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A case study on MGT-based CHP systems for urban commercial applications: case of London

Dr. Jafar Alzaili
Prof. Abdulnaser Sayma

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Department of Mechanical engineering and Aeronautics

What it is about

- Application of MGTs in small-scale CHP in urban areas
- the battle against Gas Engines
- NOx story: Do we need to cost it to win?
- A case study for applications in London

Application of MGTs in small-scale CHP in urban areas

- 70% of the world's population will be living in cities by 2050
- Growing pressure on resources and infrastructure
- Means we need to become more efficient and identify new lower carbon sources of supply
- Needs to be managed flexibly so that we are always utilising the lowest carbon and cheapest energy

Application of MGTs in small-scale CHP in urban areas

- Nearly 80% of emissions come from buildings

- 30% of London's CO_2 emissions – and approximately 50% of its energy demand - are attributable to heat

- Great opportunity for CO_2 reduction within London is to reduce demand for heat through building retrofit and low carbon, local (decentralised) heat supply

- Focus on connecting to <u>medium</u> and large scale heat networks

- <u>Decarbonising</u> heat networks
  - Transition increasingly to <u>renewable</u> and secondary heat sources

Application of MGTs in small-scale CHP in urban areas

- Government has announced recently £320m for local authorities to develop heat networks
- targets mature technologies at TRL9 or higher
- good opportunity for small-scale CHP

Drivers and incentives for small CHP systems in urban areas

- Driving forces
  - Economic: lower energy bill
  - Emissions reduction
    - Potential reduction of up to 200 kg/MWh compared to conventional separate generation
  - Security of supply

- Incentives
  - Climate Change Levy
  - Carbon Price Floor
  - Enhanced Capital Allowance

Barriers to CHP application in urban areas

- Economic:
  - Payback periods < 4 years
  - The initial capital outlay
  - Variability of fuel prices

- Air quality issues in urban areas
  - London particular:
  - Health impact: 88,113 life-years lost
  - Economic impact: £1.4 Billion to £3.7 billion
  - UK Standards
    - Clean Air Act (1956): mainly to abate use of coal for heating
    - Sustainable Design and Construction by GLA (2014)

Barriers to CHP application in urban areas

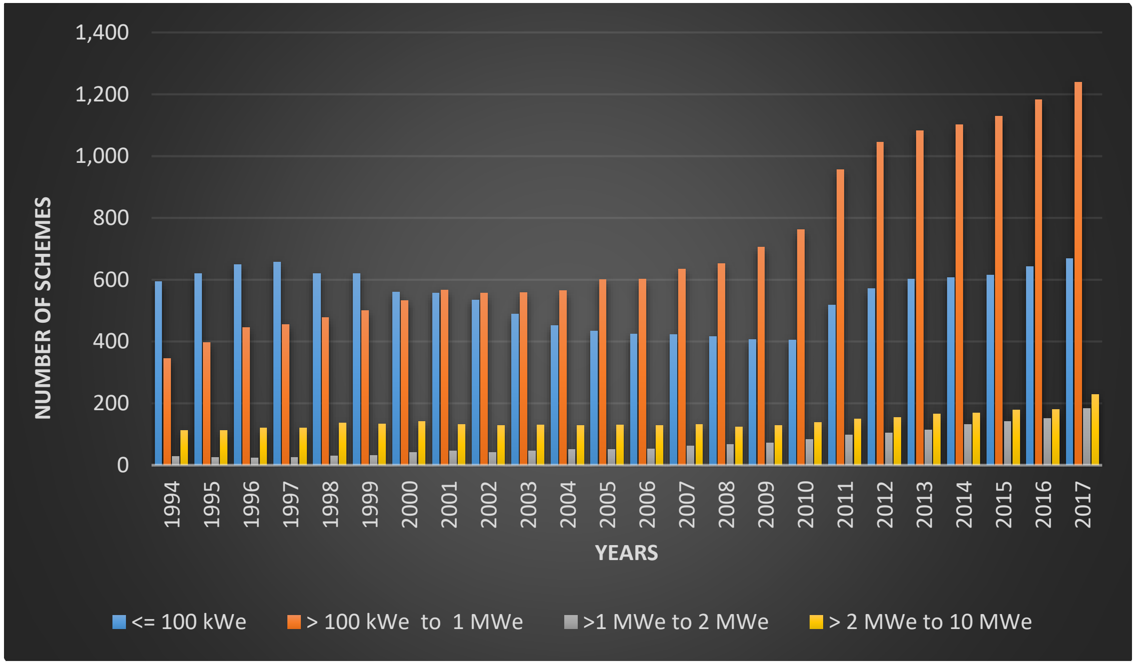
- Air quality issues in urban areas
  - Medium Combustion Plant Directive (2017)
    - for combustion capacity of 1 MW to 50 MW
    - implementation of the MCPD in the UK could contribute to 9% of NO_X by 2030
  - Germany's TA-LUF regulations
  - Netherland's BEMS regulation

