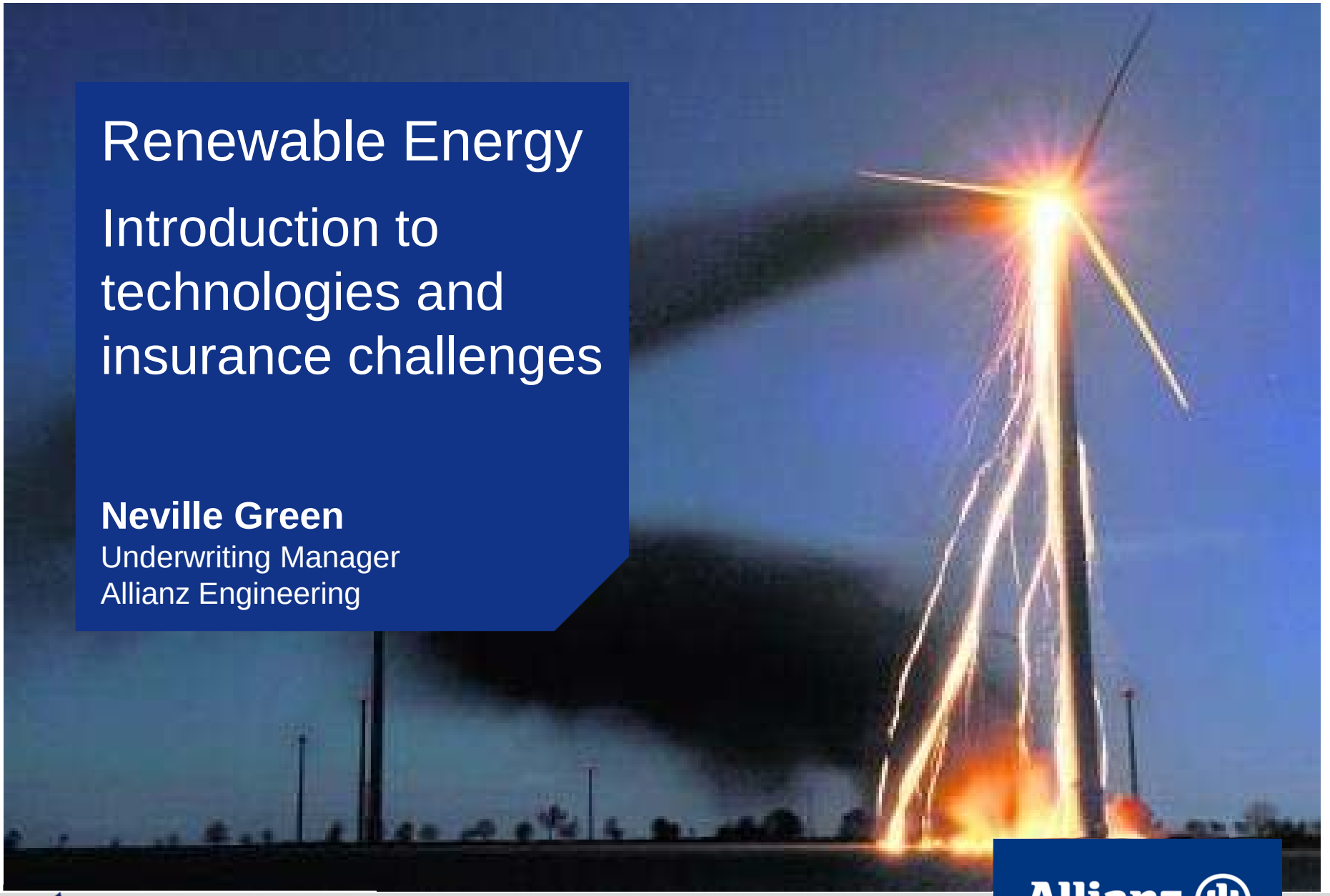

Renewable Energy

Introduction to technologies and insurance challenges

Neville Green
Underwriting Manager
Allianz Engineering

Insurance POST
THE BRITISH INSURANCE AWARDS

2019 Winner Business Sustainability/ Corporate Social Responsibility Initiative of the Year

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Topics

1 Overview

2 Wind

3 Solar PV

4 Hydro

5 BioMass

6 Challenges

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1

Overview

What is Renewable or Green Energy?

Energy from a source that is not depleted when used, or form a source which can be naturally replenished within the lifetime of a person.

Why?

CO2 Levels at their highest for 650,000 years

Global temperatures have risen over 1.1 Degess since 1980

Arctic Ice is depleting at the rate of 12.8% per decade

Sea Levels rising 3.3mm per year.

As temperatures rise, fresh water is moving around the world

Already dry areas becoming drier, wildfires burn hotter and longer

The average size of vertebrate (mammals, fish, birds and reptiles) populations declined by 60 per cent between 1970 and 2014

Paris Agreement focuses on keeping global temperature this century to well below two degrees Celsius above pre-industrial levels – ideally to 1.5 degrees Celsius – to avoid “severe, widespread and irreversible” climate change effects

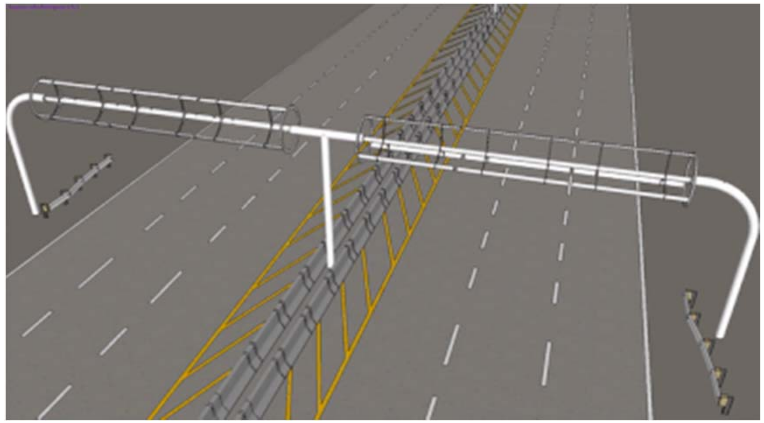
Finite and rapidly dwindling reserves of fossil fuels

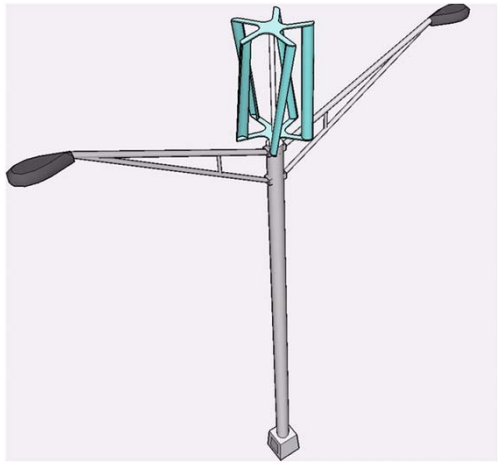
UK Government has committed to reducing UK greenhouse gas emissions by 80% by 2050

