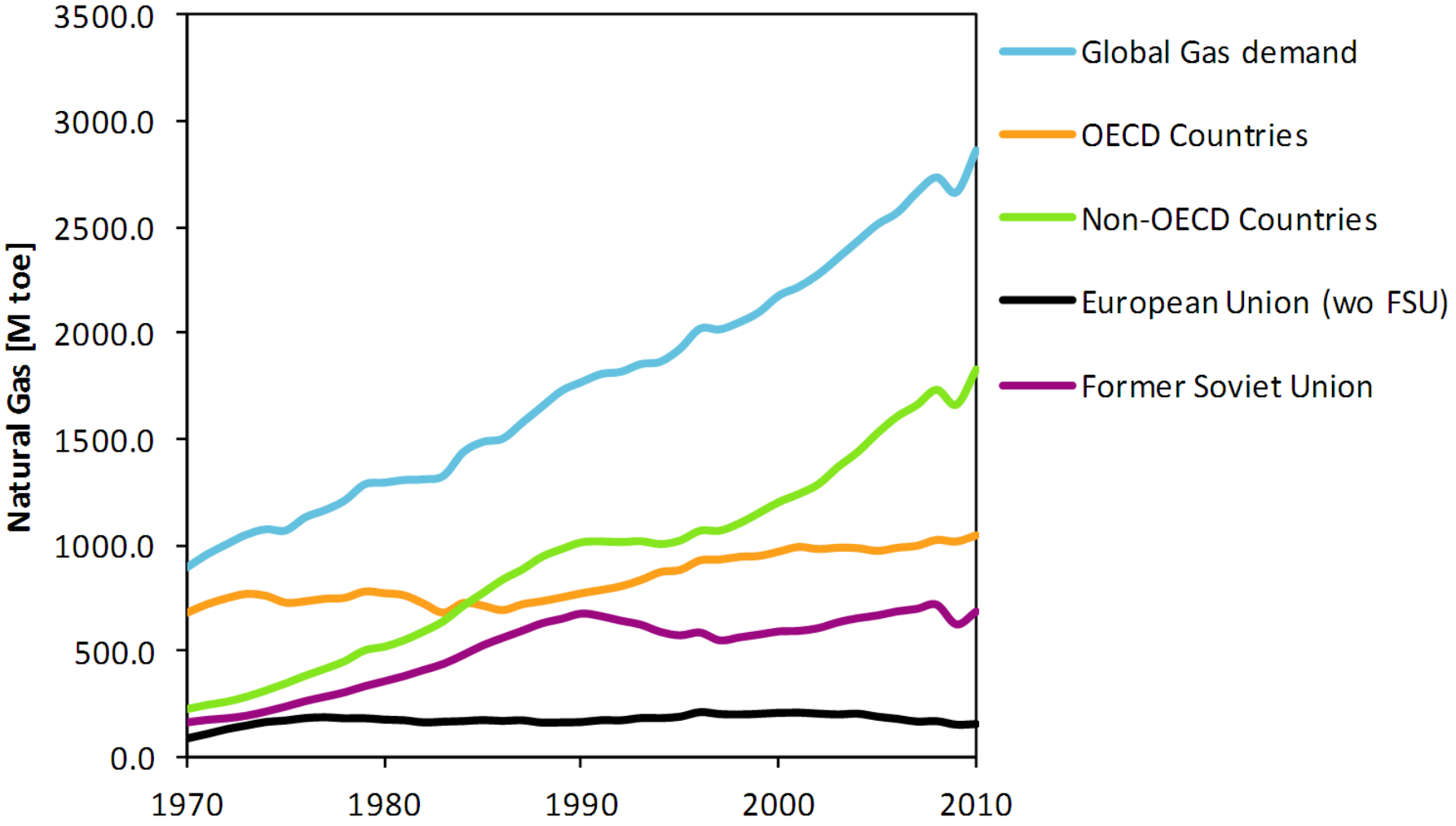
AECOM

Energy – Price



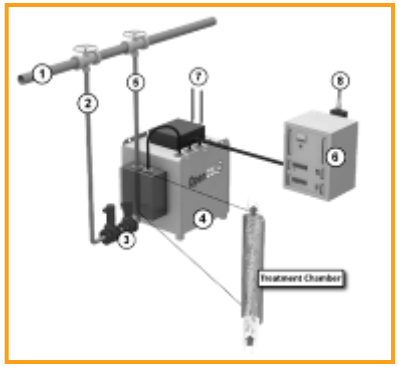
AECOM

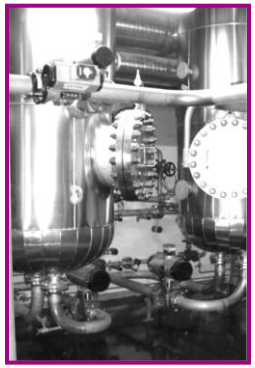
Energy – Security

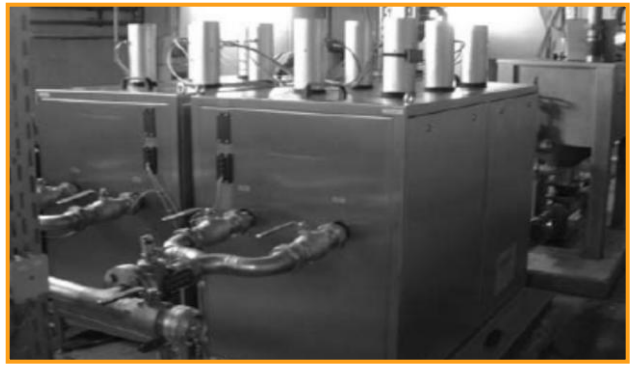


AECOM

Water Industry
Advanced Anaerobic Digestion







Ultrasonics

High Pressure Shear

Electric Pulse

Chemical Lysis

Medium Pressure Maceration

Rapid Decompression

Thermal Hydrolysis

Acid Phase

Biological Hydrolysis

AECOM

Benefits of Advanced Digestion

Greater Stability

Higher biogas production

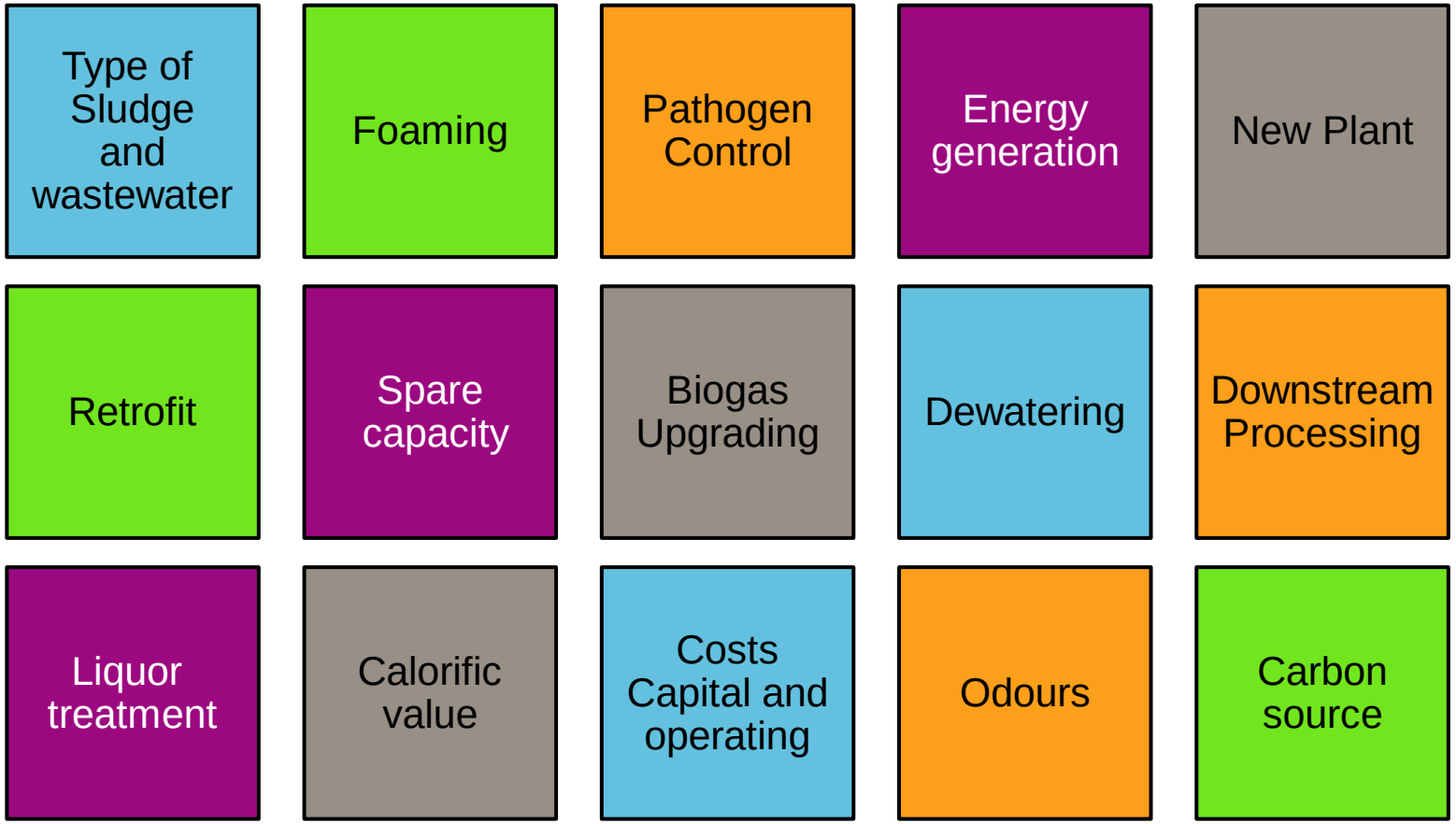
Smaller Digestion Plants

Better dewatering

Advanced treated

Reduced secondary emissions

Choice of pre-treatment technology is complex



Different sites will require different solutions...

AECOM

Alternative uses for Biogas

CO2 119 g/km (automatic!

1.4 l Compressor/Turbo

150 ps/5500 rpm

220 Nm/1500-4300 rpm

450 – 500 km range

0-100 km/h 9.8 s

213 km/h

AECOM

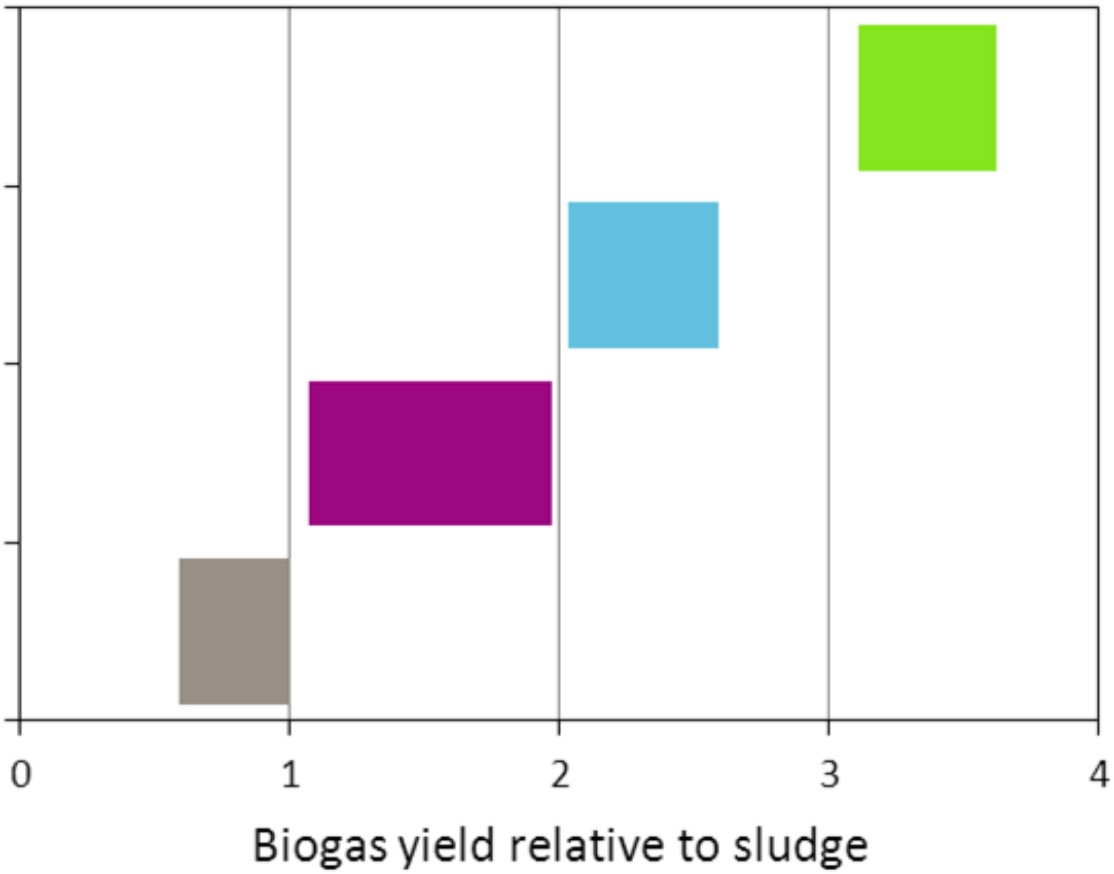
Biogas yield of wastes relative to sewage sludge