Prime mover	GLA	German TA-LUFT	Dutch BEMS	MCPD	
				Existing	New
GT	0.4	0.66	1.2	1.3	0.4
GE	1.1	1.3	0.9	0.5	0.2

comparison of different NO_x emission standards (g/kWh)

Barriers to CHP application in urban areas

- Air quality issues in urban areas
  - concerns over the possible impact an increase of the current CHP systems could have on the air quality of urban areas



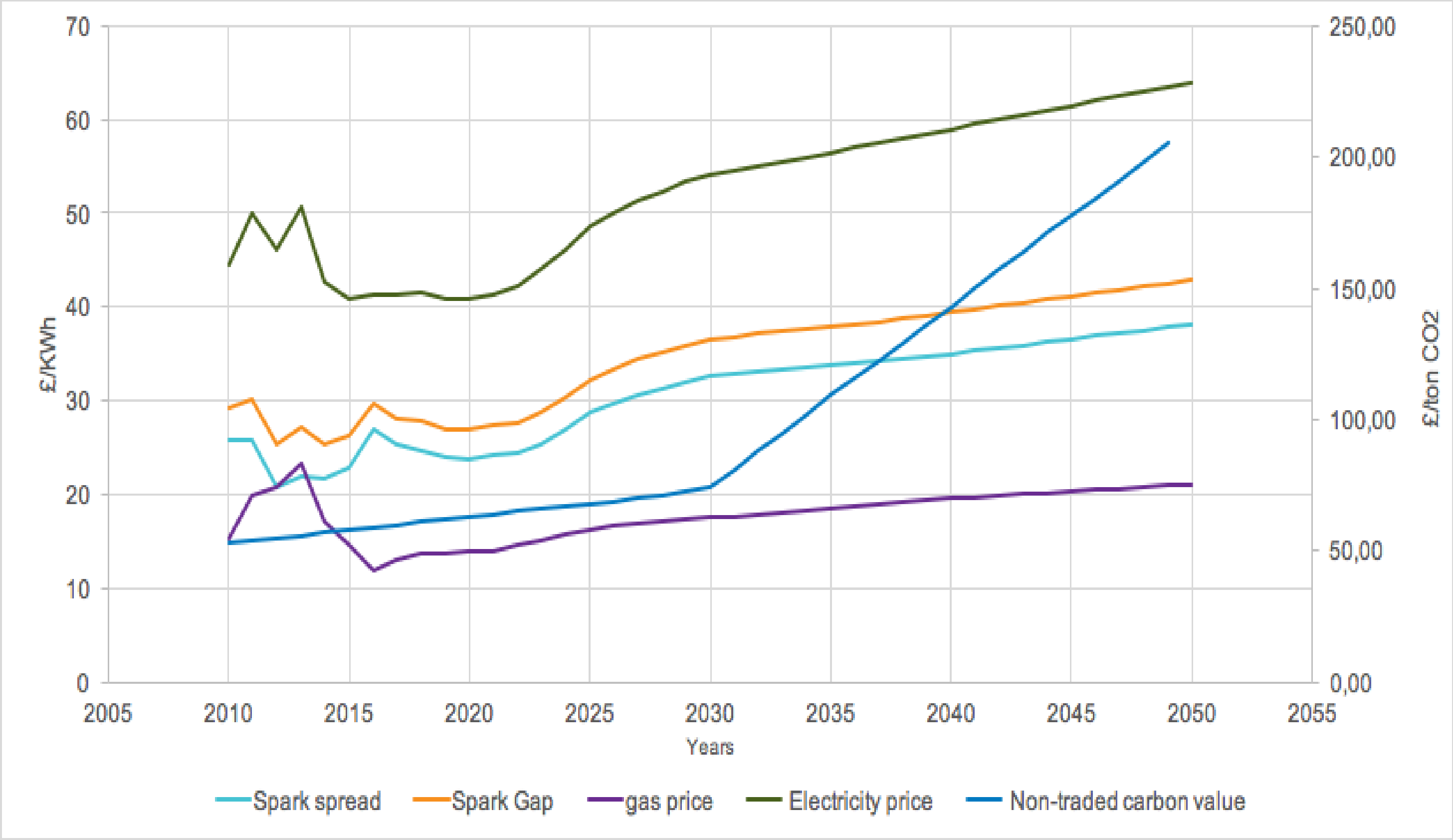
25% of power in form of DG by 2025

Too much?!