2

Wind Power

Types of Wind Turbine

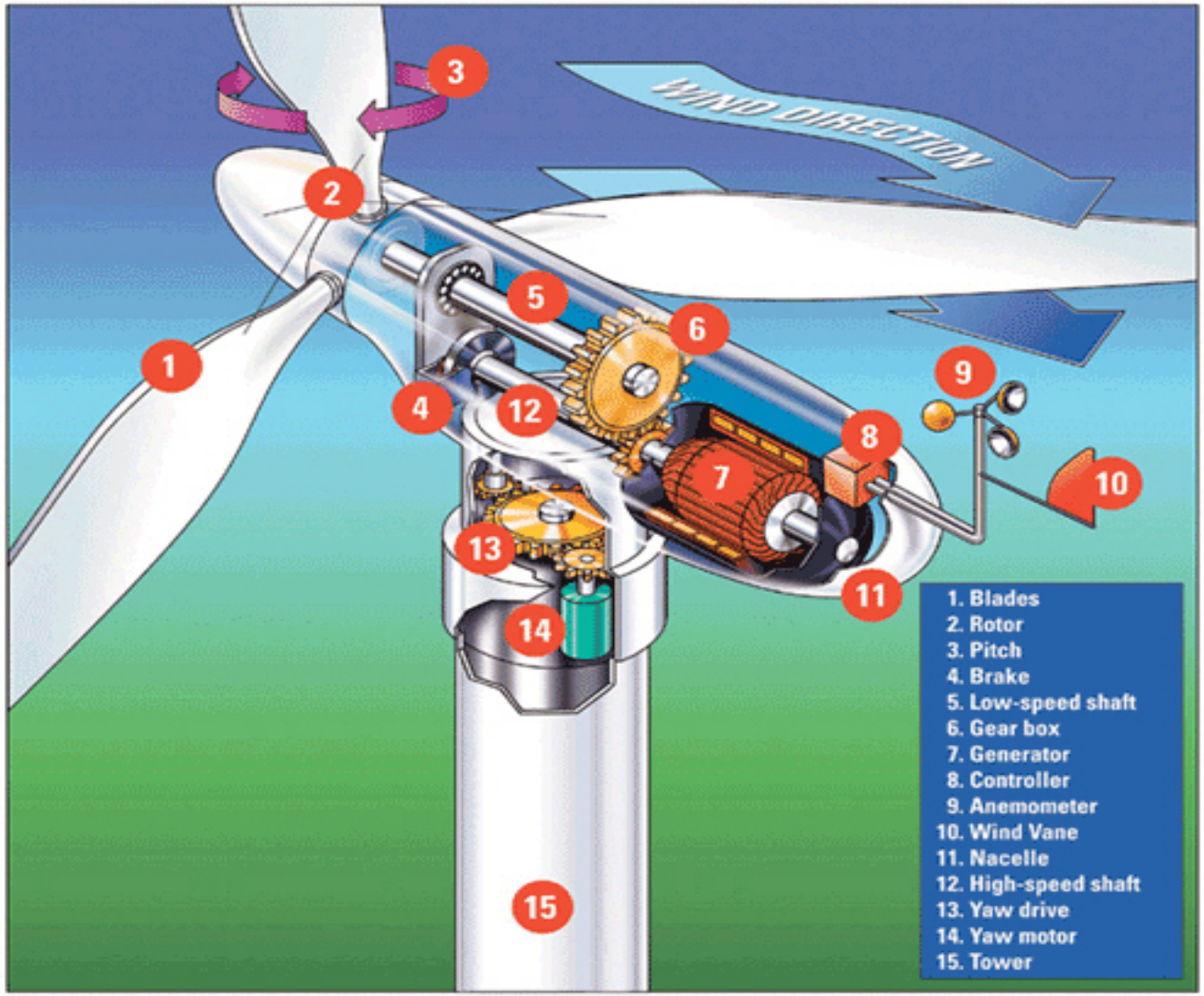




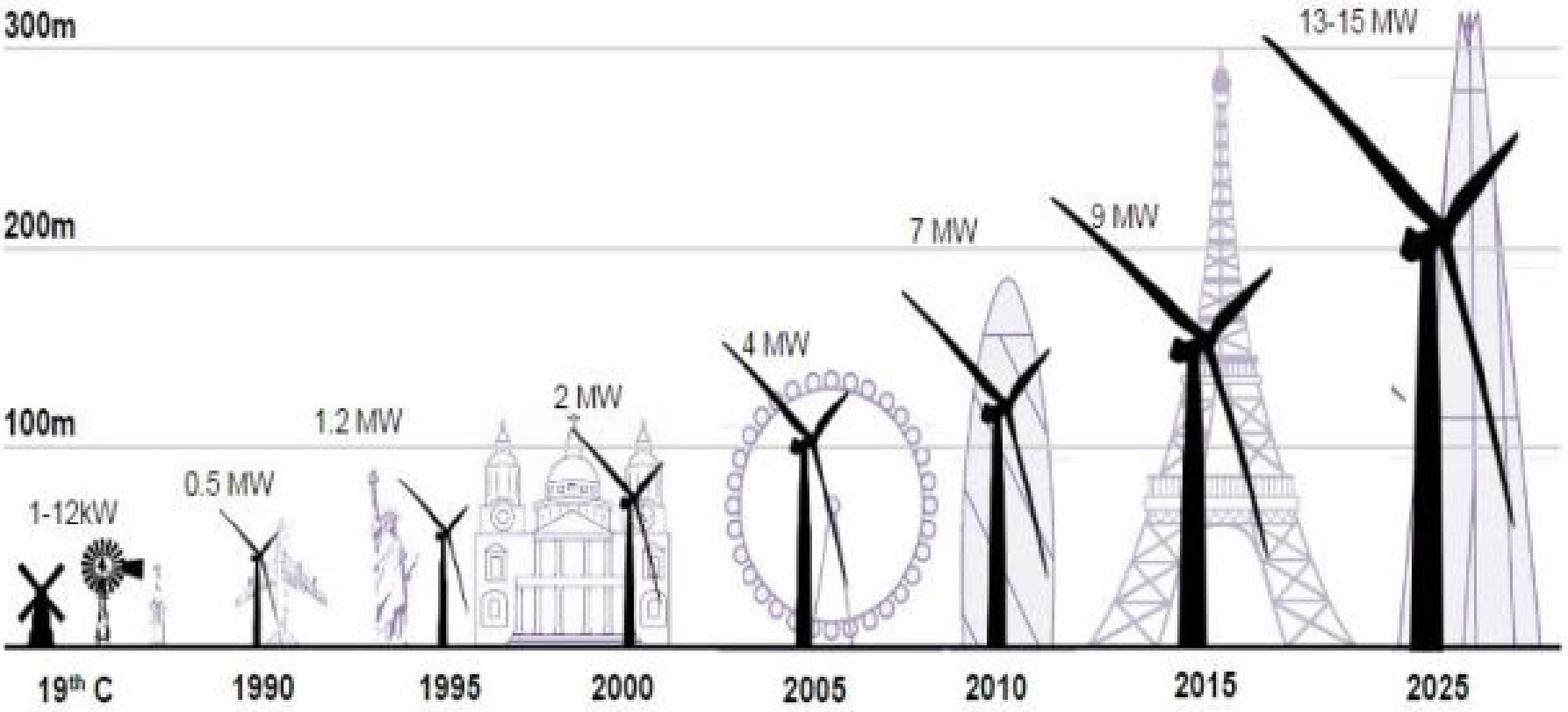
With thanks


Photo by PtrQs

Anatomy Of A Wind Turbine



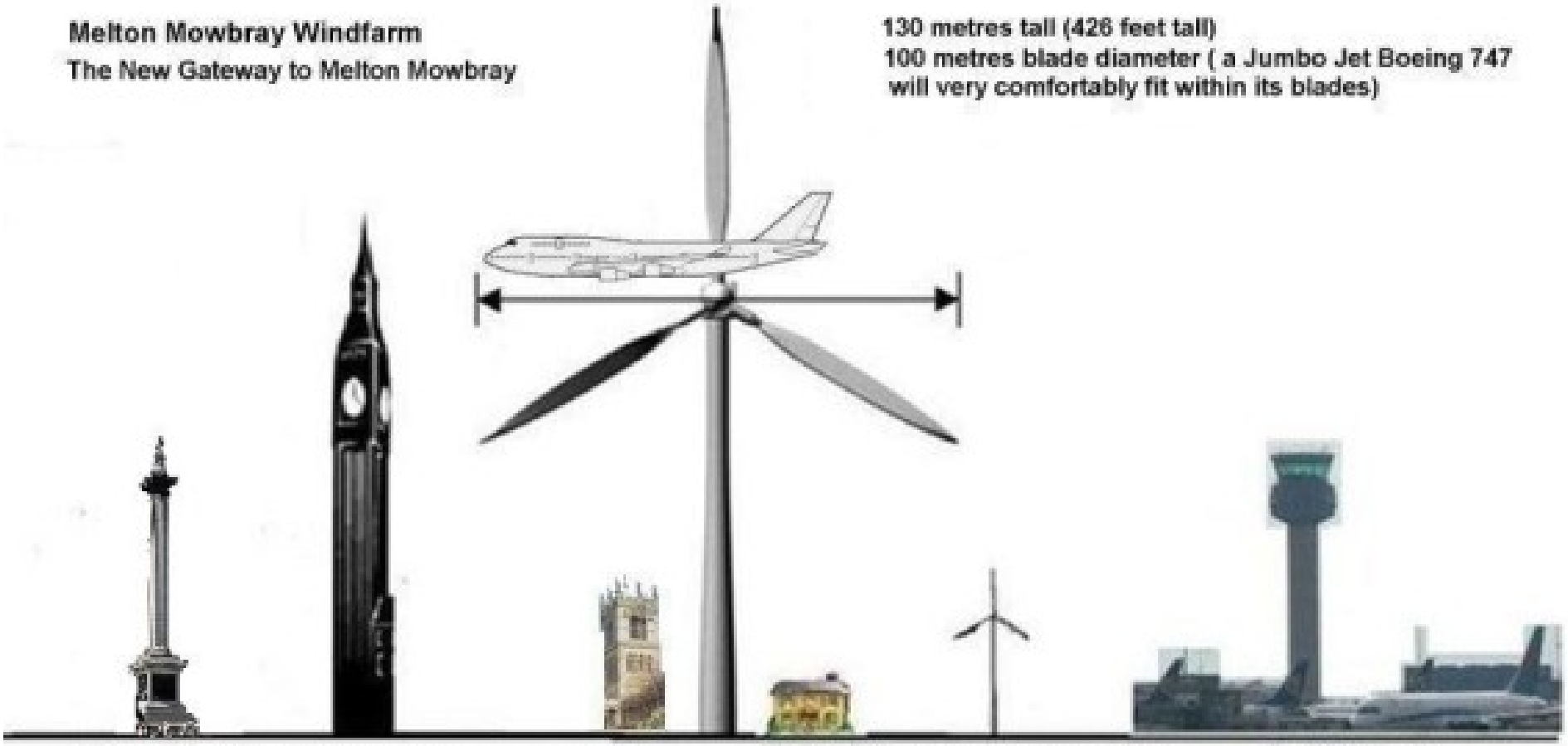
Evolution of wind turbine heights and output