FOG, Brewery, Energy Crops

Maize, cheese, glycerol, high energy food

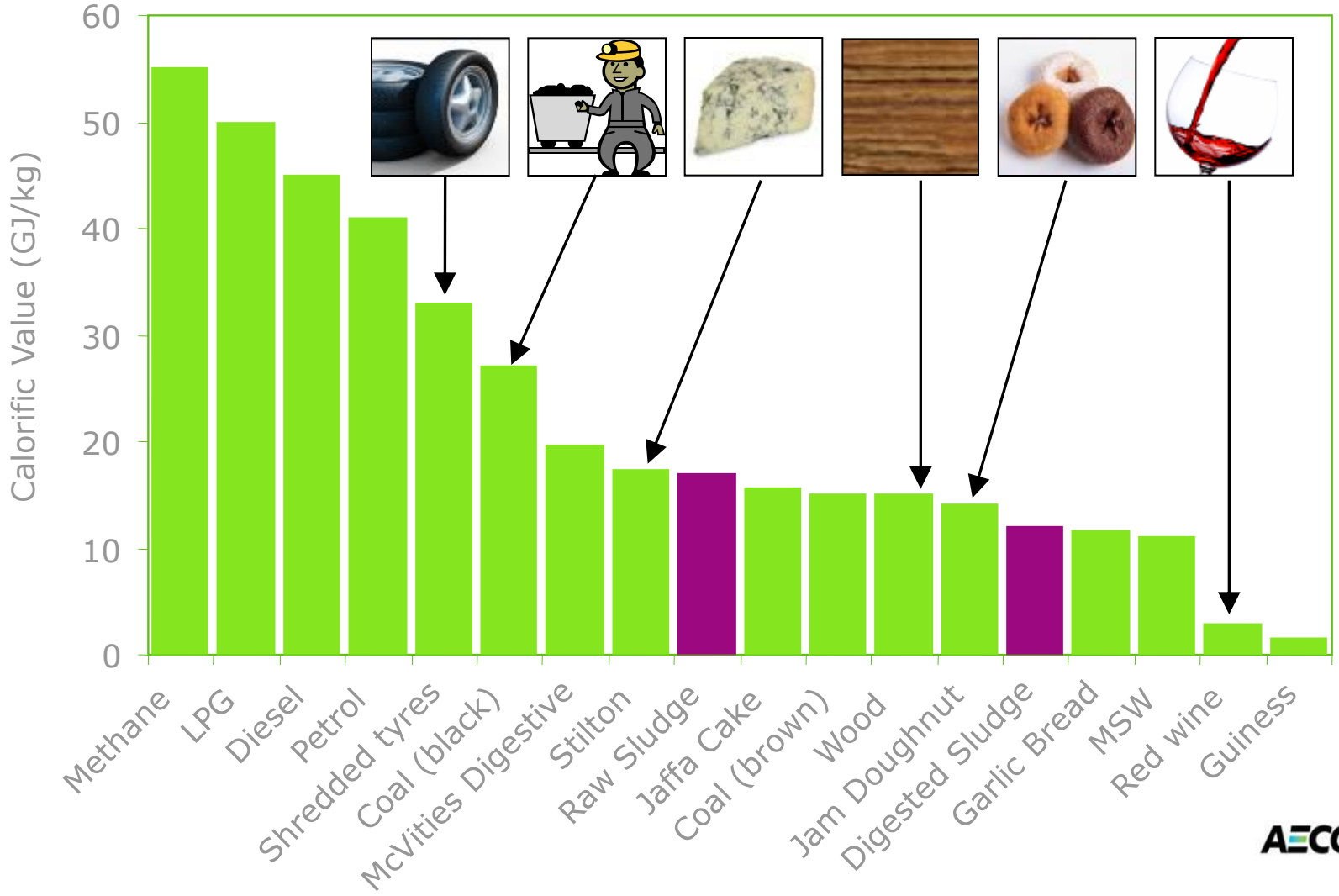
Molasses, sugar beet, low energy food, grasses, silage

Animal mucks and manures, wheat straw

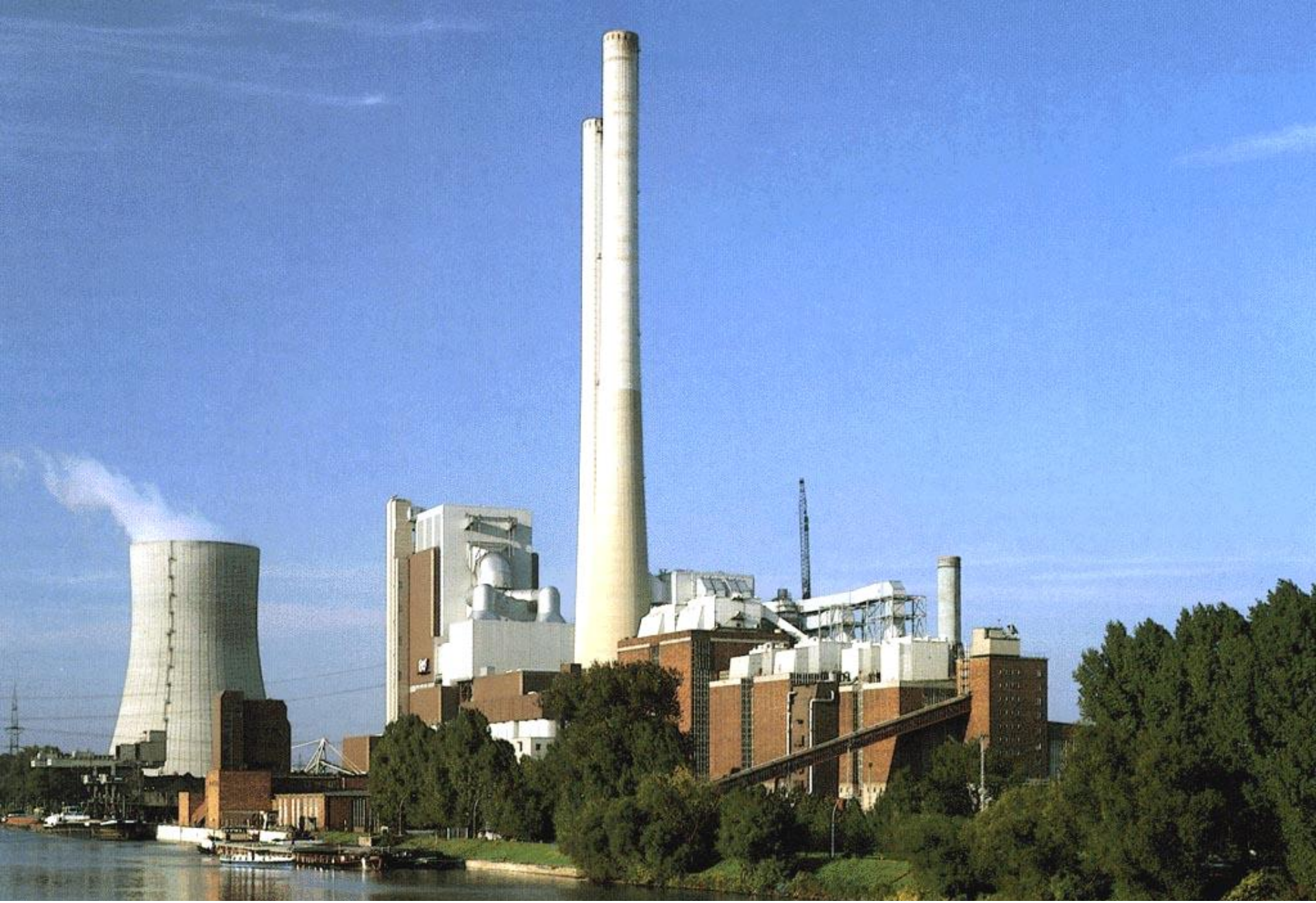


AECOM

Calorific Value of Substances



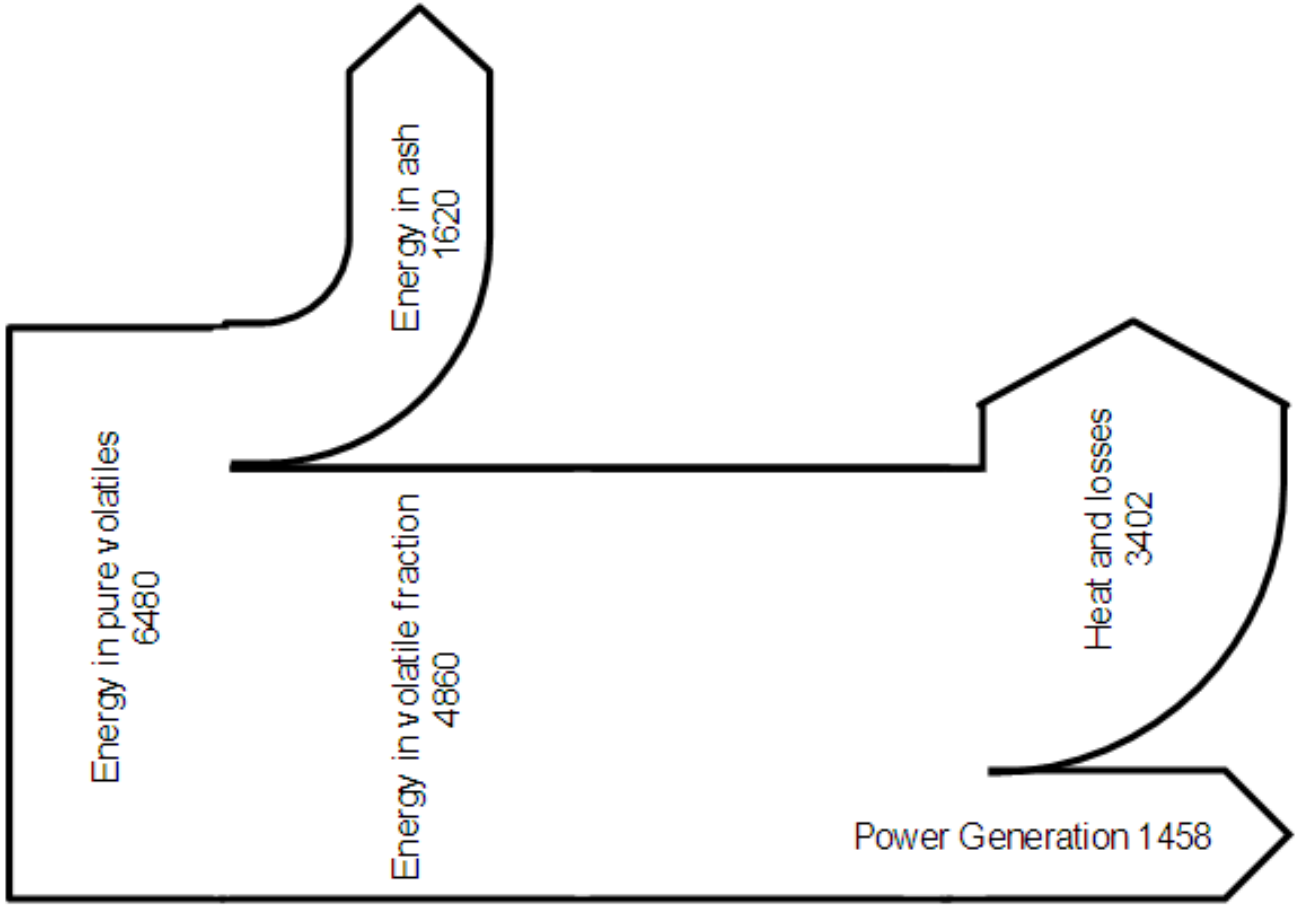
AECOM



Heilbronn Power Station

Holistic Energy Recovery from Biosolids

Raw (no digestion)