DG NO_x > Transport emission by 2025 in London!

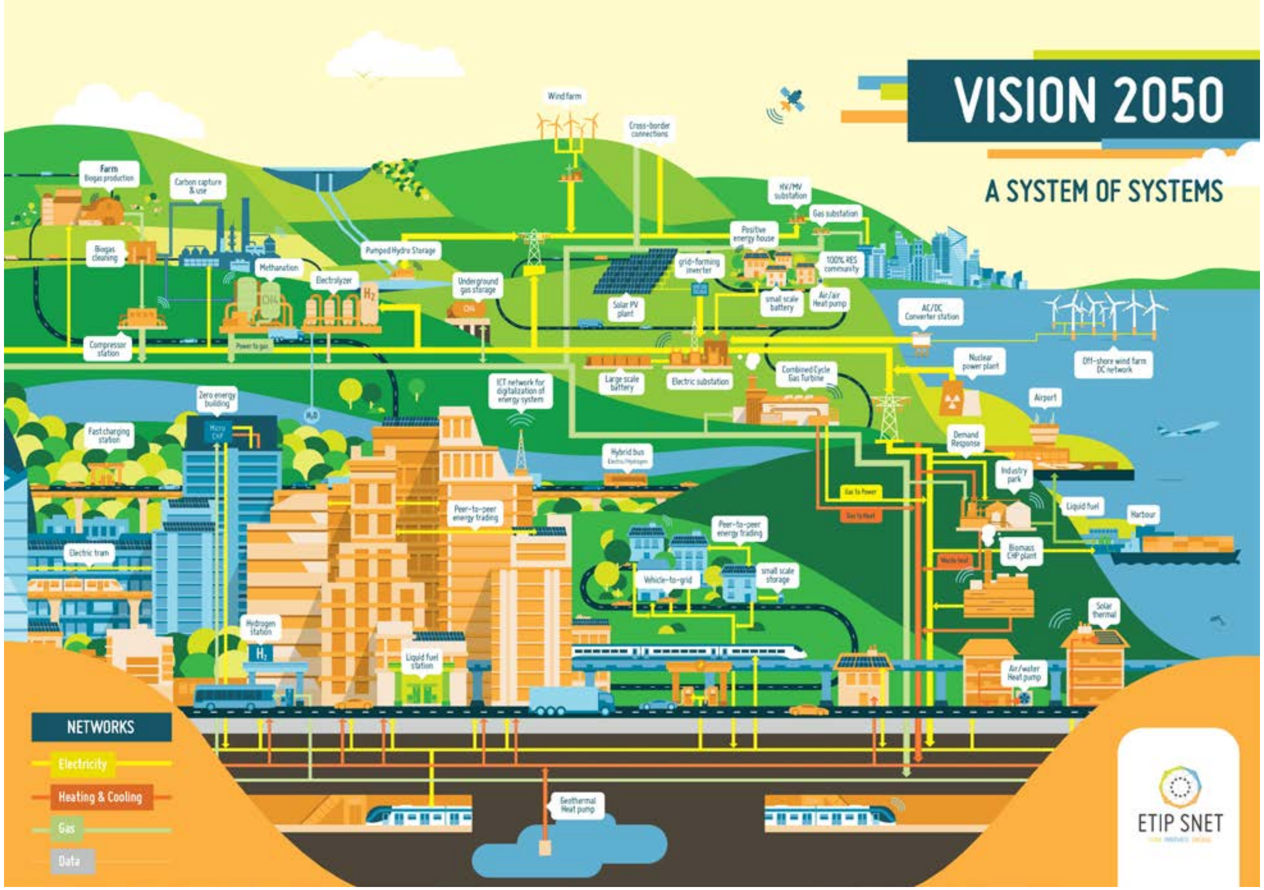
Barriers to CHP application in urban areas

- Future: Sensitivity to Gas and Electricity Prices, policy ,etc.