Sources: Various; Bloomberg New Energy Finance

Melton Mowbray Windfarm
The New Gateway to Melton Mowbray

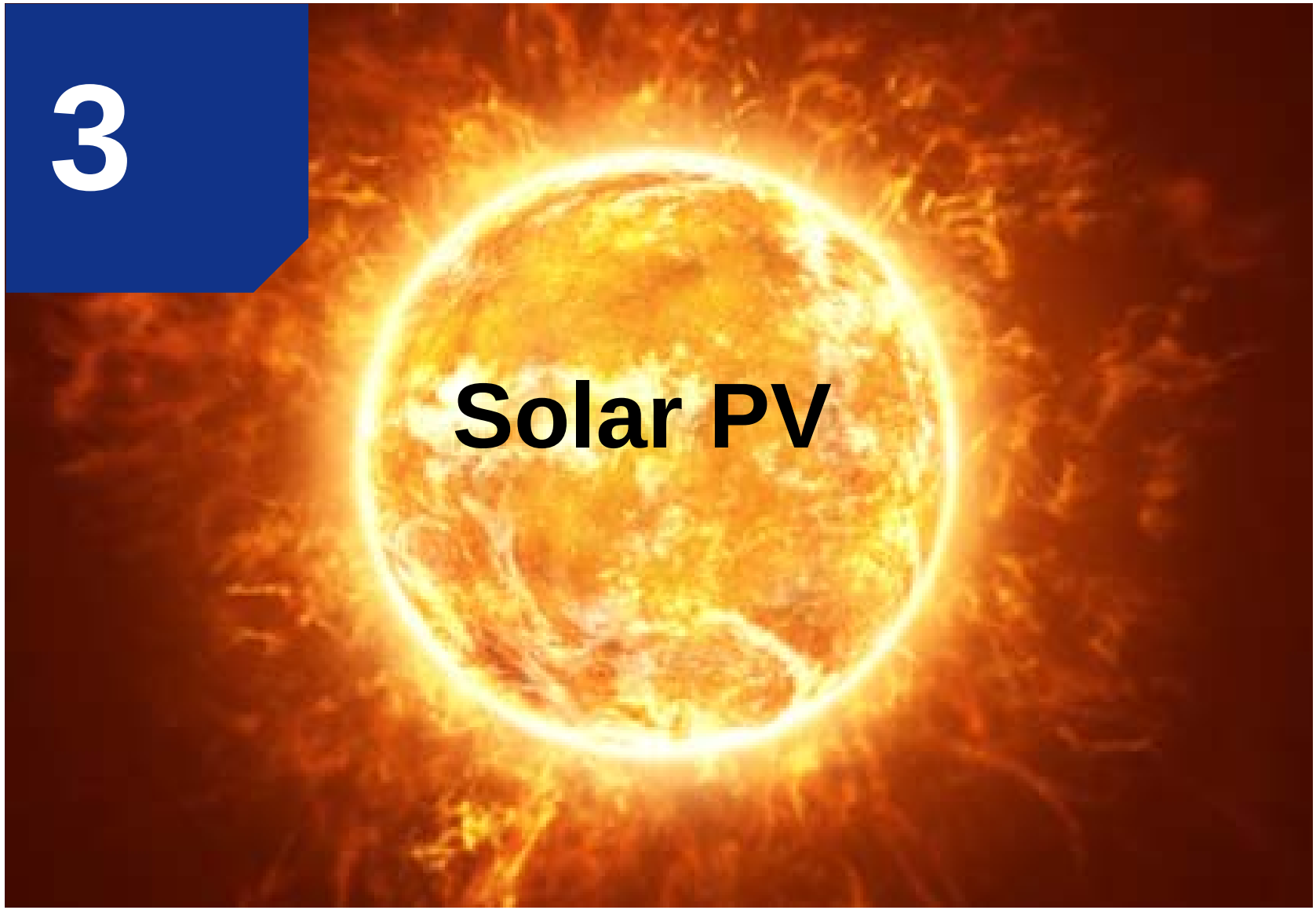
130 metres tall (426 feet tall)
100 metres blade diameter (a Jumbo Jet Boeing 747 will very comfortably fit within its blades)



Facts And Figures

Size of Turbine	Avg Cost ***per Mw***
20 - 100 Kw	£4.8m
> 100Kw - 0.5Mw	£3.0m
>0.5Mw - 1.5Mw	£2.0m
2Mw	£1.25m

3

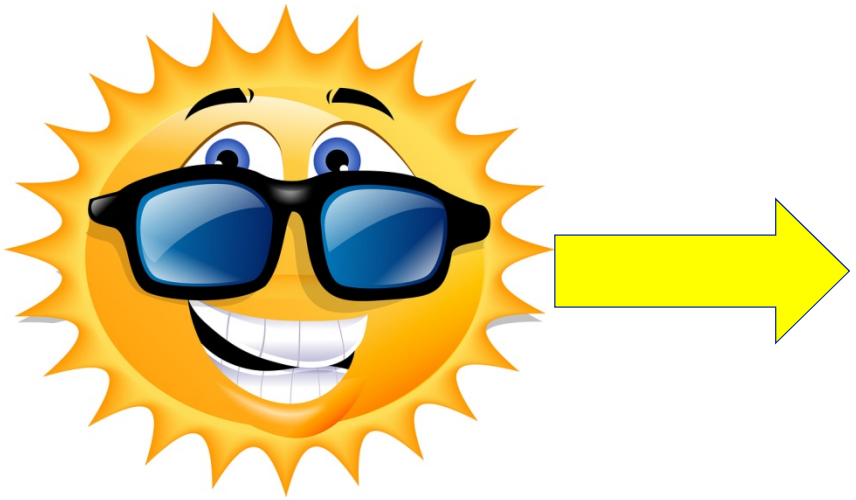


Solar PV

More Solar Energy is absorbed by the Earth and its atmosphere in 1 hour than the population of the World uses in a year