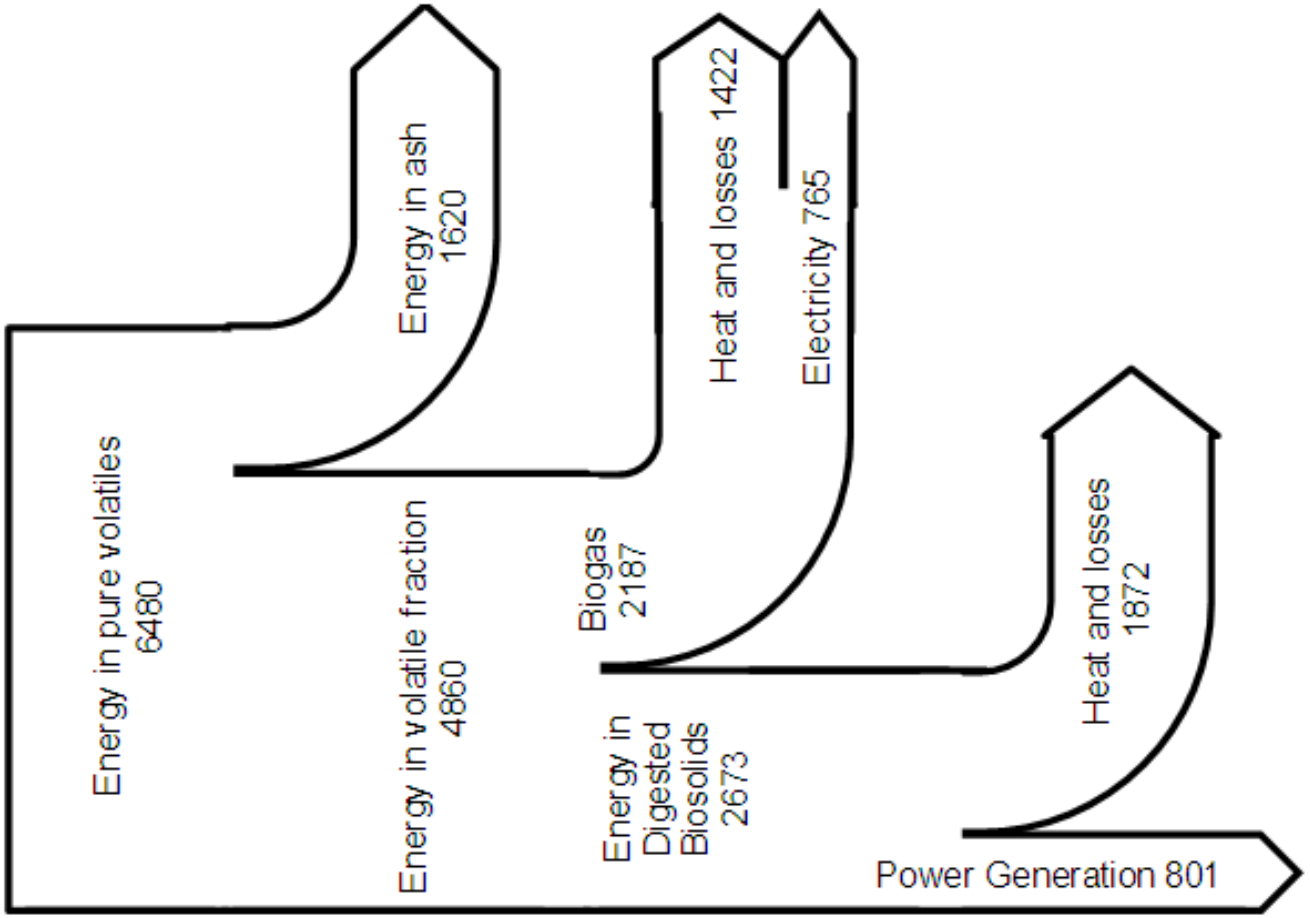


Energy recovered 1458

By Water Company 0%

AECOM

Holistic Energy Recovery from Biosolids
With anaerobic digestion

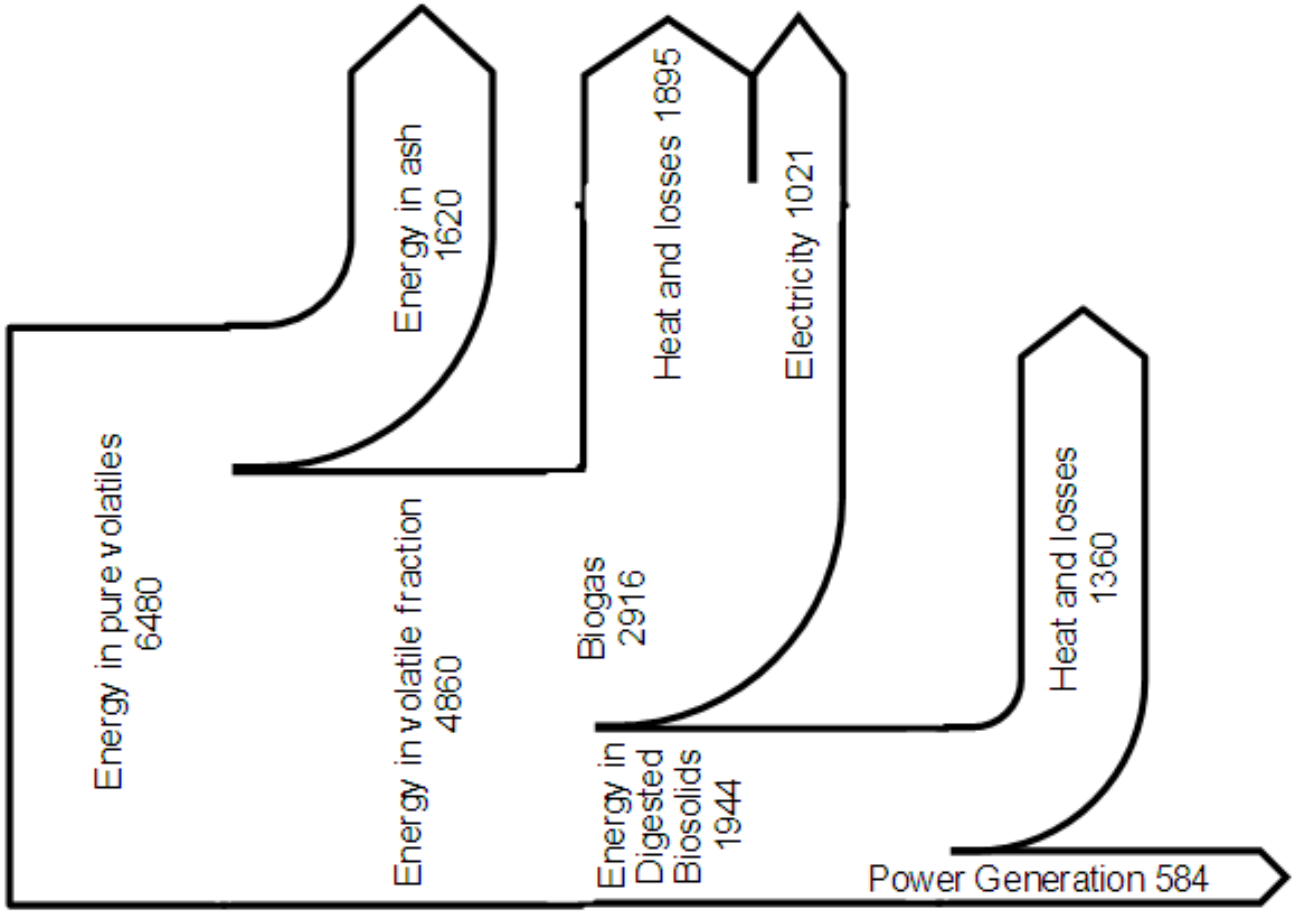


Energy recovered 1566

By Water Company 48%

AECOM

Holistic Energy Recovery from Biosolids
With advanced digestion

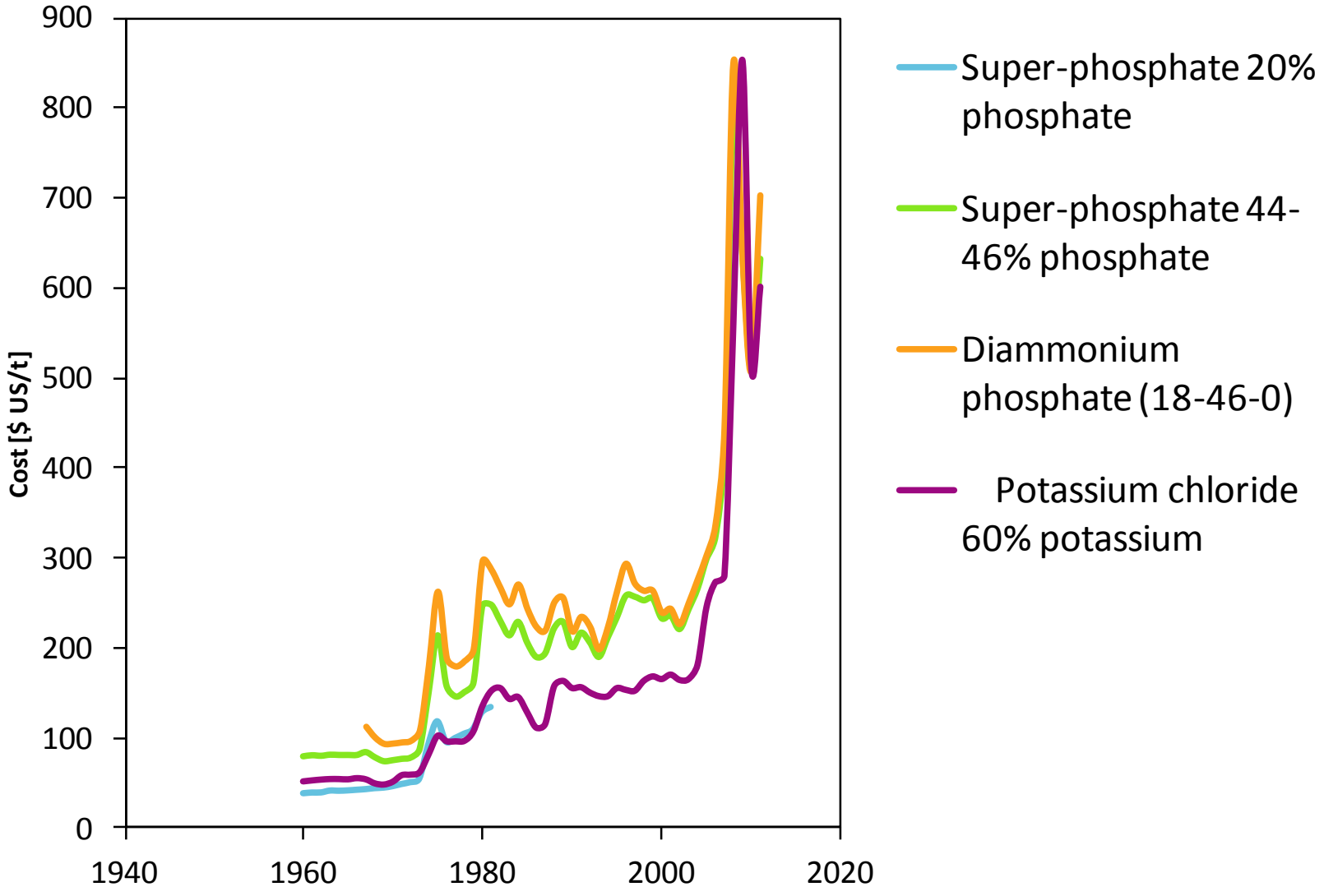


Energy recovered 1605

By Water Company 64%

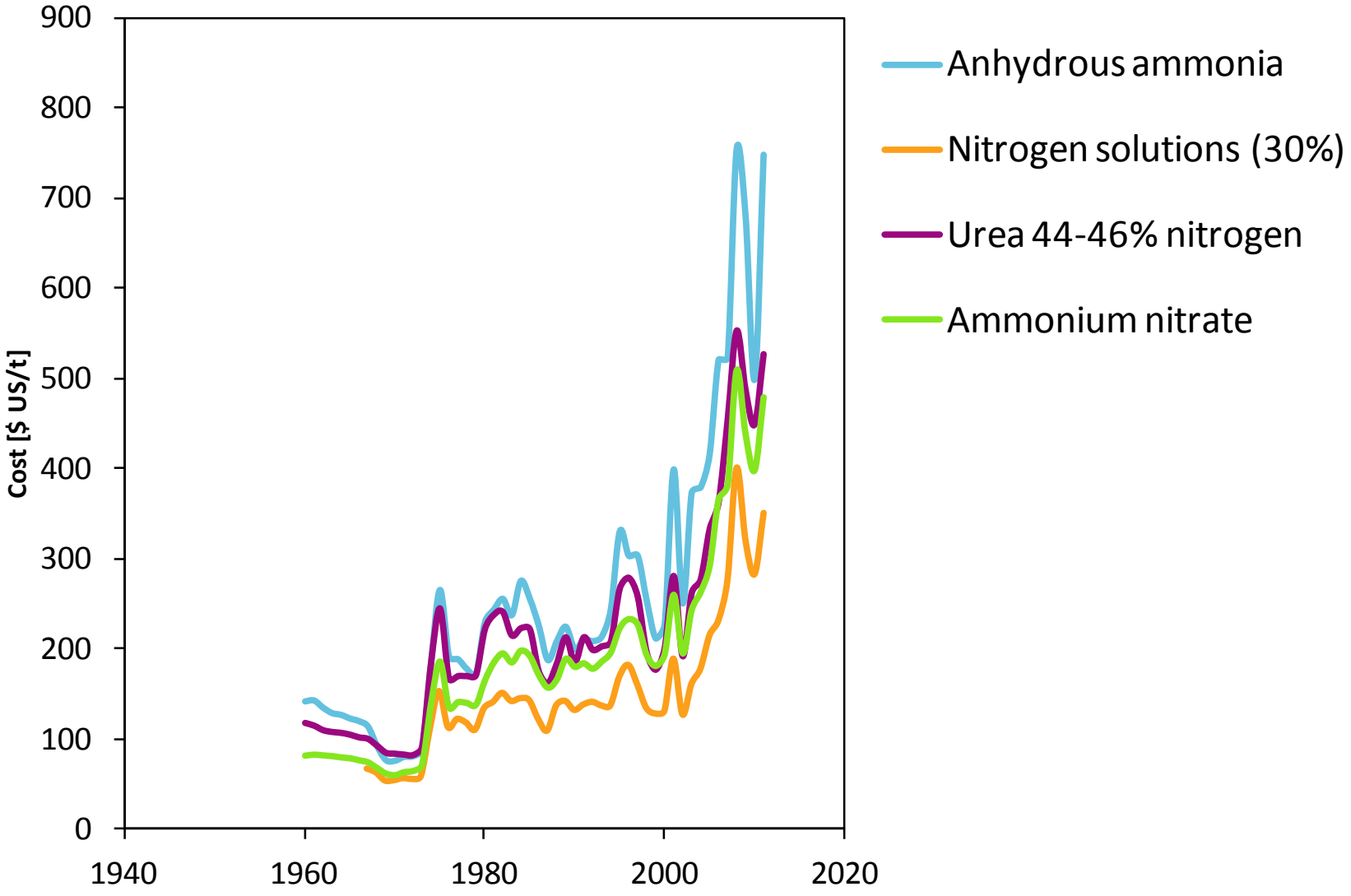
AECOM

Fertiliser Costs – Phosphorus



AECOM

Fertiliser Costs – Nitrogen

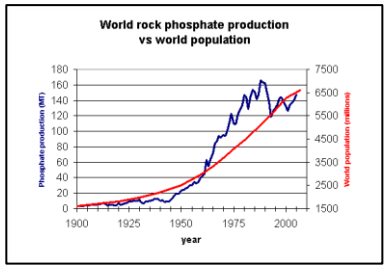


AECOM

Phosphorous

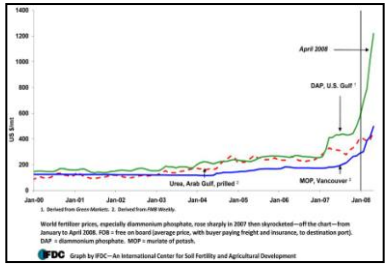
- World population increasing
  - Becoming urbanized
  - Changing food habits