Barriers to CHP application in urban areas

- BUT we are adaptable and clever!



NO_x Valuation?

- small urban areas £18,000/tonne NOx
- inner London £120,00/tonne NOx
- cost of abatement?

All these should be part of CBA

Example of Sweden: reached maximum reduction of 40%

Can we do any better?

A case study in London: City University

- The NPV and payback period calculations

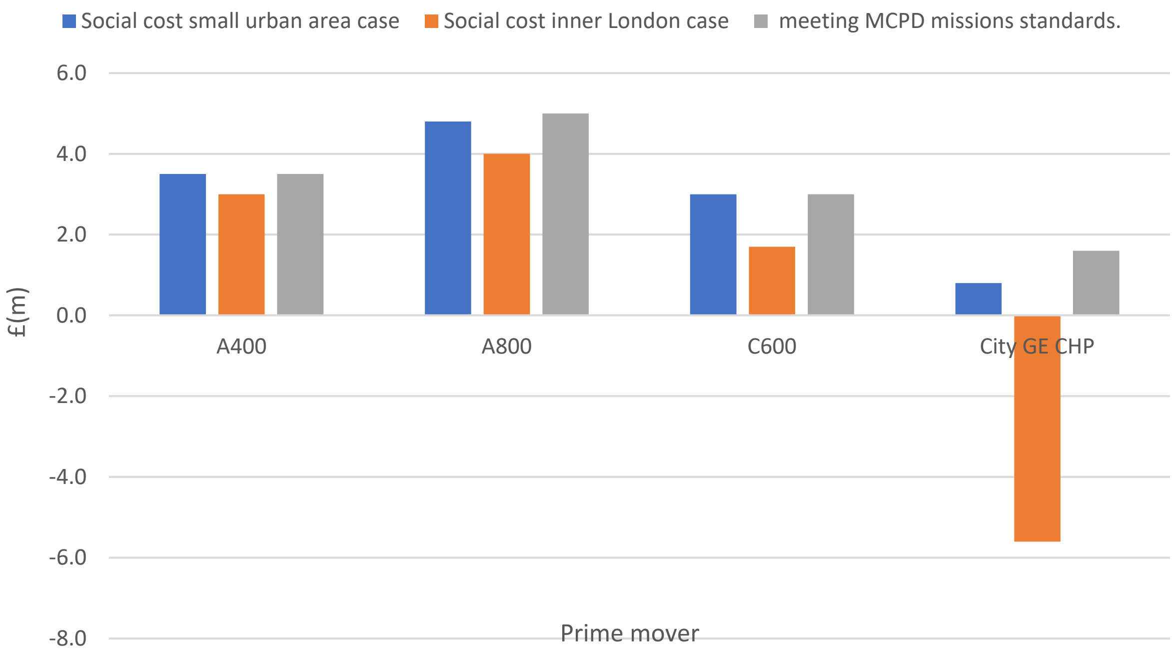
- The emission impact of the different CHP systems

- The sensitivity analysis of the CO_2, electricity, and gas prices

- The sensitivity analysis of the discount count rate.