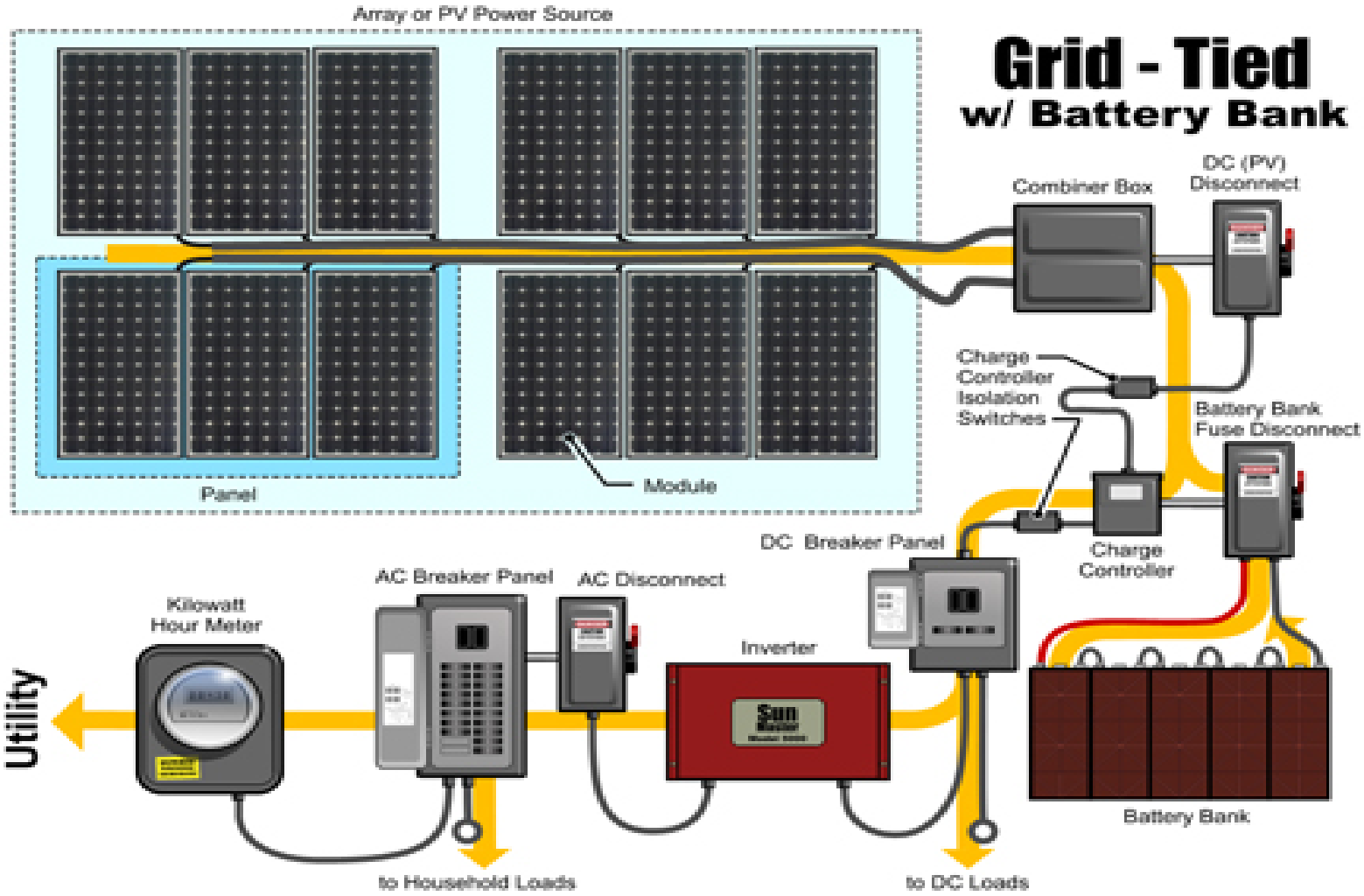
Solar PV = Solar Photovoltaic

Conversion of light to Electricity

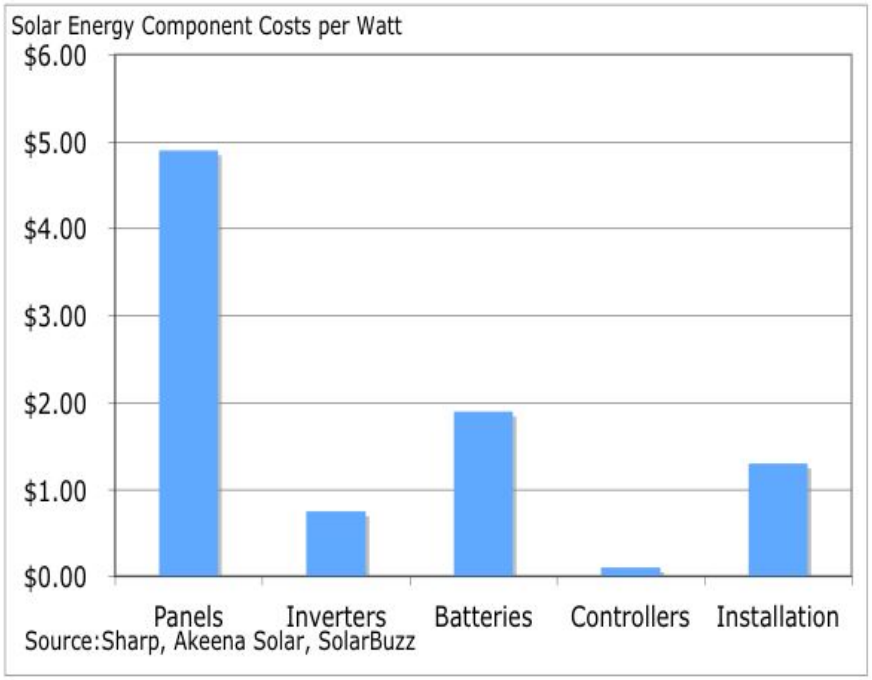


HOW ?

Anatomy Of A Solar PV System

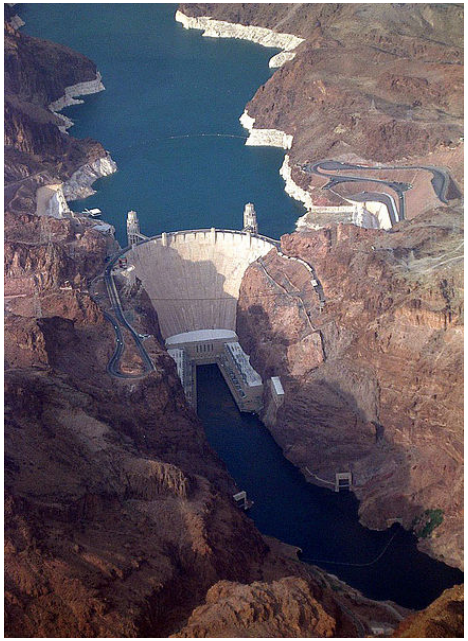


Facts And Figures



Component	% of Total
Panels	55%
Batteries	21%
Installation	14%
Inverters	9%
Controllers	1%

Types of Scheme



Dammed

Largest and most powerful. Valleys often flooded to create reservoirs. Thousands of Megawatts

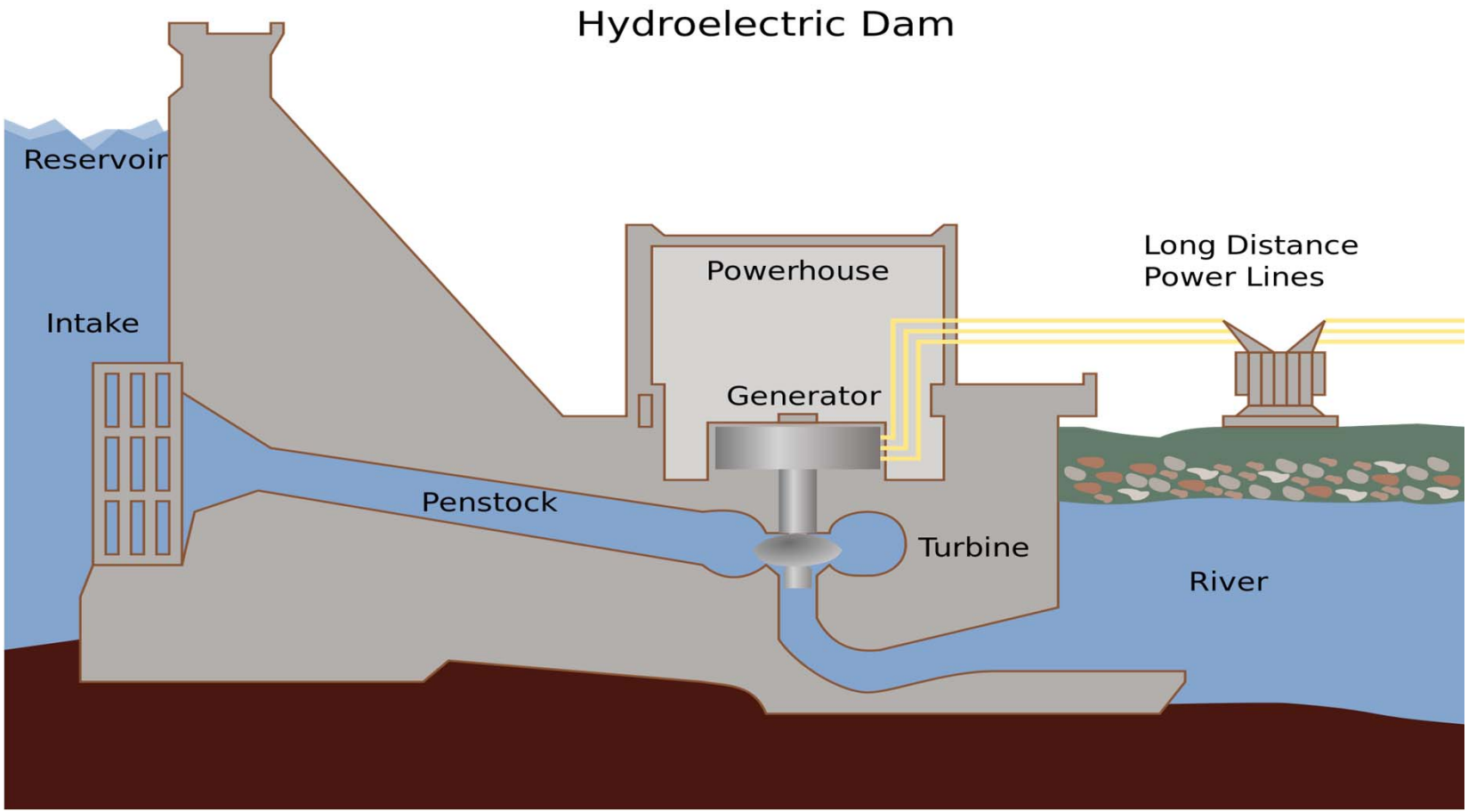
Large Run of River

Tens of MW to Thousands of MW.

Small Run of River

Now increasing in use – Tens of KW to Tens of MW – community energy projects.

Anatomy Of A Hydro System



5

Biomass

Widest Of All Categories…..