  - Global demand increased 4.7 million tones in 3 years (equivalent to USA consumption)
    - 0.6 – 1.6 kg P/person.year

Demand



- Peak P predicted at 2035?
  - 50 – 100 years of easily mined P remain
  - >70% of all reserves in Morocco
  - China imposed P export tax (+110%)

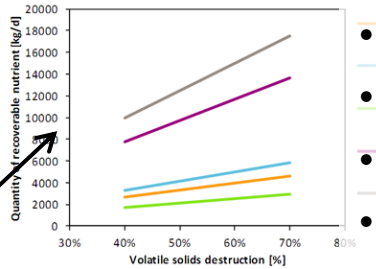
Supply



AECOM

Phosphorus Recovery

Struvite

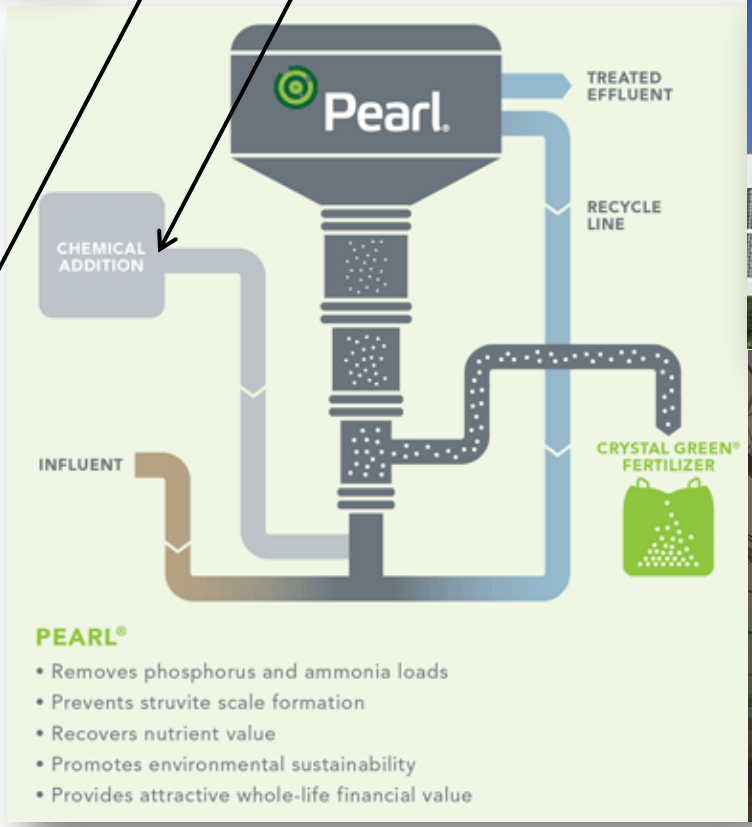


Influenced by:

- Physical parameters
- WWTP configuration
- Digestion performance
- Reactive phosphorous

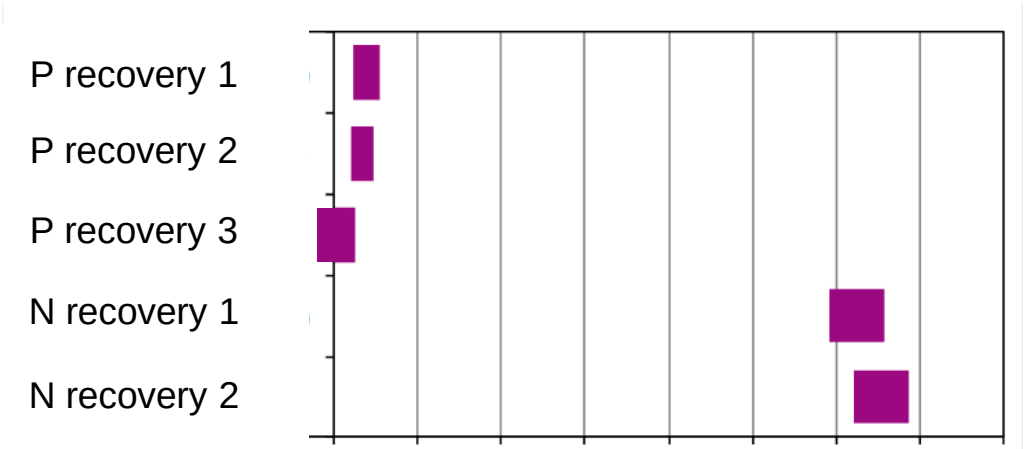
NH_4 Mg $PO_4 \cdot 6H_2O$

Aeration Savings



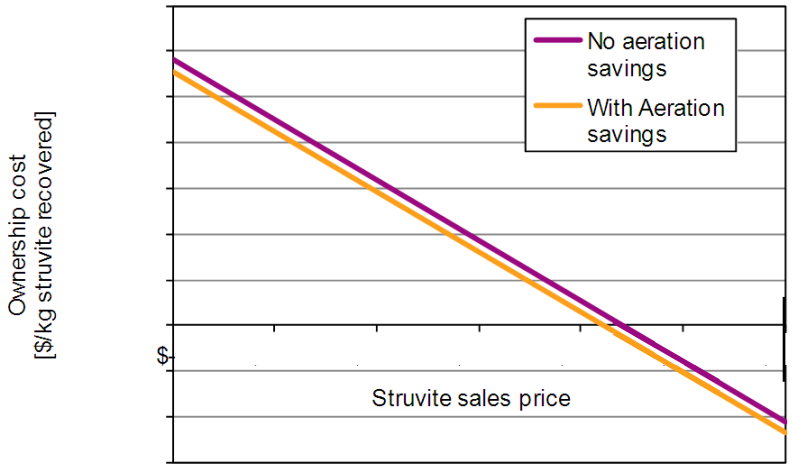
AECOM

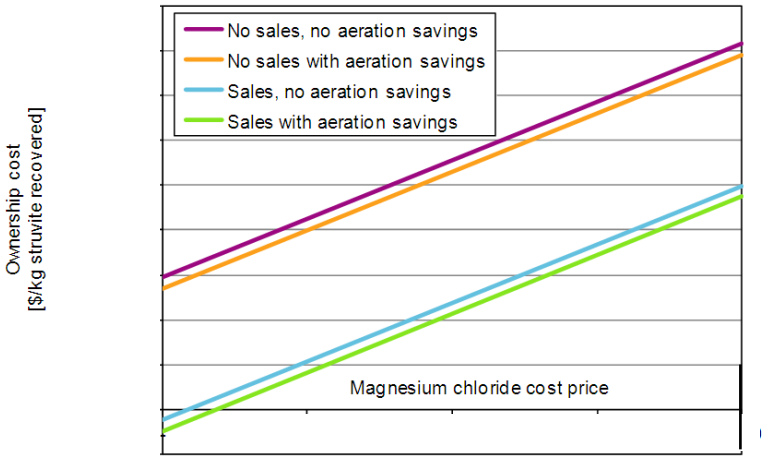
Nutrients – Cost Effective Recovery?