A case study in London: City University

- The NPV under the three scenarios for the different CHP systems



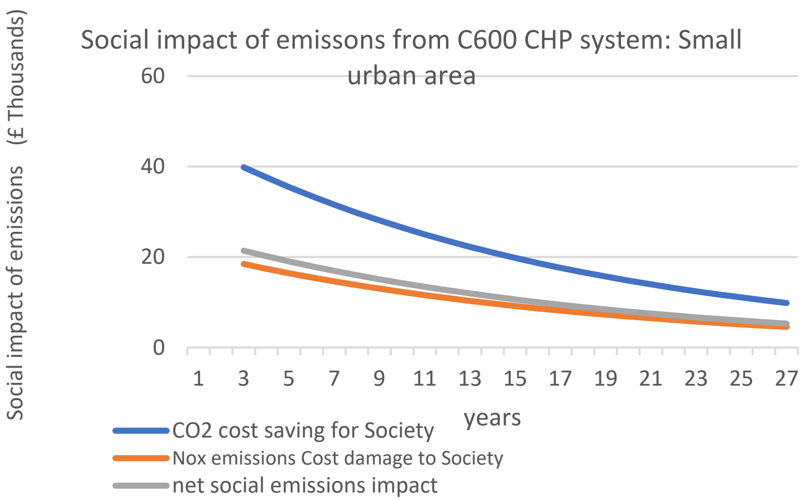
A case study in London: City University

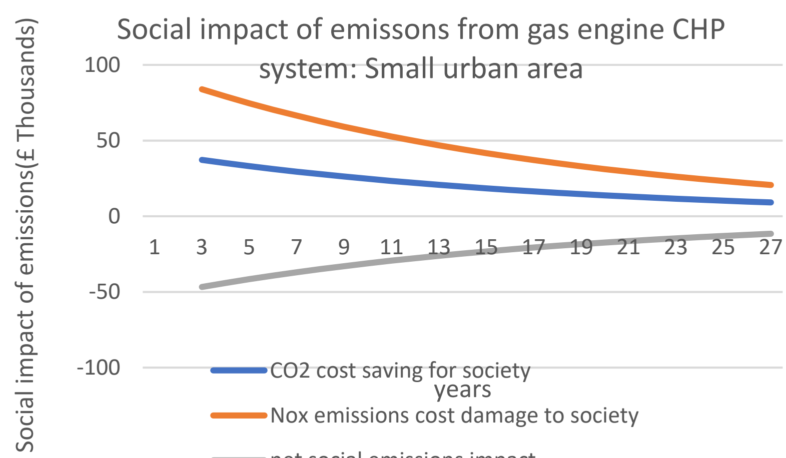
- Payback under the three scenarios for the different CHP systems

Scenario	A800	A400	C600	CHP
Small Urban Area	2.6	2.18	3.8	9.5
Inner London	2.9	2.5	5.7	-
MCPD	2.50	2.2	3.6	7.5

A case study in London: City University

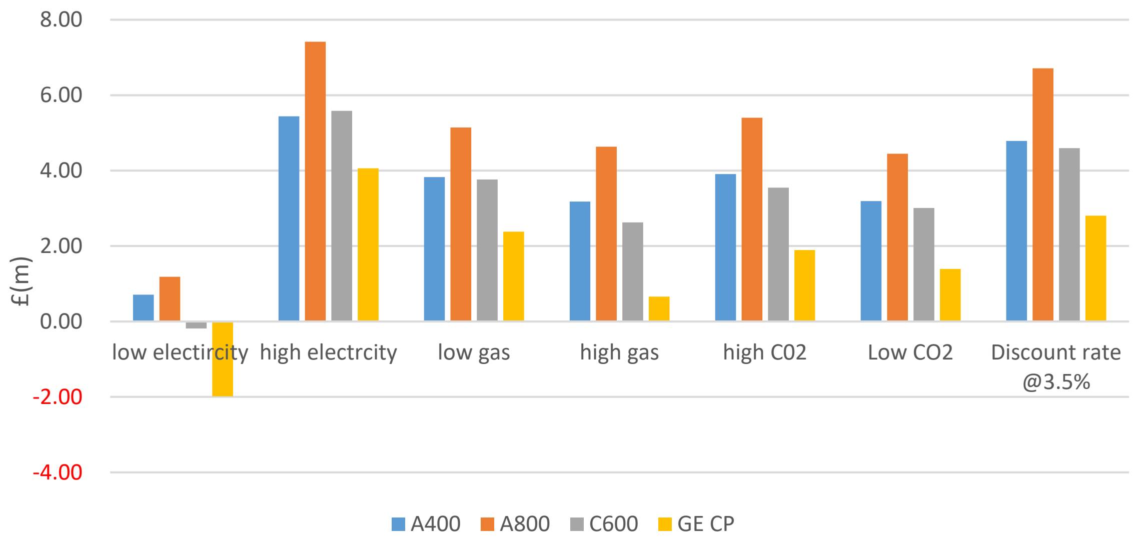
- Social impact cost of emissions (£) from C600 and Gas Engine CHP Systems for small urban areas (based on CO_2 benefits and NO_x social cost