Waste Burning

Bio Diesel

Processed Waste Burning

Bio Ethanol

Sugar Alcohol / Bagasse

Anaerobic Digestion

Pyrolysis Gasification / Syngas

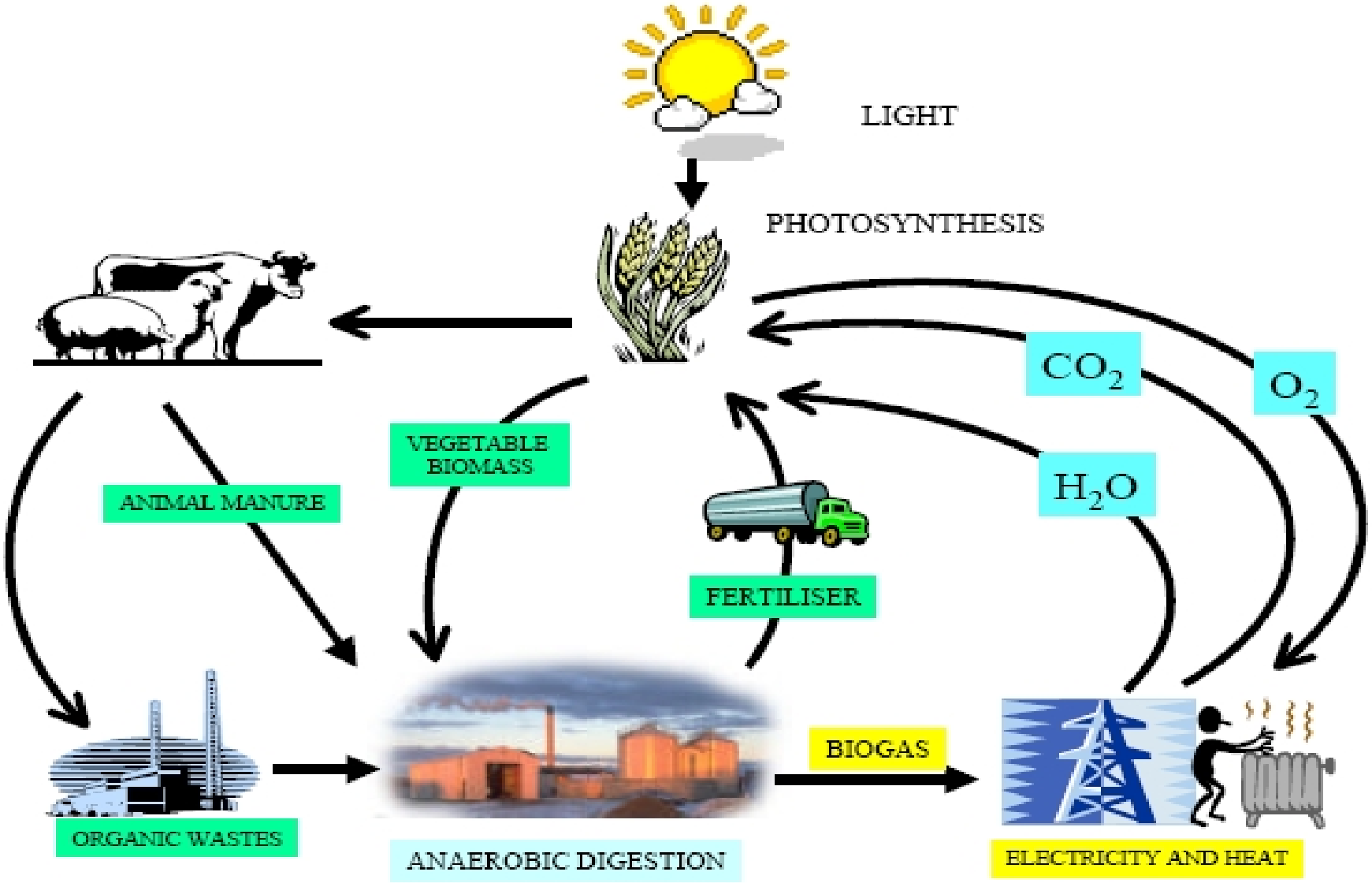
Coppiced Willow

Woodchip / Pellet Burning

And many many others……..