- Nutrient sales price
- Market place
- Chemical costs
- Site impacts
- Power costs

← Makes money $0 Costs money →

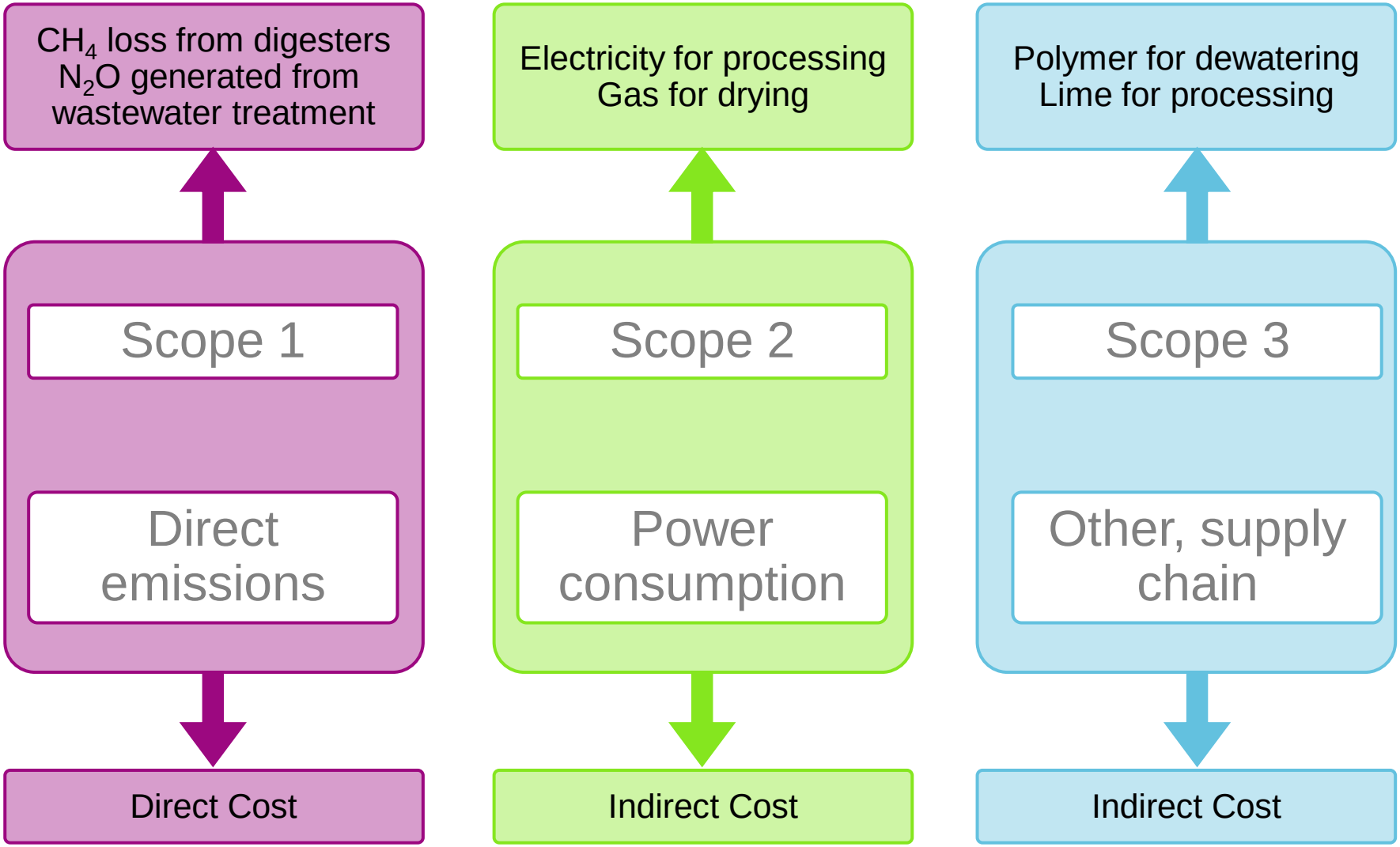




Nutrient recovery consumes large quantities of chemicals and energy…..will this be sustainable in the future especially when compared to direct application of nutrients within biosolids?