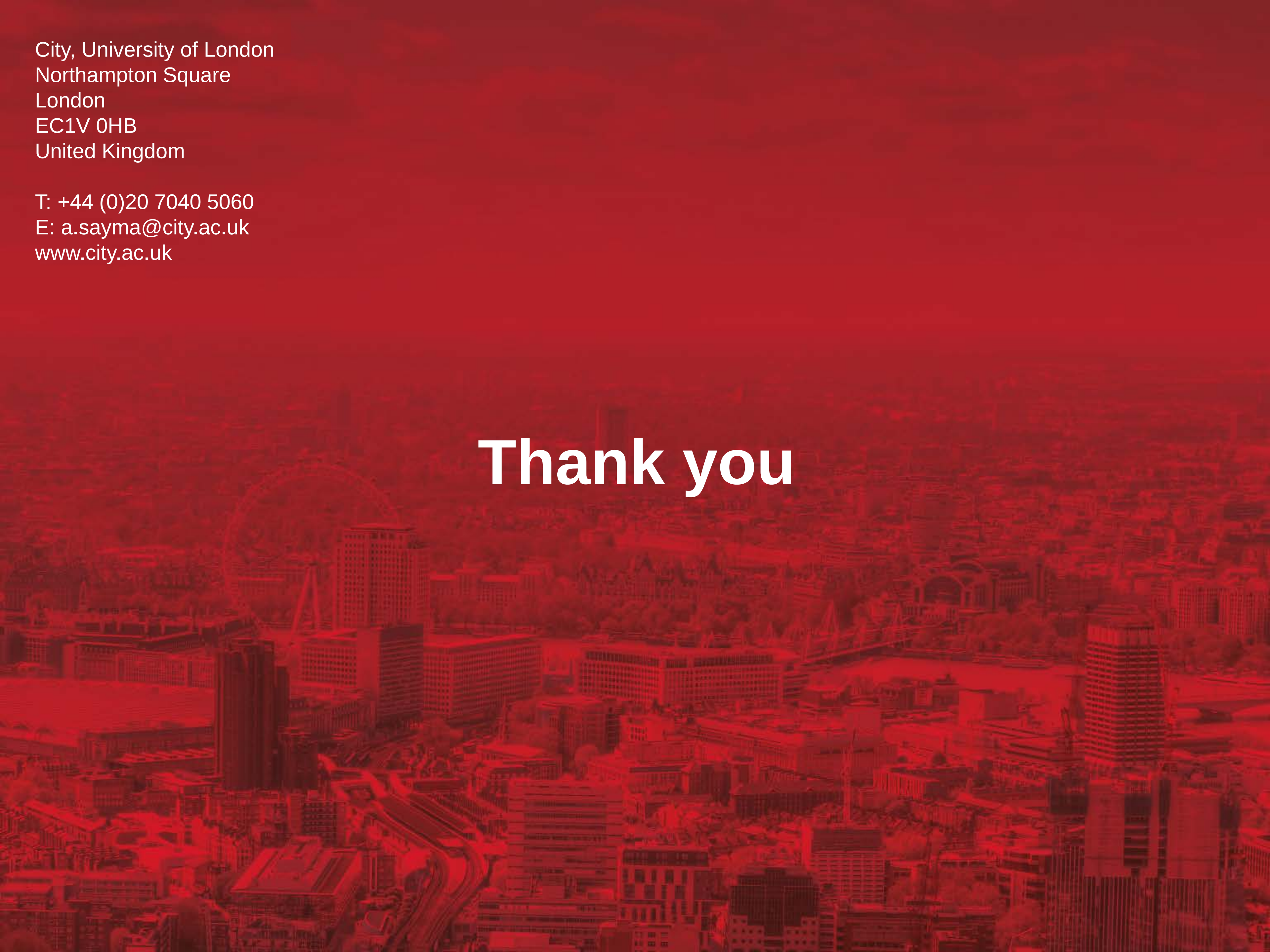
A case study in London: City University

- Sensitivity analysis for MCPD NOx emissions standards



Conclusion

- Identify the factors driving the uptake of small scale CHP systems (100 kW-2MW) in urban areas and the barriers to their successful uptake
- Evaluating the methodologies to assess the economic feasibility of CHP systems.
- Devise a model for calculating and comparing the benefits and costs of small gas turbines and reciprocating gas engine CHP systems in urban areas.
- Apply the model to an urban area based case study to evaluate the economic performance of each CHP system.
- Formulate recommendations on the economic feasibility of using small gas turbine in CHP systems for urban area application.



City, University of London
Northampton Square
London
EC1V 0HB
United Kingdom

T: +44 (0)20 7040 5060
E: a.sayma@city.ac.uk
www.city.ac.uk

Thank you