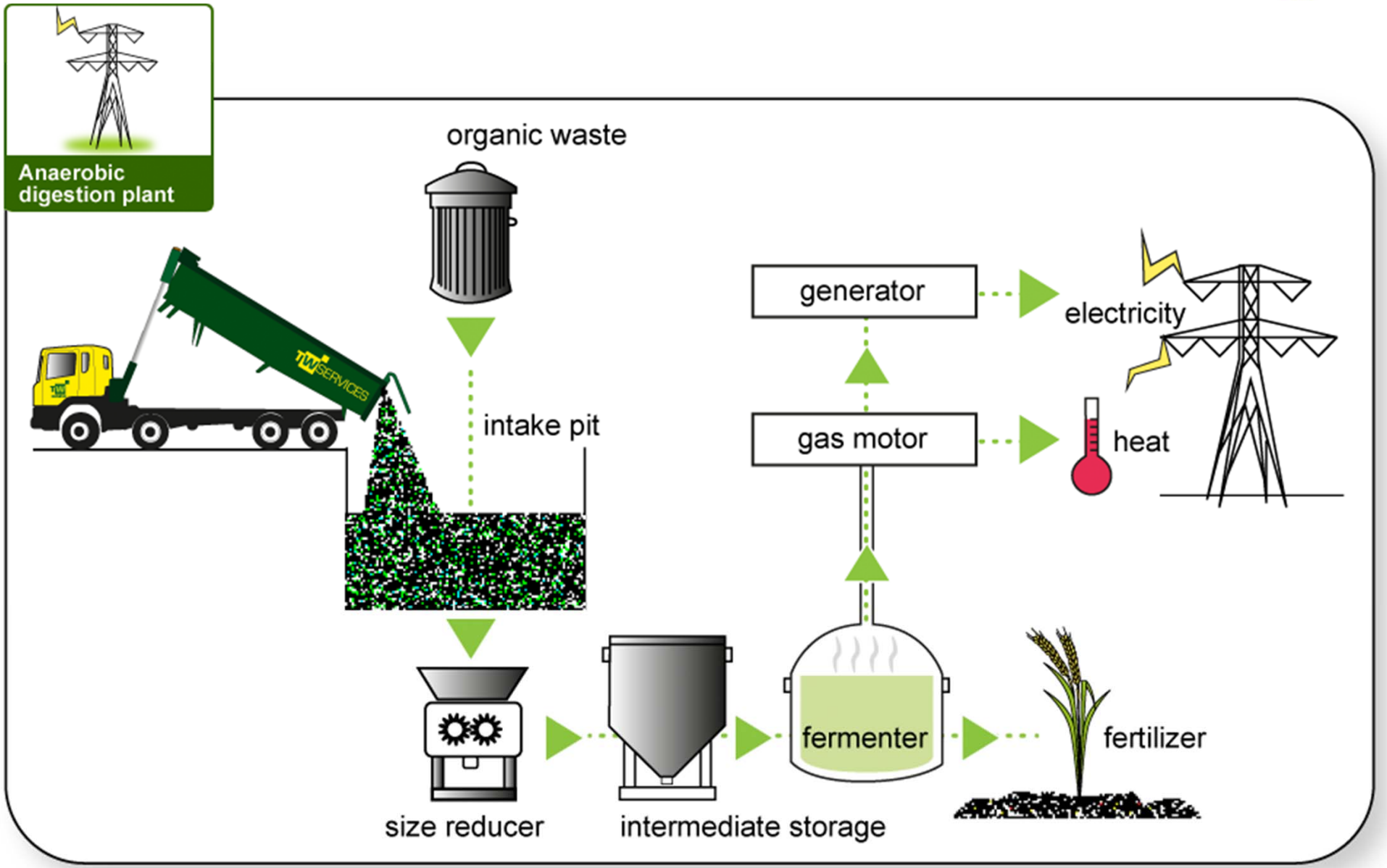
Anaerobic Digestion

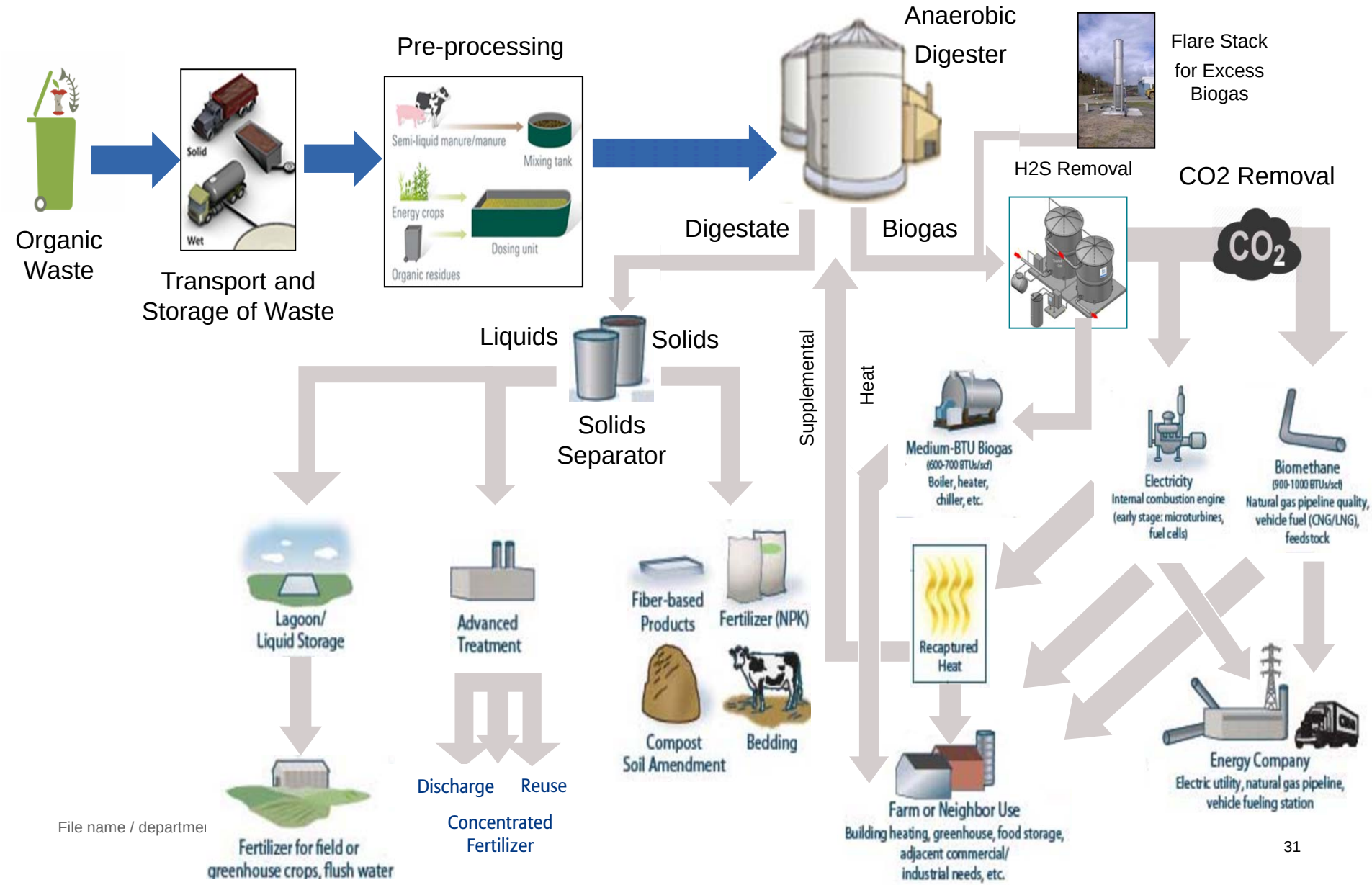
- Commonly on farms
- Digest organic waste
- Gas
- To Grid
- CHP Unit
- Slurry
- Fertiliser
- Compost

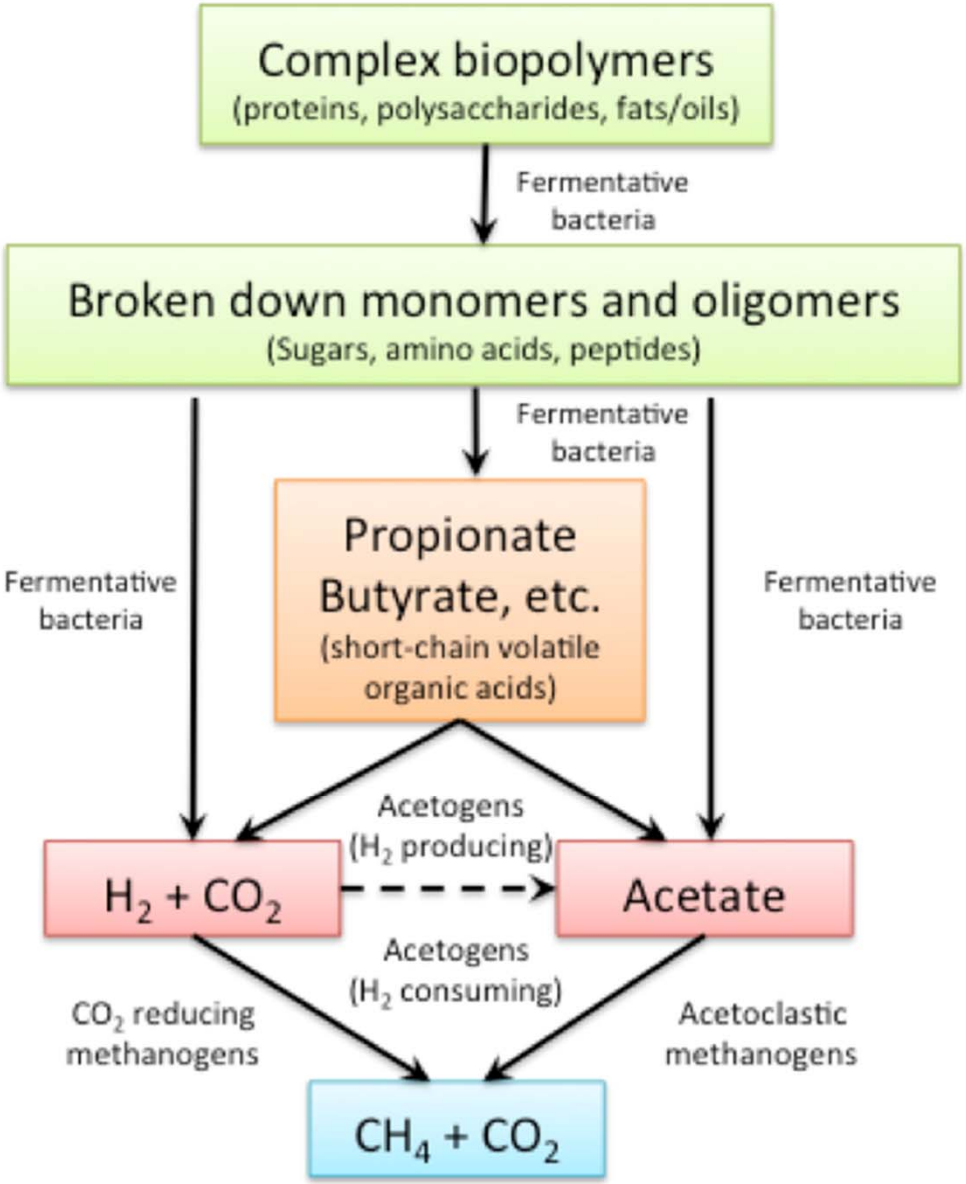


Feedstock

- Sileage
- Animal waste
- Human waste
- Maize
- Sugar Beet
- Food waste
- Other organic wastes




Organic Waste
Solid
Wet
Transport and Storage of Waste
Pre-processing
Semi-liquid manure/manure
Mixing tank
Energy crops
Dosing unit
Organic residues
Anaerobic Digester
Flare Stack for Excess Biogas
H2S Removal
CO2 Removal
Digestate
Biogas
Liquids
Solids
Solids Separator
Supplemental Heat
Medium-BTU Biogas
(600-700 BTUs/scf)
Boiler, heater, chiller, etc.
Electricity
Internal combustion engine (early stage: microturbines, fuel cells)
Biomethane
(900-1000 BTUs/scf)
Natural gas pipeline quality, vehicle fuel (CNG/LNG), feedstock
Lagoon/ Liquid Storage
Advanced Treatment
Fiber-based Products
Fertilizer (NPK)
Recaptured Heat
Compost Soil Amendment
Bedding
Energy Company
Electric utility, natural gas pipeline, vehicle fueling station
Discharge
Reuse
Concentrated Fertilizer
Farm or Neighbor Use
Building heating, greenhouse, food storage, adjacent commercial/ industrial needs, etc.
Fertilizer for field or greenhouse crops, flush water


Complex biopolymers
(proteins, polysaccharides, fats/oils)
Fermentative bacteria
Broken down monomers and oligomers
(Sugars, amino acids, peptides)
Fermentative bacteria
Fermentative bacteria
Propionate
Butyrate, etc.
(short-chain volatile organic acids)
Fermentative bacteria
Acetogens (H_2 producing)
$H_2 + CO_2$
Acetate
Acetogens (H_2 consuming)
CO_2 reducing methanogens
Acetoclastic methanogens
$CH_4 + CO_2$


Phase 1
Hydrolysis
Phase 2
Acidogenesis
Phase 3
Acetogenesis
Phase 4
Methanogenesis

- **Hydrolysis**
  - Breaking down of the large lumpy matter into simple sugars, amino acids, and fatty acids. Acetate and Hydrogen produced along with a kind of coarse bacterial soup.
- **Acidogenesis**
  - Breaks down the remaining components by using fermentative bacteria. Volatile Fatty Acids, ammonia, CO2, and hydrogen sulphide(H2S). This process is similar to the way milk sours.
- **Acetogenesis**
  - Simple molecules created through the acidogenesis phase are digested by acetogens to produce, acetic acid, carbon dioxide and hydrogen.
- **Methanogenesis**
  - Final stage of the process - methanogens use the products of the preceding stages and convert them into methane, carbon dioxide, and water. Process sensitive to acidity level and occurs between pH6.5 and pH8. Remaining, indigestible material the microbes cannot use and any dead bacterial remains constitute the digestate.

