



# Supergen



Bioenergy

# Bioenergy research priorities

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5 September 2018

# Energy source

- Low carbon
- Secure
- Resilient
- Flexible
- Economic



# Vision for UK Bioenergy

- Up to 45% of UK bioenergy demand<sup>1</sup>
- 10% electricity (baseload)
- 50% heat (industrial, district, gas)
- 20% liquid fuels (aviation, shipping, heavy duty/mobile plant)

1. Welfle A., Gilbert P., Thornley P., Securing a bioenergy future without imports, Energy Policy, vol 68, 2014

# Evolution of UK Bioenergy

- Near term flexible heat and power (diverse feedstocks, pollutants, materials, ecosystem benefits, circular economy, pre-treatment)
- Medium term fungible hydrocarbons (catalysis, pre-treatment, yield increases)
- Long term gaseous vectors (gasification, AD, hydrogen) and negative emissions

# Challenges

1. Conversion: efficiency, reliability, maintainability, cost
2. Resource: characterization: and adaptation
3. Vector: choice
4. Fuel quality expectations & standards
5. System: sustainability



# 1. Conversion: efficiency; reliability; maintainability; cost

- Combustion
- Pyrolysis/gasification/hydrothermal
- Biological (pre-treatment)
- Catalytic
- Electrochemical



