Water Innovation & Research Centre

UNIVERSITY OF BATH

Some Challenges for Water Innovation and Research

Professor Sarah Hainsworth OBE FREng

University of Bath

Our mission

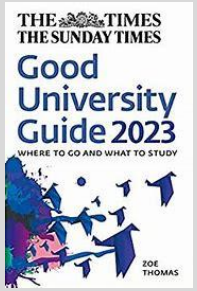
To deliver world-call research and teaching, educating our students to become future leaders and innovators and benefiting the wider population through our research, enterprises and influence.

Our Strategy

To drive excellence in education and high-impact research, foster an outstanding and inclusive community, and enhance our strategic partnerships.

Achievements

Since 1966 the University has grown in strength and reputation



University of the year in Times Good University Guide 2023

Ranked 7th in the Guardian University Guide 2023

2021 Research Excellence Framework, 92% of submitted research was found to be world- leading or internationally excellent

Awarded gold in first Teaching Excellence Framework

Ranked 3rd in the UK with 86% for overall student satisfaction in the National Student Survey 2022

Our University Strategy...

...at a glance

Our University Our Future: Connected

UNIVERSITY OF BATH

Fostering an outstanding and inclusive community

- Progress our Equality, Diversity and Inclusion Strategy
- Build on our successes in student experience, working with The SU
- Reinvigorate our alumni network
- Support individual staff success as well as collective endeavour

Driving high impact research

- Build on institutional research themes: Sustainability, Health and Wellbeing and Digital
- Develop clearer strategies for research at all levels
- Encourage development of larger research initiatives
- Strengthen local, national and international engagement

Driving excellence in education

- Develop new, rigorous and relevant courses for high-achieving students
- Enhance the educational benefit of placements
- Widen accessibility nationally and internationally
- Develop sustainable online learning resources

Enhancing strategic partnerships

- Forge international educational alliances
- Encourage new research alliances, including with business and industry
- Forge partnerships to drive enterprise
- Develop our civic role in Bath and the region

Our Values

Delivering quality and excellence, whilst being quick to listen and learn

Nurturing high aspirations, for the benefit of all

Aspiring to the highest standards of scientific, ethical and professional integrity, whilst supporting the freedom to challenge received wisdom

Supporting a sustainable community and adopting best environmental practice

Fostering inclusion, equality, diversity and accessibility where the unique value of each individual is recognised as we build a community of trust and care by treating each other with respect

Our Mission is to deliver world-class research and teaching, educating our students to become future leaders and innovators, and benefiting the wider population through our research, enterprise and influence.

Our Vision is to be an outstanding and inclusive University community, characterised by excellence in education, research, and innovation, working in partnership with others for the advancement of knowledge, in support of the global common good.

Faculties & Schools

Undergraduates	3346
Taught Masters	215
PGR	243
Home students	3000
Overseas	804
Staff	419

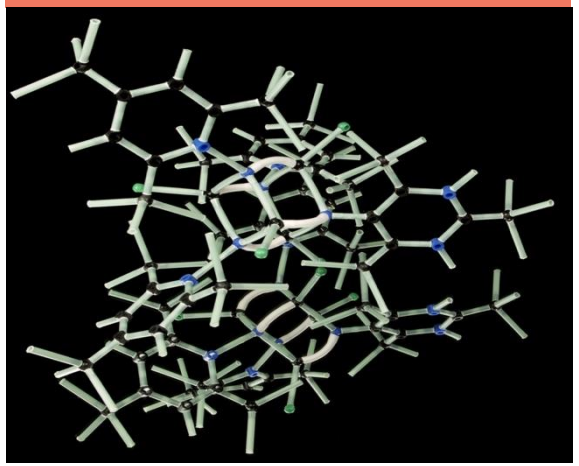
Faculty of Engineering and

School of Management

Undergraduates	1798
Taught Masters	618
PGR	242
Home students	1689
Overseas	969
Staff	266

Undergraduates	3805
Taught Masters	1345
PGR	481
Home students	5004
Overseas	627
Staff	652

Faculty of Science



Faculty of Humanities & Social

Undergraduates	4291
Taught Masters	1601
PGR	645
Home students	5338
Overseas	1199
Staff	562

Research strategy 2021 - 2026

RESEARCH THEMES

1). Raise the profile of the research at Bath while building on cross - disciplinary research