Summary

- Every AD plant is a sophisticated mini chemical works handling:
  - Corrosive acids
  - Explosive gas
  - Hazardous biowaste

Wood / Waste Burning

- **Wood burning boilers**
- **Incineration to steam**
- **Pyrolysis**
- **Gasification**

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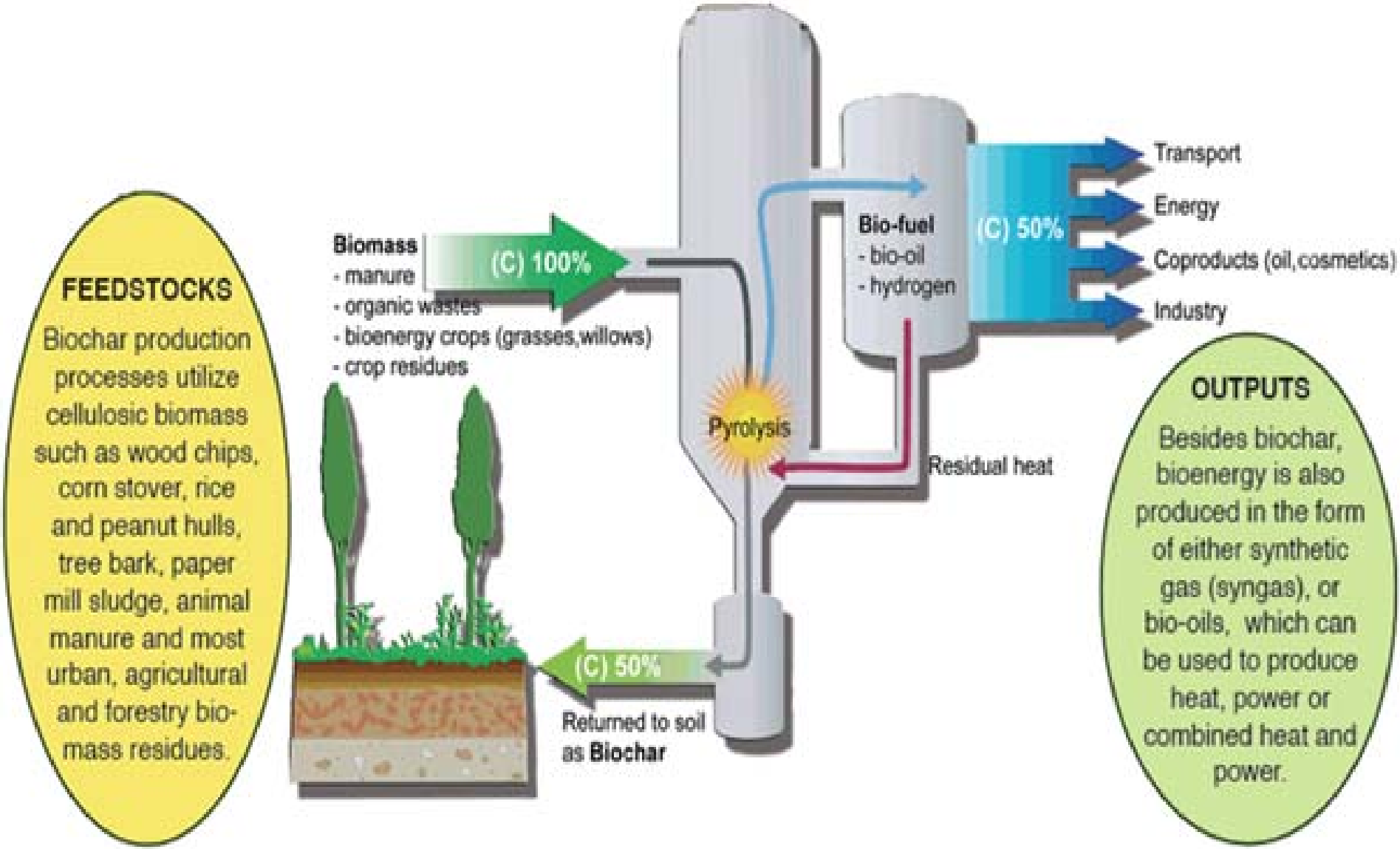
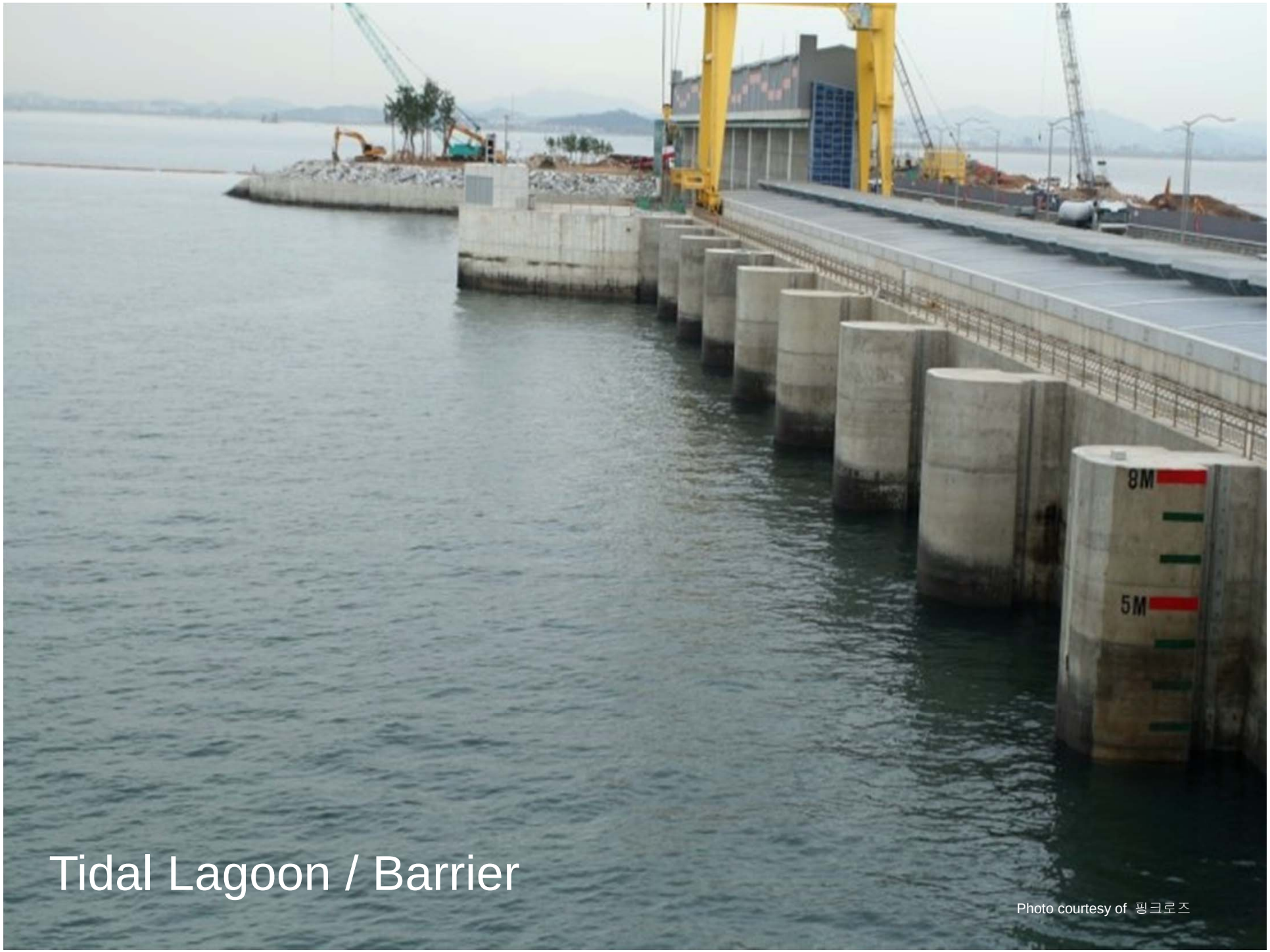


Some Evolving / Maturing Technologies



Tidal Lagoon / Barrier

Photo courtesy of 핑크로즈

Fuel Cells

Photo courtesy of Ysc usc

Battery Storage

Solar Transport

Photos courtesy of
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Deep Geothermal

Photo By Gretar Ívarsson – Edited by Fir0002 - Gretar Ívarsson, geologist at Nesjavellir, Public Domain, https://commons.wikimedia.org/w/index.php?curid=2523755

6

Challenges For The Insured & Insurer

Client - Purchase Decision

What Technology?

What subsidies are available?

How much will it cost me?

When will I break even?

How much will I make?

How do I finance it?

What are the running costs?

What maintenance do I need?