# Conversion to electricity

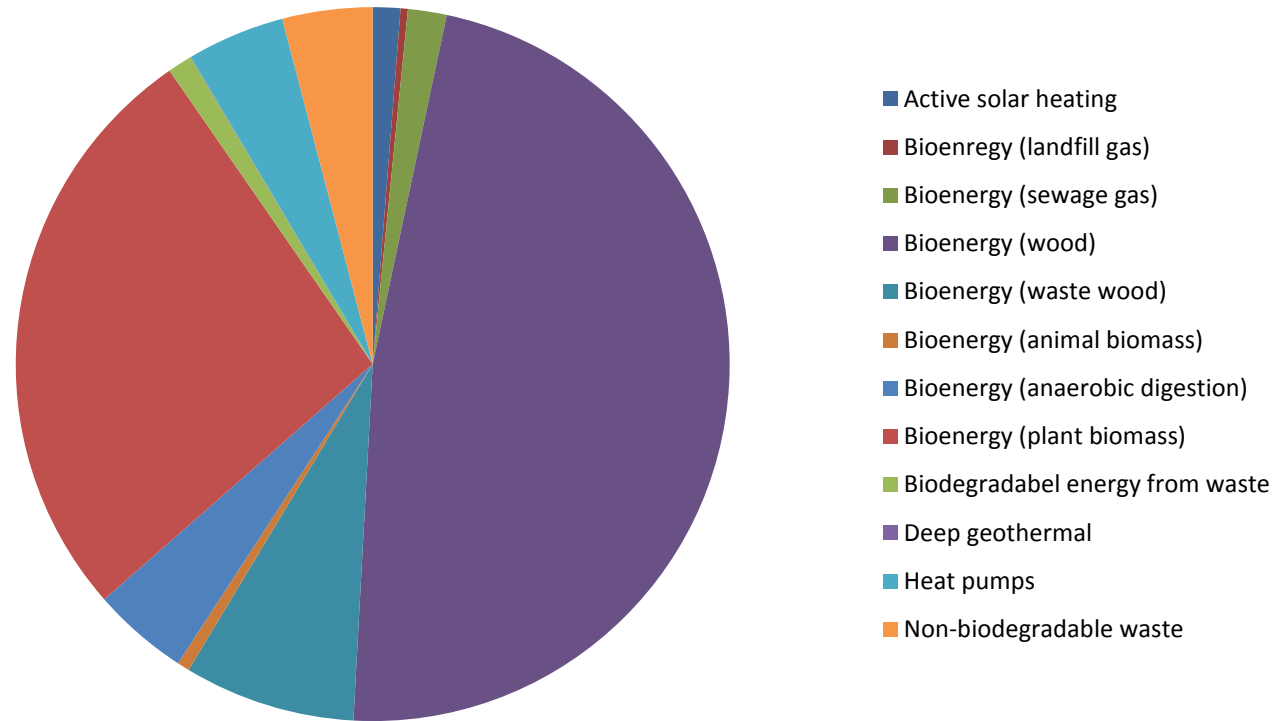
## UK electricity generation 2016

Renewable electricity	2016 Oupput (TWh)	% change from 2015
Onshore wind	21.1	-7.8
Offshore wind	16.4	-5.8
Hydro	5.4	-14.6
Solar PV	10.3	+36.1
Bioenergy	29.6	+0.7
All renewables	82.8	-1.0
All generation	338.6	-0.2

BEIS, UK Energy Statistics, 2016 & Q4 2016, 30 March 2017

# Conversion to heat

## 2016 Renewable sources used to generate heat

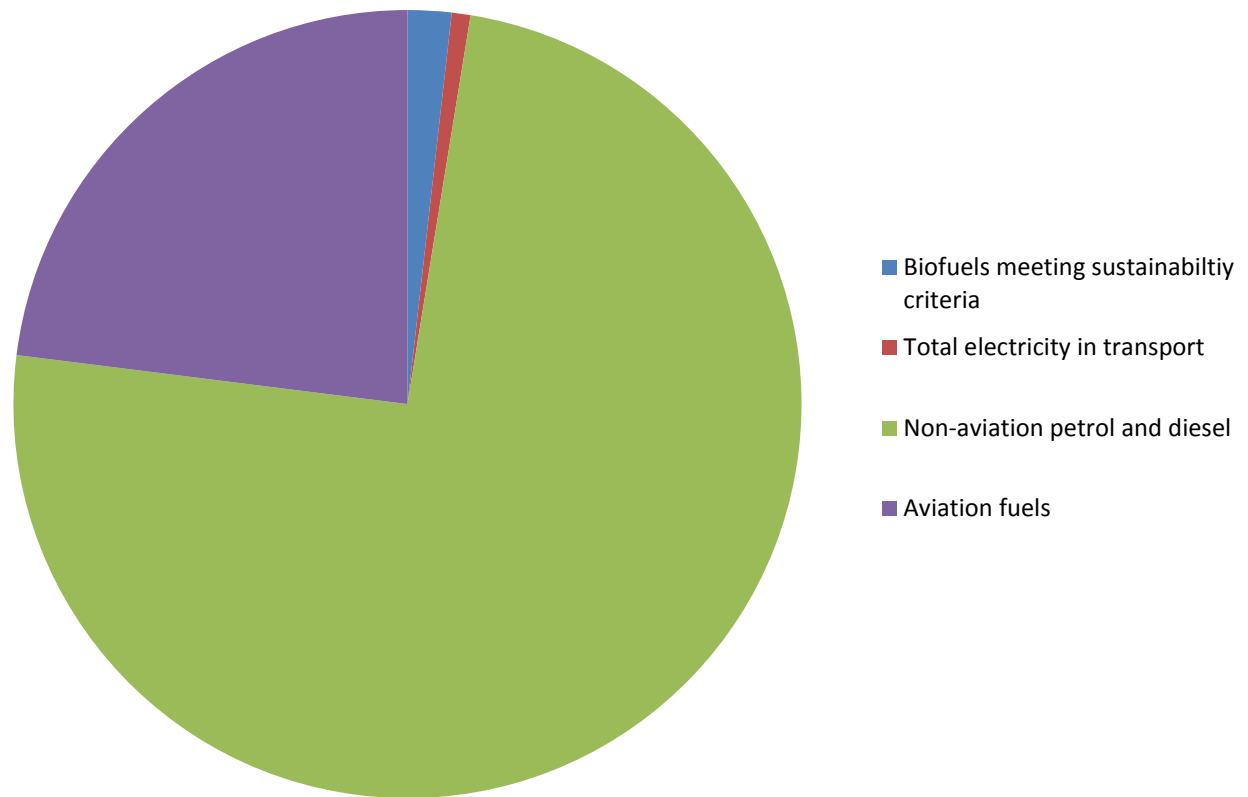


BEIS, Digest of UK Energy Statistics, 2017 (table 6.6)