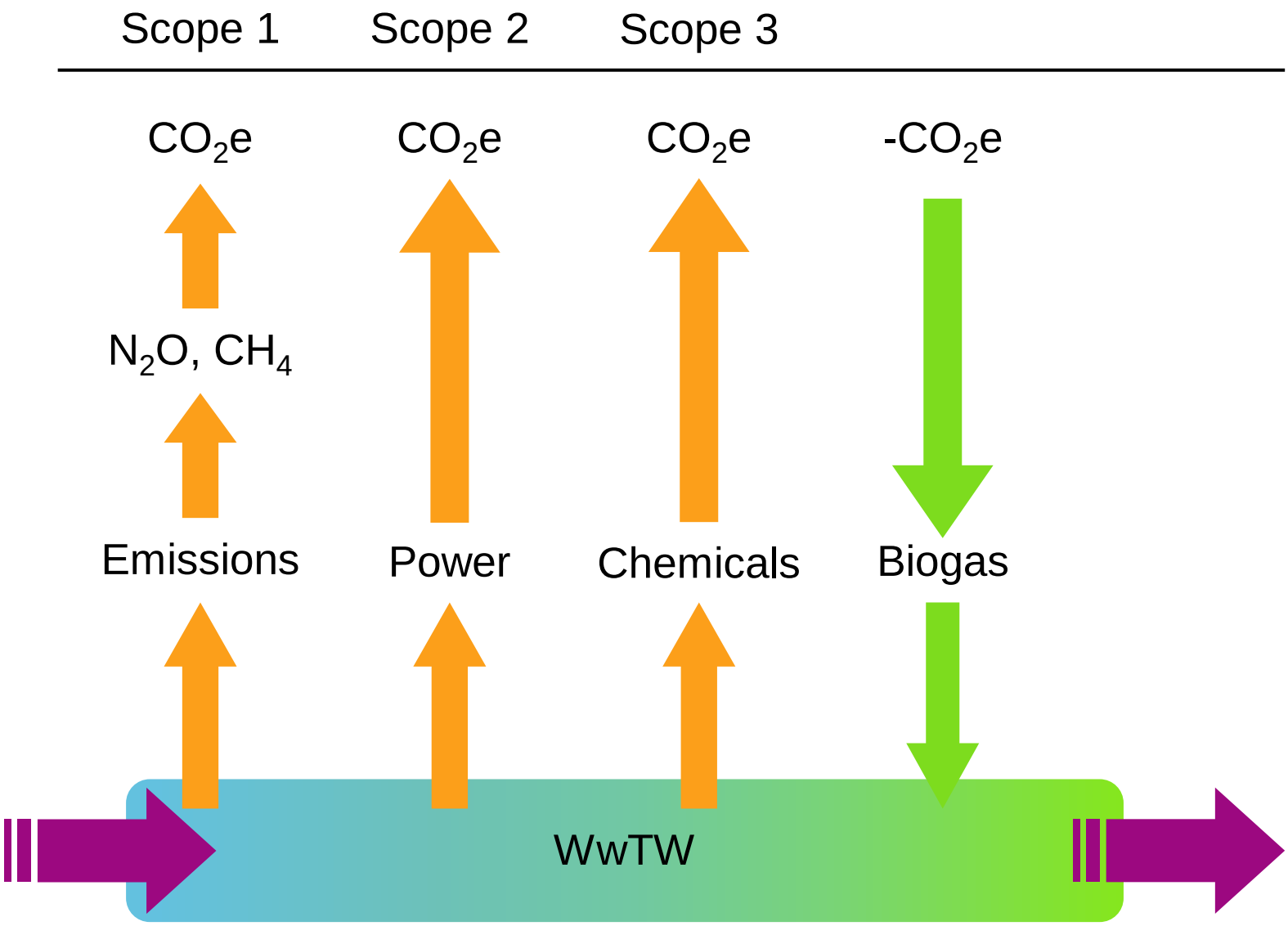
AECOM

Carbon footprint associated with biosolids/WW treatment



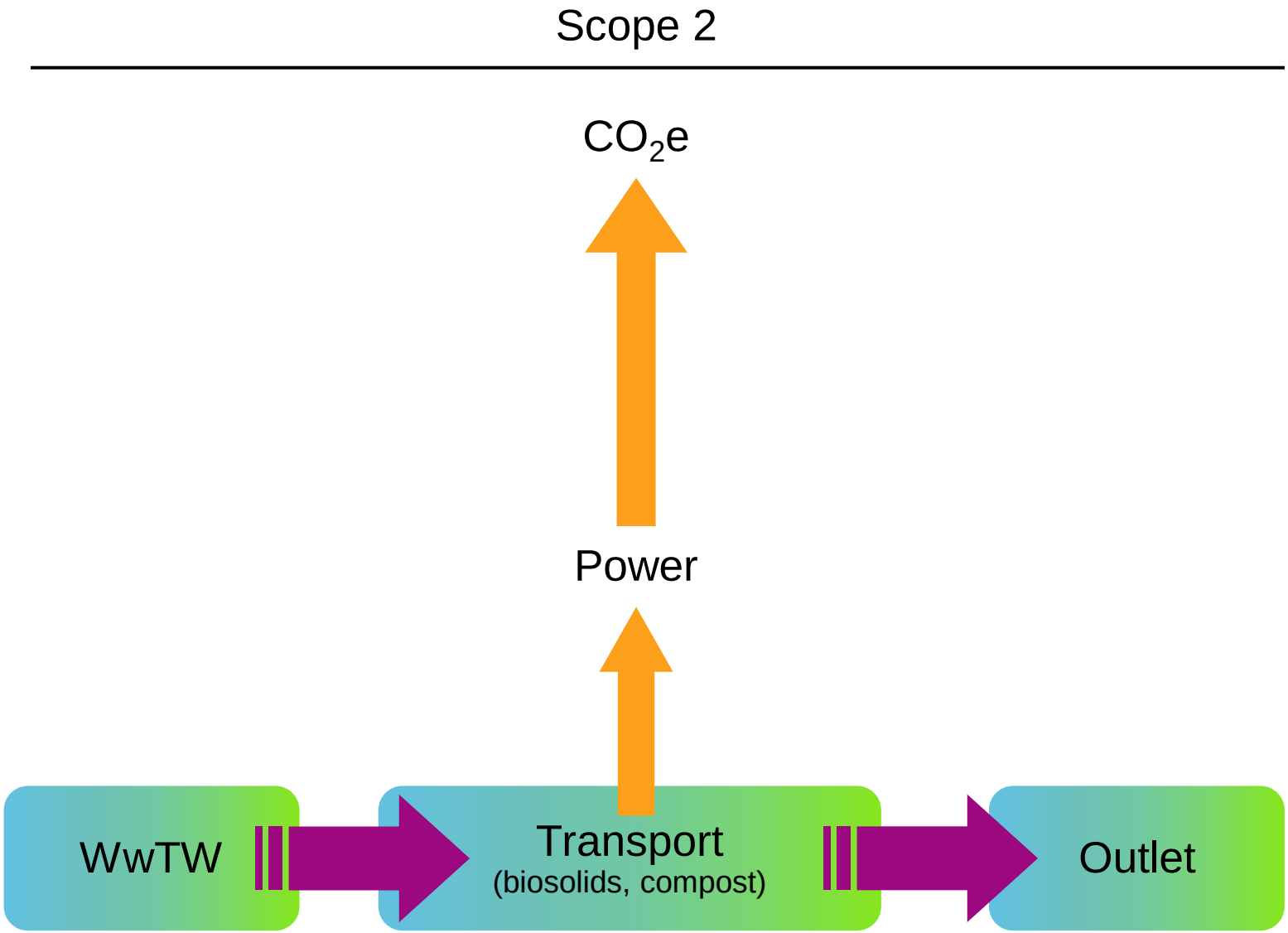
AECOM

Influence of Biosolids on Carbon Footprint



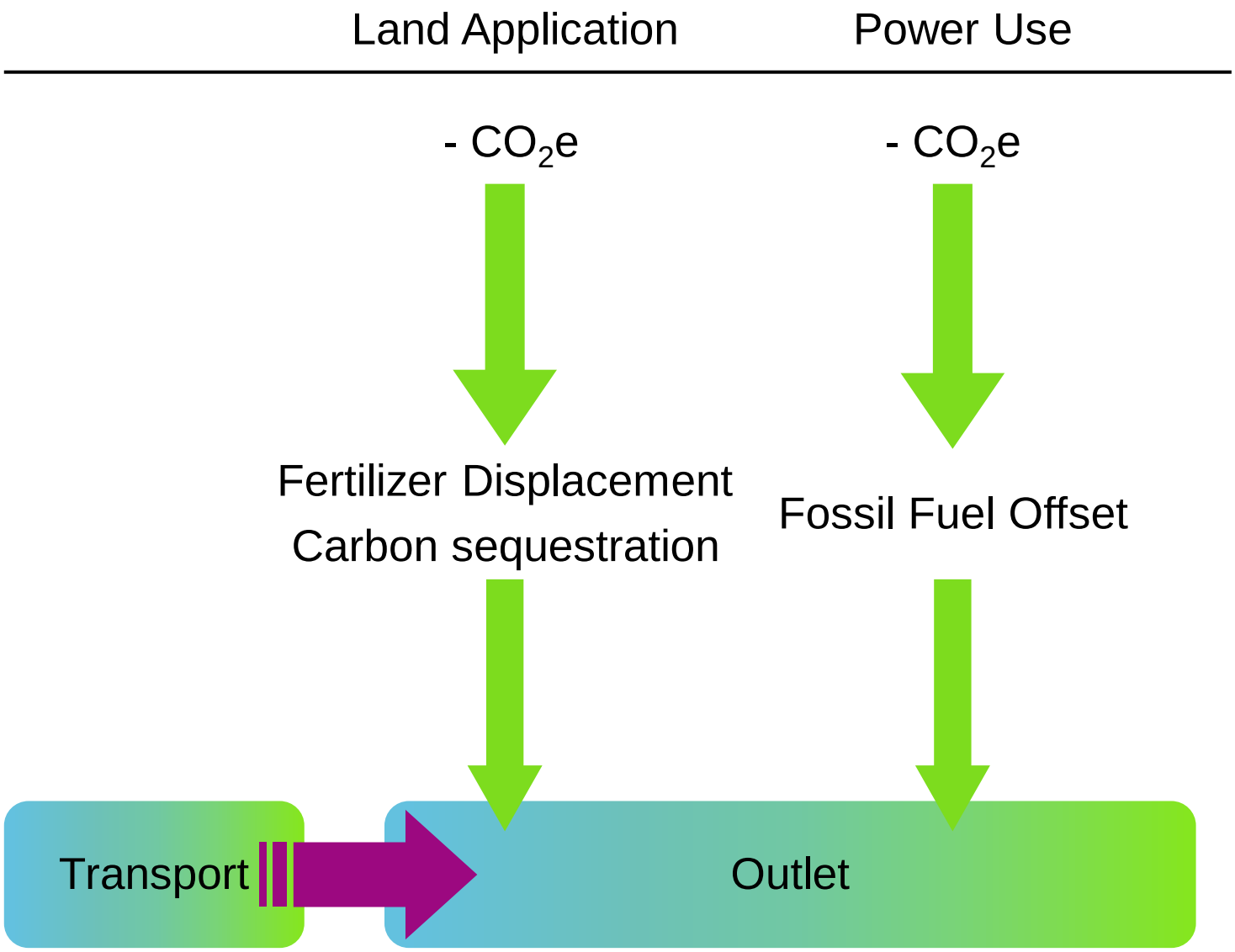
AECOM

Influence of Biosolids on Carbon Footprint



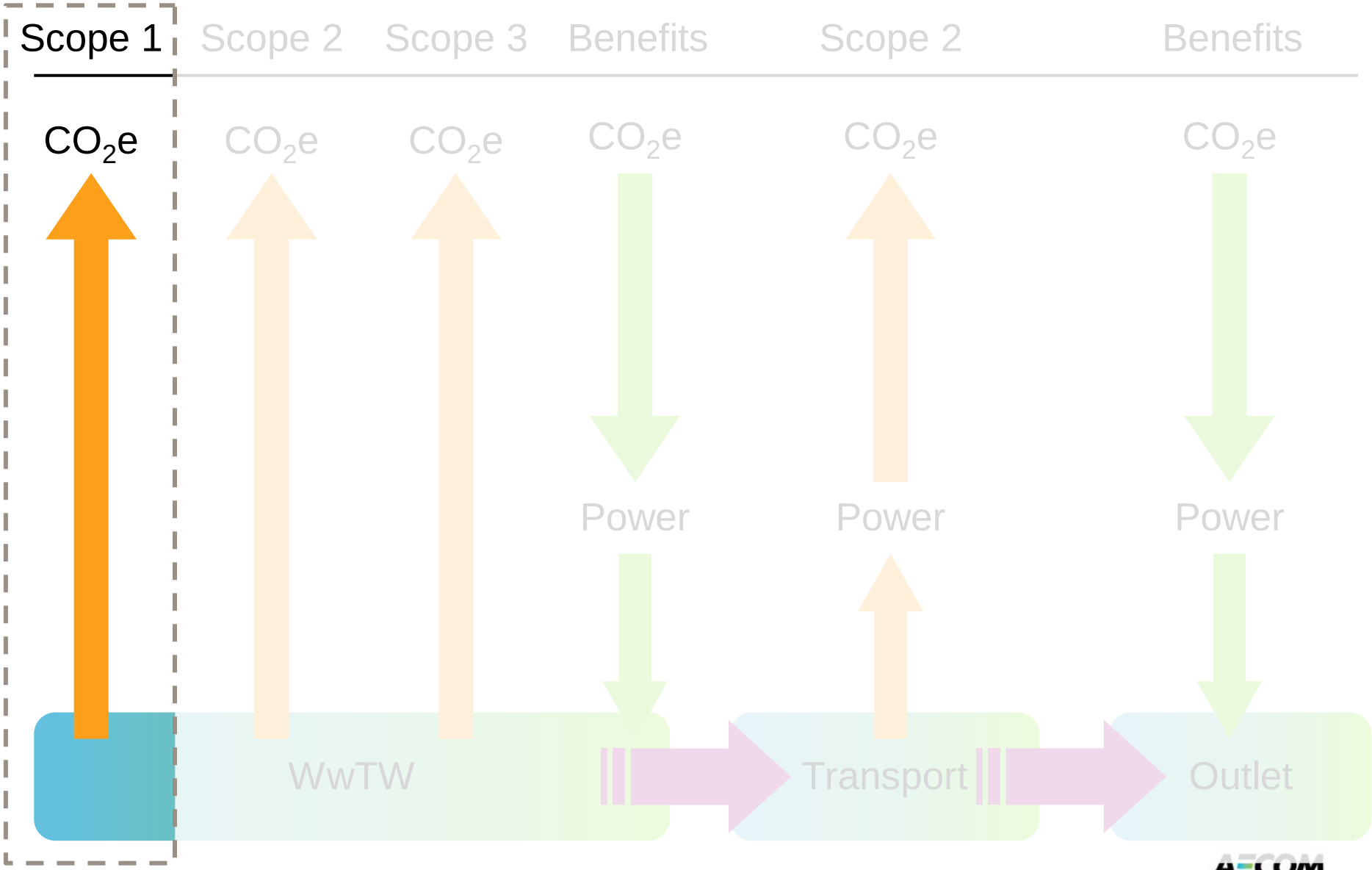
AECOM

Influence of Biosolids on Carbon Footprint



AECOM

What is counted under current methodology



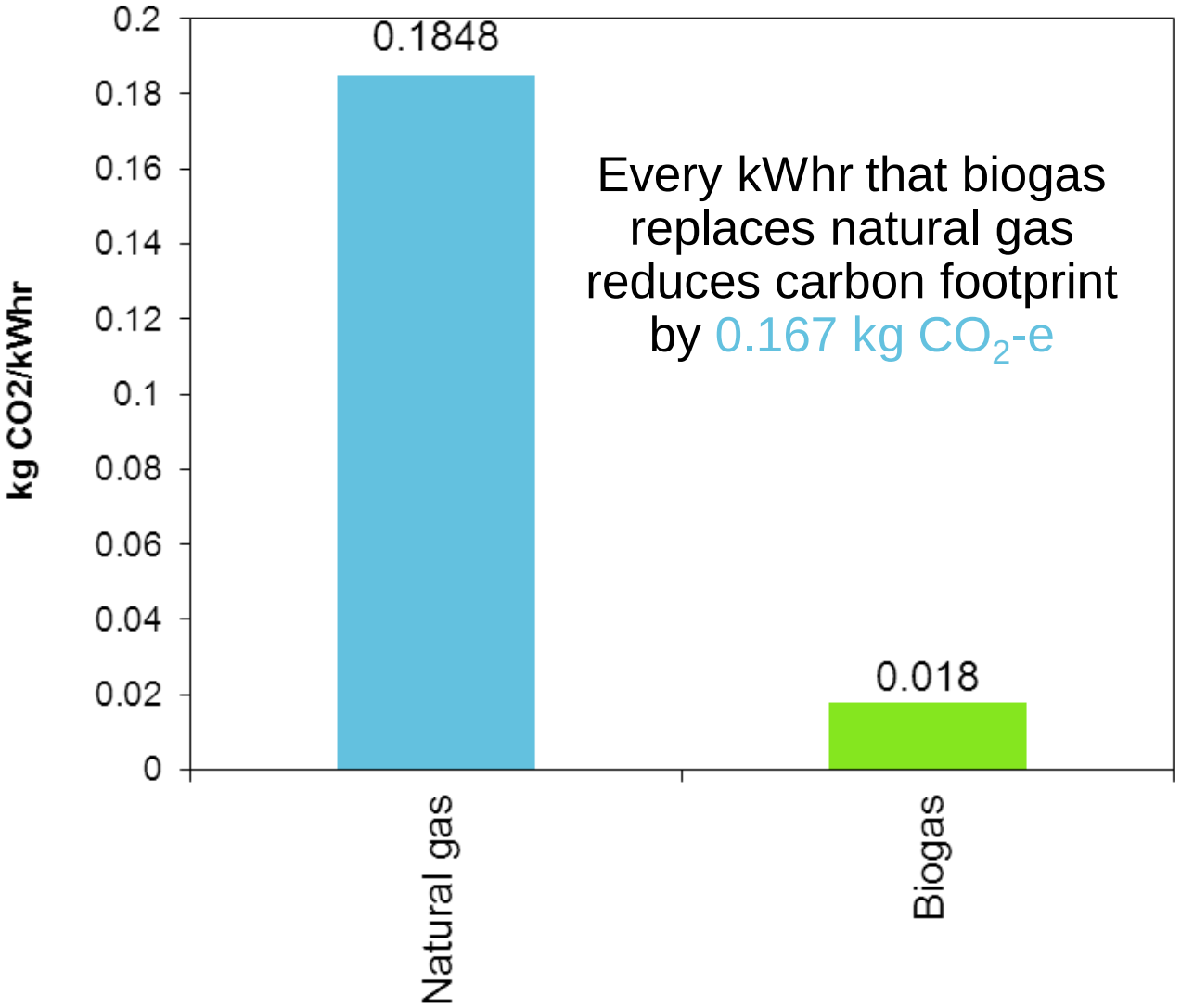
AECOM

Opportunities

- Which could currently be recognized
  - Energy from biogas produced by anaerobic digestion
  - Low carbon fuel for burning
- Potential (but not covered under regulation)
  - Low carbon fertilizer
- Other
  - Carbon sequestration