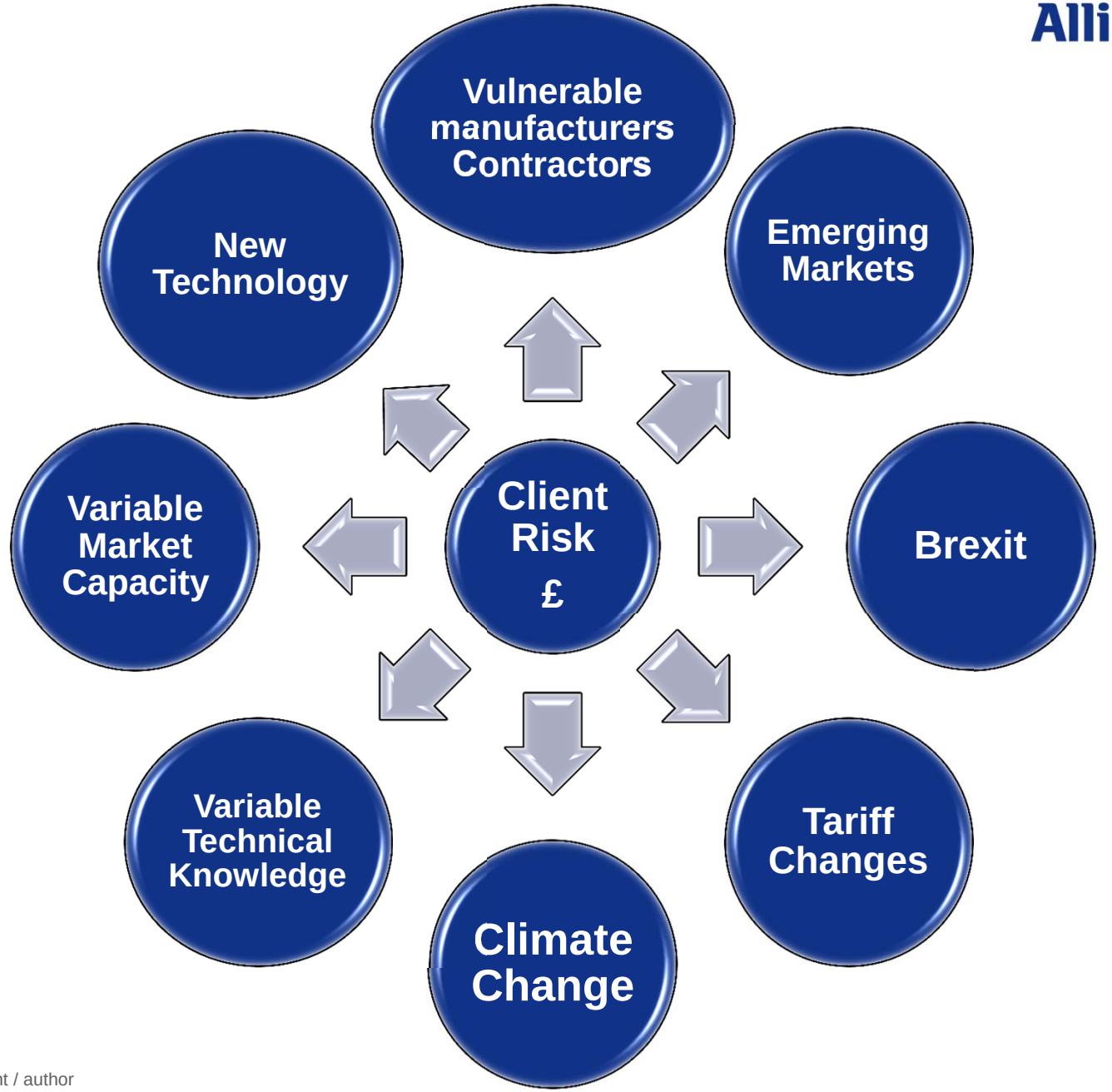
How much does it cost to insure?

Insurer – Key Underwriting Considerations

What Technology?
Who made it / who Installed it?
Where is it?

How old?
What warranties in place?
Who is maintaining it?

Loss record of the client?
Loss record of the technology?



Wind - Construction & ALOP

- Often heavy awkwardly shaped equipment
  - Difficult lifts
- High value single items

- Construction methods
- Ground conditions
- Location & access
- Long replacement lead times
- Heavy testing exposures


ICCS Limited
COLLETT
CAUTION
REAR STEER
Photo : Paul Anderson

Wind - Operational

- All risks + Breakdown cover
- PL often required
- New technology
- New manufacturer
- Nat Cat Covers
- Lightning strike

- Long lead times for replacements
- Size of the Insured & influence on supplier with regard to lead times on replacements
- Resistance to risk Improvements
- Series losses (esp Gearboxes)
- Online monitoring - SCADA

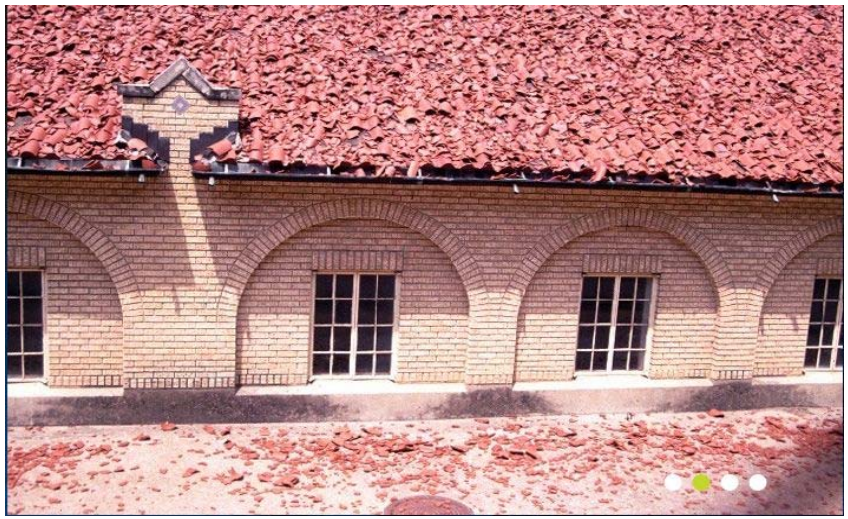
Solar – PV Construction & ALOP

- Inherent fragility of panels
- Theft risk
  - Panels / Cable
- Nat cat exposures - Windstorm

- Location / Security
- Long replacement lead times
- Moderate testing exposures
  - Transformers
  - Inverters

Solar PV - Operational

- All risks + Breakdown cover
- PL often required
- New technology
- New manufacturer
- Nat Cat Covers
- Hail / Windstorm



- Building construction
- Long lead times for replacements
- Size of the Insured & influence on supplier with regard to lead times on replacements
- Series losses (esp panels)
- Increasing theft losses.

Solar PV - Operational

Solar PV - Operational

Solar PV - Operational

Solar PV - Operational

Hydro - Construction & ALOP

- Wet works
- Flood

- Location / Security
- Replacement lead times
- Heavy testing exposures

Hydro - Operational

- All risks + Breakdown cover
- PL often required
- Technology reasonably mature
- Type of technology
- New manufacturers
- Flood / Inundation

- Trash screens
- Long lead times for replacements
- Size of the Insured & influence on supplier with regard to lead times on replacements
- Remote location / unattended
- Online monitoring - SCADA


© Reuters

BioMass - Construction & ALOP

- Often substantial civils required
- Manufacturer experience
- Fuel storage

- Construction methods
- Often plant conversion
- Location & access
- Long replacement lead times
- Heavy testing exposures

Biomass - Operational

- All risks + Breakdown cover
- PL often required
- Technology rapidly changing
- Prototype / Unproven
- New manufacturers
- Stability of fuel supply

- Long lead times for replacements
- Size of the Insured & influence on supplier with regard to lead times on replacements
- Remote location
- Online monitoring - SCADA

Biomass - Operational

- Lengthy re-start times
- Contaminant removal
  - Hydrogen Sulphide
  - Siloxane

- Significant fire / explosion risks
- Pollution potential
- Experience of the operators
- Understanding the revenue stream

Biomass - Operational

Significant Dangers

Methane

- Lighter than air - collects in the upper spaces of building.
- Explosive at 5% to 15% concentrations.
- Non a toxic but displaces air, creates an oxygen-deficient atmosphere.

Carbon Dioxide

- Odourless
- Heavier than air.
- Displaces oxygen supply in the bloodstream, causes death.

Biomass - Operational

Significant Dangers

Hydrogen Sulphide

- Highly toxic
- Heavier than air.
- Smells like rotten eggs
- Destroys the sense of smell and produces respiratory paralysis.

Ammonia

- Lighter than air
- Pungent odour / irritant to eyes and respiratory tract.
- Displaces oxygen in the bloodstream.

Biomass - Operational

Significant Operational Risks

- Explosion / Fire
- Acidic and highly toxic environment
- Accelerated / aggressive corrosion
- Misfuelling
- Runaway reactions / foaming
- Lengthy cleanout and repair times
- Produced gas can be corrosive - damage to engines
- Significant pollution potential

Biomass - Operational

- Monitoring
  - Condition / corrosion
  - Foaming
  - Gas quality
  - Regular condition reports on all containment
- Gas leak detection / auto shutdown / flare off
- levels / emergency control measures
- Strict maintenance regime – manufacturer regime – increased where condition monitoring indicates.

Any questions