# Conversion to liquid fuels

## 2016 Transport Fuel Sources



BEIS, Digest of UK Energy Statistics, 2017 (table 6.7)

# Priorities for conversion research

- Thermochemical: critical role of gasification
- Biological: pre-treatment
- Catalytic: potential
- Flexible operating envelope
- Operational continuity & scale-up



# Supergen

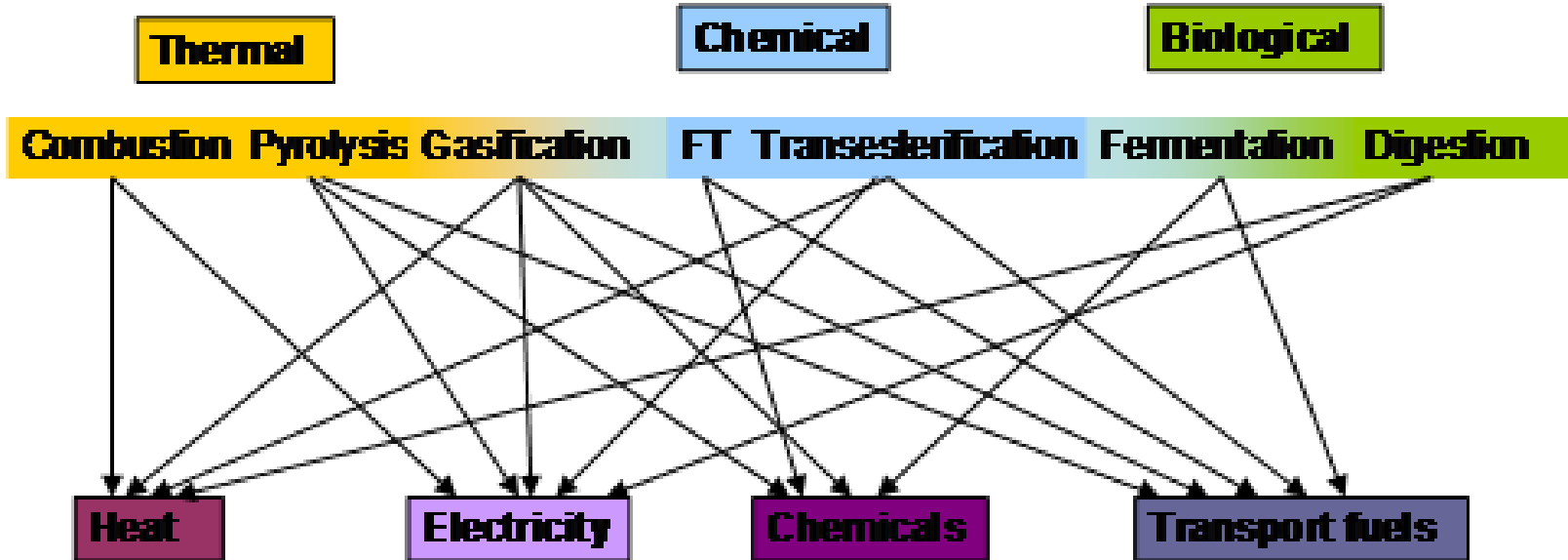


# Priorities for resource research

- Quantification across bioeconomy
- Characterization (to optimize conversion)
- Land interfaces & ecosystem benefits



# 3. Vector choice



Thornley, P., "Biofuels Review", Report for Government Office for Science, prepared as part of the Foresight Programme, June 2012

# Priorities for vector research

- Liquid, gas, heat, material
- Metrics: carbon, cost, availability, quality, alternatives
- Vector quality – consistent definition
- Scale & context – affect metrics