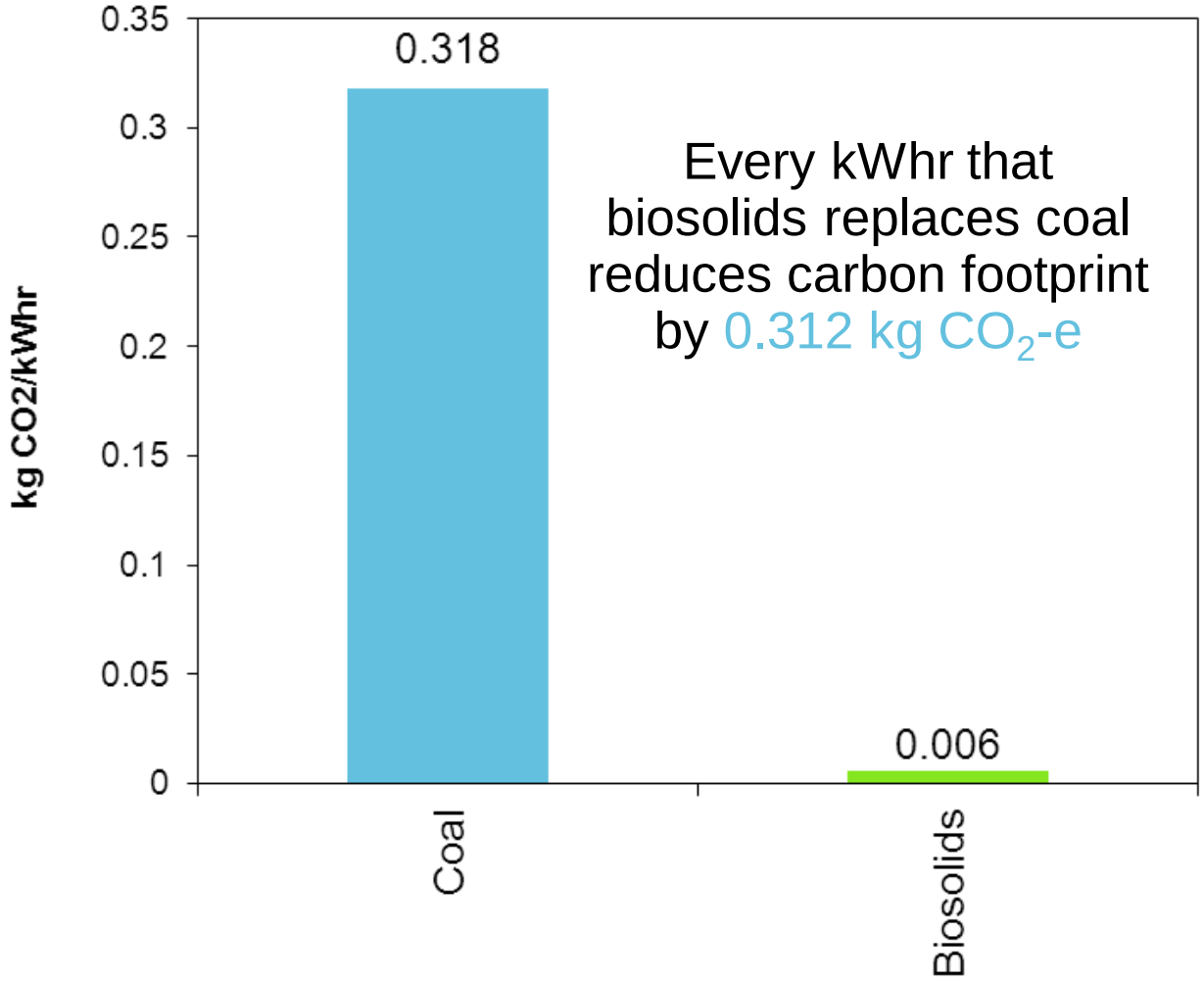
Opportunities – Biogas

- Based on NGER methodology



Opportunities – Biosolids Burning

- Based on NGER methodology



AECOM

Opportunities – Biosolids Burning

100 MW ⇨ 280,000 t CO_2e ⇨ $6.41M

Opportunities – Biosolids Burning

95 MW ⇨ 265,000 t CO_2e ⇨ $6.09M

⇧ 5 MW

Biosolids are worth $315k to the power station in reduced carbon taxes

⇩

You need <13,000 tDSA biosolids to generate 5 MW

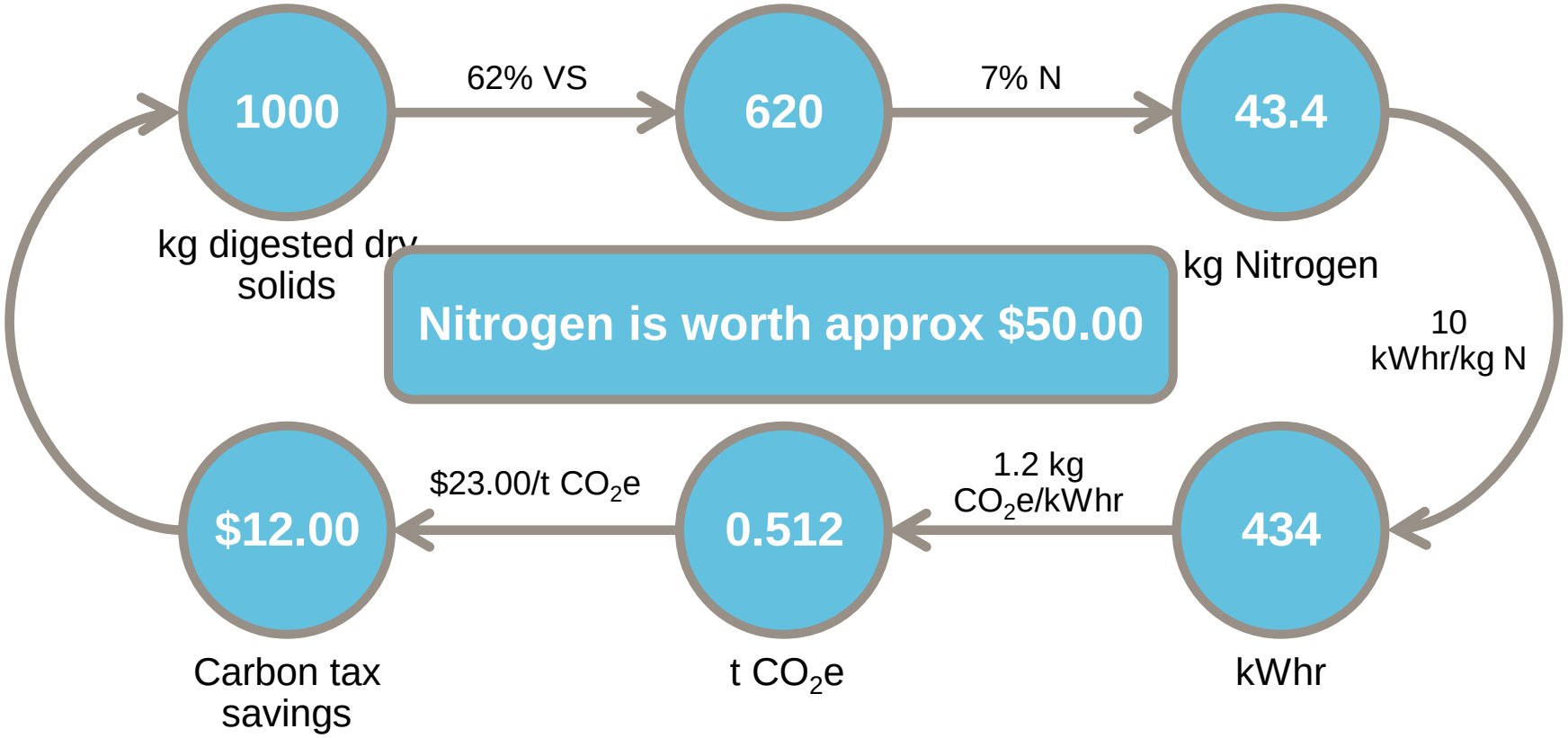
⇩

The biosolids are worth approx $25/tDS to the power station in carbon tax reductions

AECOM

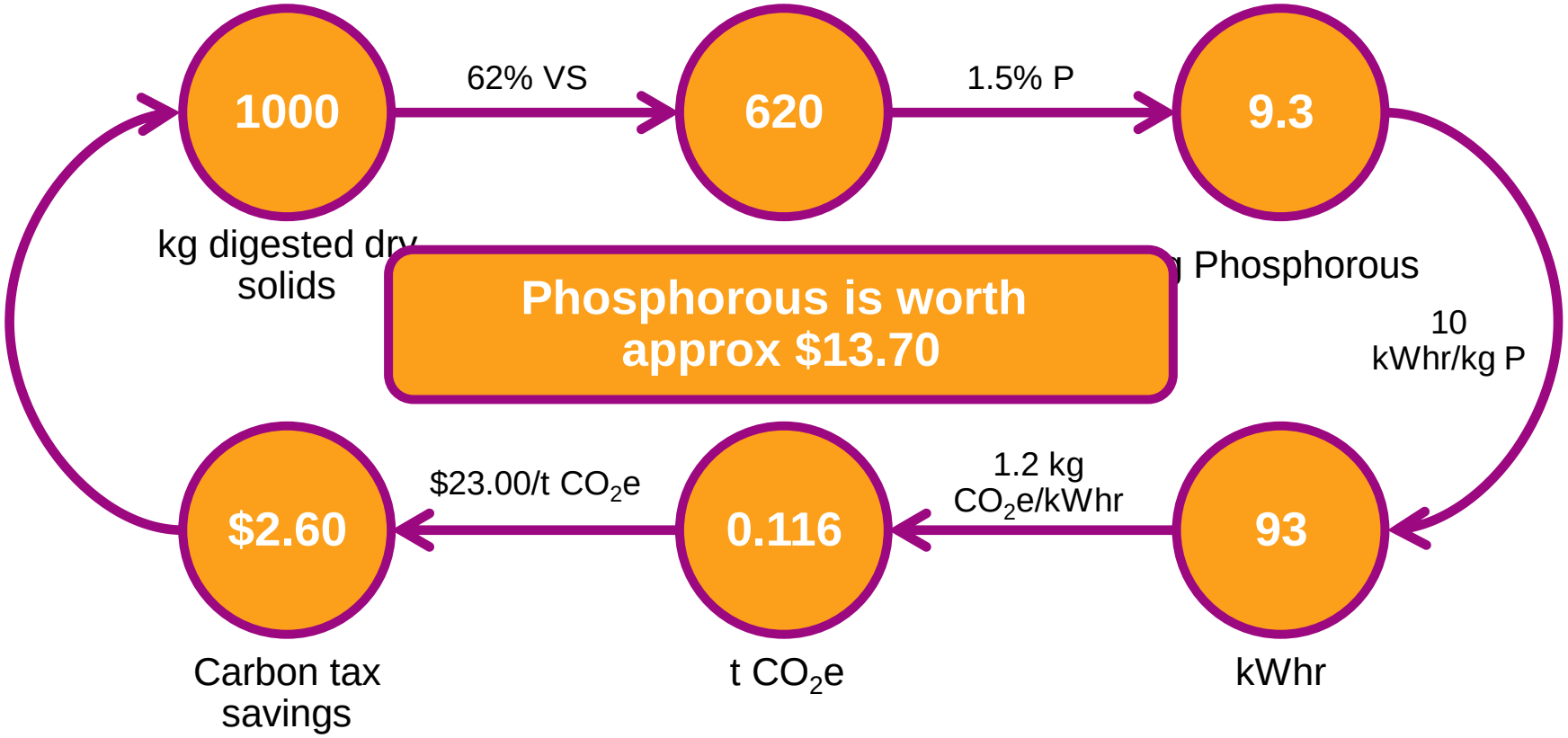
Opportunities – Low Carbon Fertilizer

- Fertilizers are large consumers of fossil fuels
  - 1 kg N consumes 10 kWhr energy
  - 1 kg P consumes 10 kWhr energy