## 4. Fuel quality expectation and standards

- Physical contamination
- Moisture content
- Variability
- Ash composition, melting point, slagging, fouling, corrosion



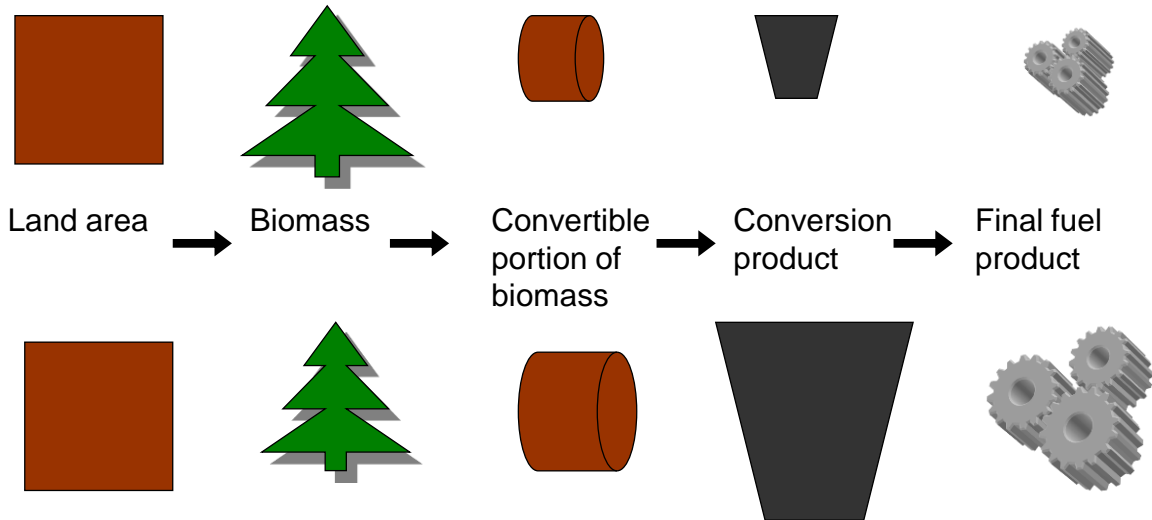
## Priorities for fuel quality research

- Feedstock environmental contaminants including heavy metals, nitrogen
- Catalyst poisoning
- CO<sub>2</sub> separation impacts
- Corrosion and slagging
- Impact on material integrity