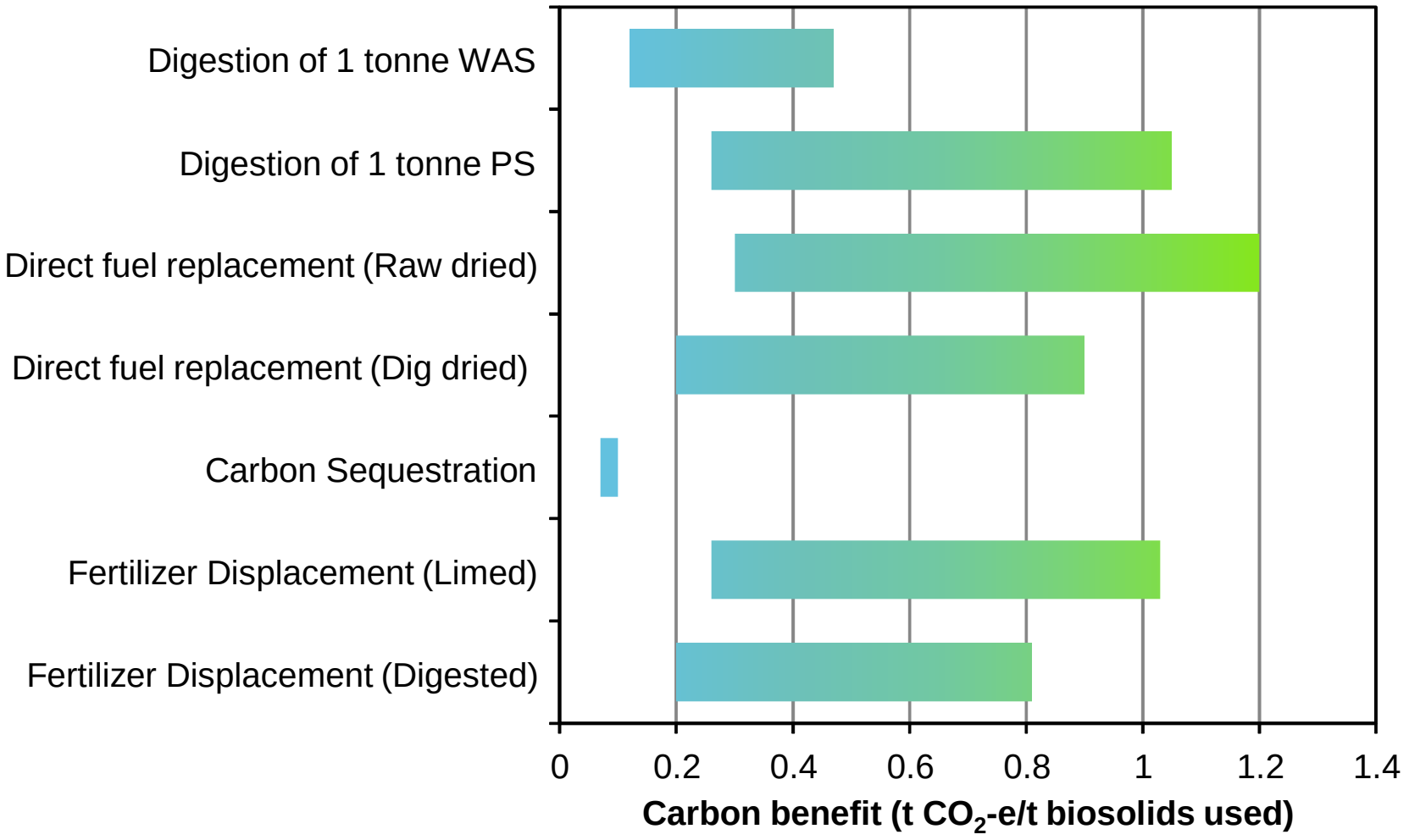


Opportunities – Low Carbon Fertilizer

- Fertilizers are large consumers of fossil fuels
  - 1 kg N consumes 10 kWhr energy
  - 1 kg P consumes 10 kWhr energy

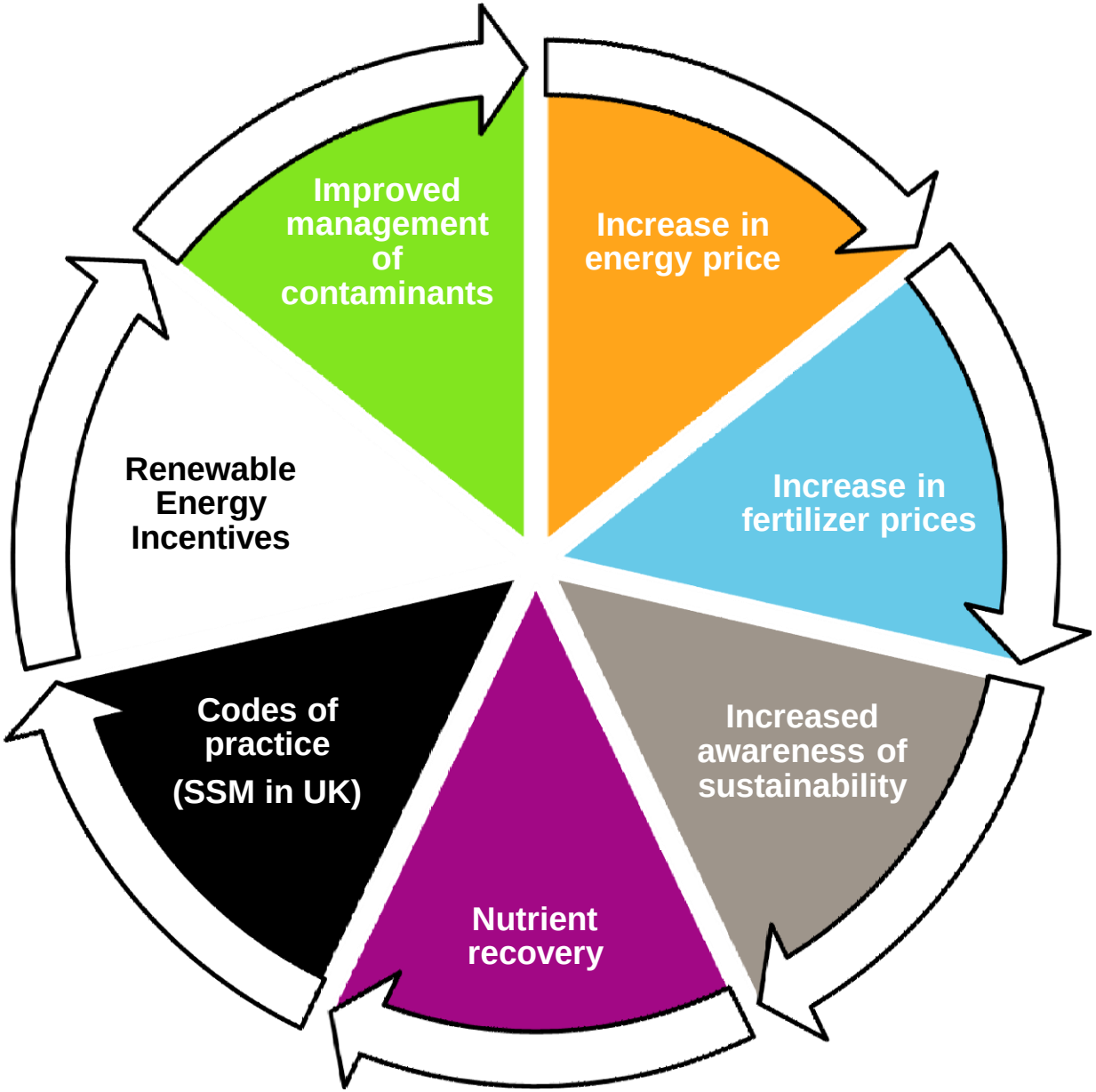


Carbon benefits of biosolids use



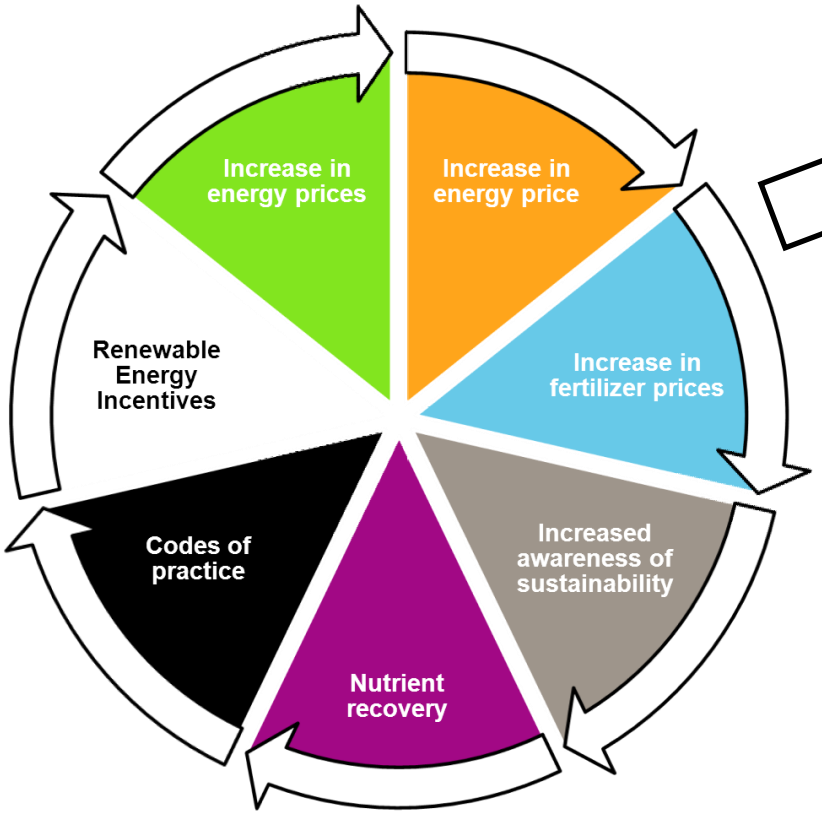
AECOM

Biosolids in Europe in 2010 and beyond



AECOM

Biosolids in Europe in 2010



Solutions with ***LOW*** :

- energy requirements
- carbon footprints

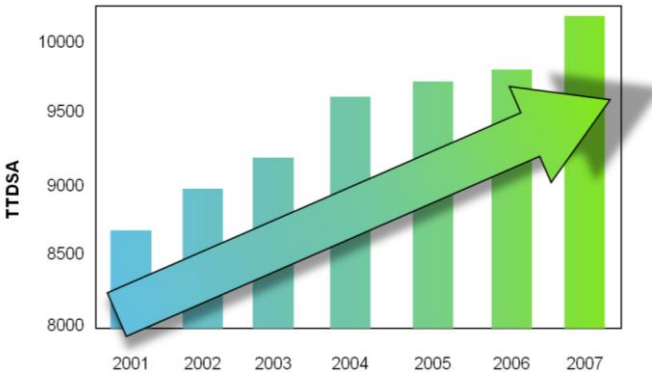
Solutions with ***HIGH***:

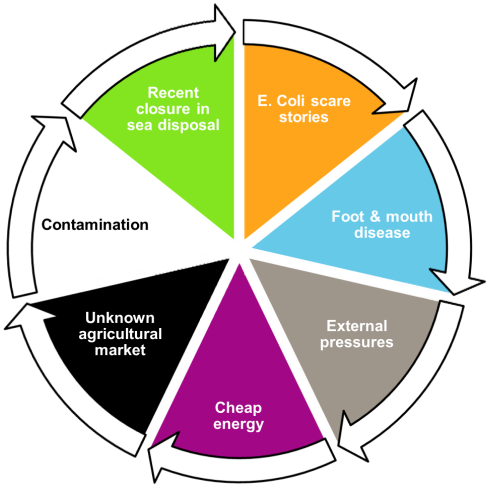
- energy and nutrient recovery

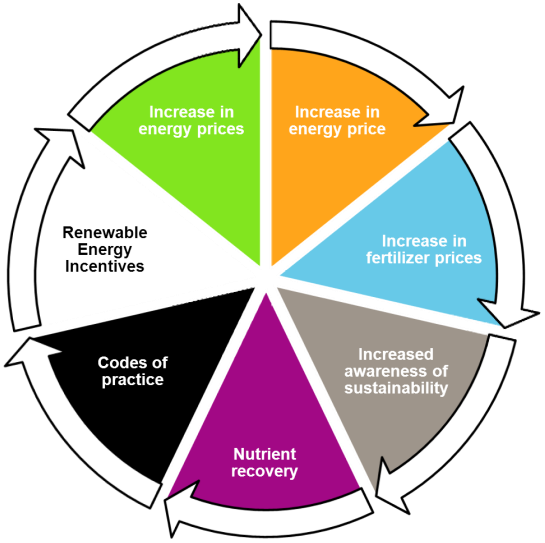
- Advanced anaerobic digestion with land recycling
- Closure of dryers/incinerators
- Closure of liming systems
- Co-digestion
- Biogas upgrading
- Nutrient recovery

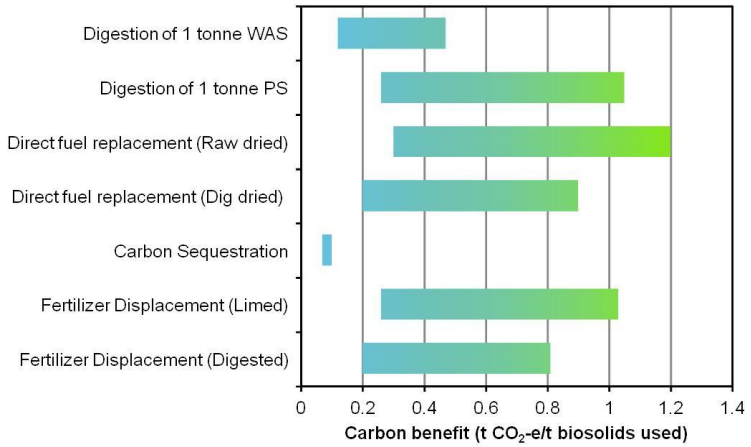
AECOM

Conclusions









AECOM

Thank you

bill.barber@aecom.com