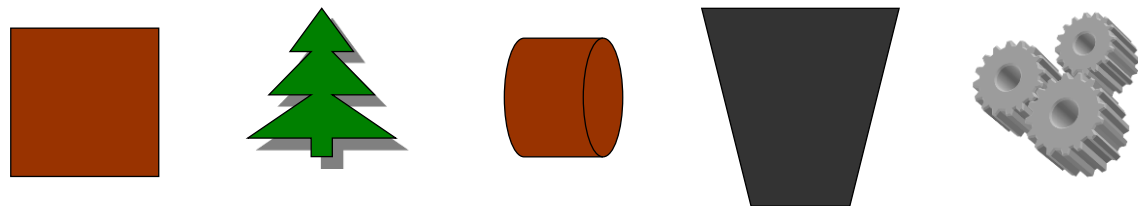


# 5. System sustainability

*First generation*



*Second generation*



## 5. System sustainability

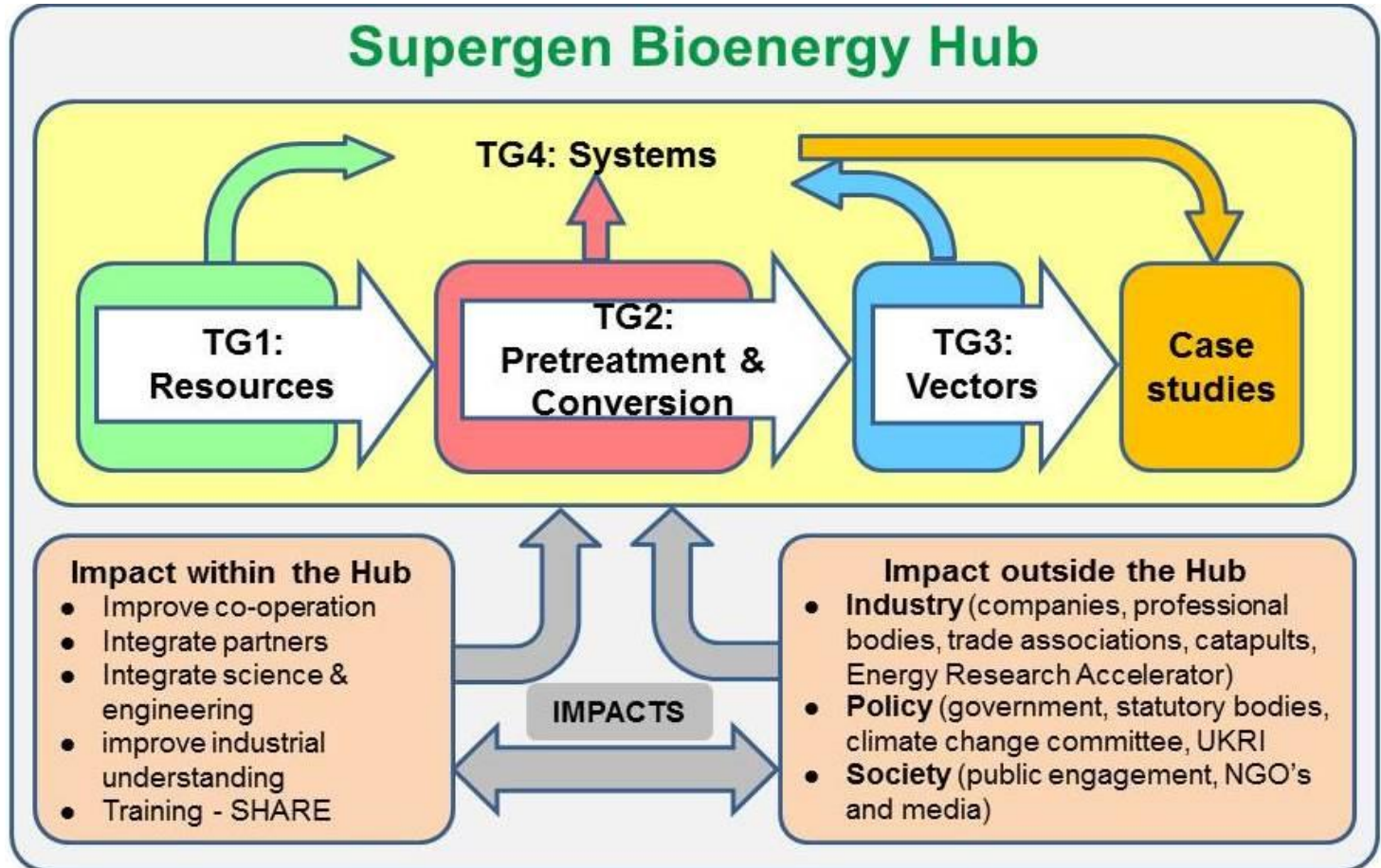
- Carbon intensity
- Resource efficiency
- Wider environmental impacts
- Availability
- Reliability
- Cost
- Land and market interfaces

# Priorities for systems research

- Best use of biomass?
- Characterize impacts of uses
- Understand directly mediated secondary impacts e.g. land-use change, forest carbon stock, GWP balancing, biodiversity
- Understand indirect impacts e.g. land-use, food, market/commodity impacts
- Aviation? Heat? Construction?
- Sustainability frameworks



# Supergen Bioenergy Hub Research



## More information

[www.supergen-bioenergy.net](http://www.supergen-bioenergy.net)

Forthcoming CCC bioenergy  
report