2). Demonstrate our commitment to contributing to the public good

OBJECTIVES

Promoting Diversity

Fostering inclusion, equality, diversity and accessibility

Athena SWAN Silver Award

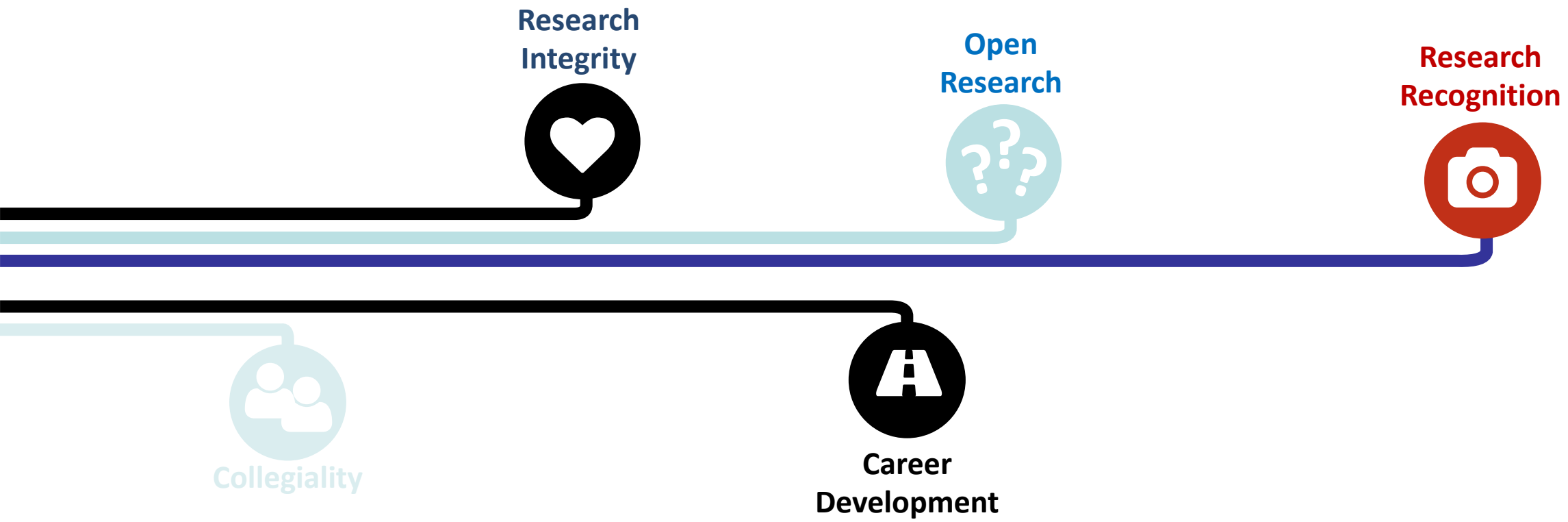
Stonewall DIVERSITY CHAMPION

RACE EQUALITY TASK FORCE

Healthy working environments attract and develop a more diverse workforce, impact positively on individual and institutional performance, and enhance staff engagement

The Future

Enhancing the research culture at Bath through:



Developing and motivating Researchers

Committed to Researcher Development Concordat and resulting university action plan

HR Excellence In Research Award

Help fund collaborators coming to Bath?

Research development support – application surgeries/writing retreats

Research & Innovation Services (RIS), incl:

Access to GW4 skills training

Research Staff Working Group

Funding advice and guidance

Business Partnerships and Knowledge Exchange expertise

SDG6

Goal: sustainable management of water supply and sanitation for all

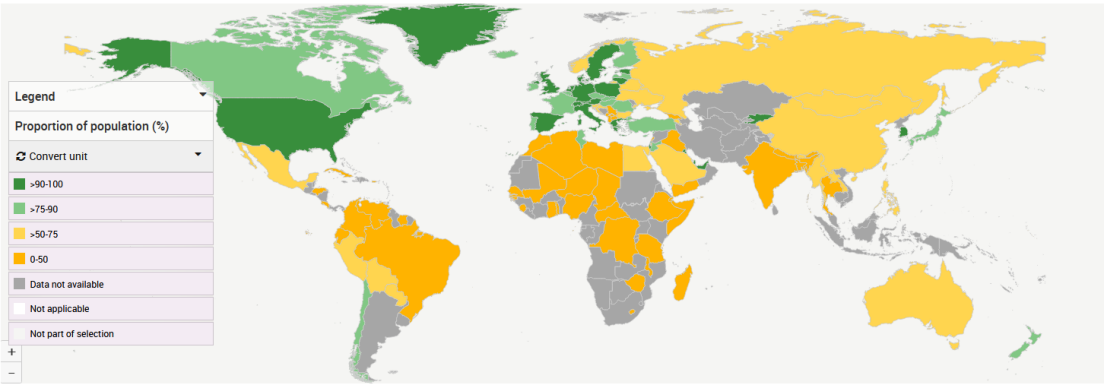
Still much work to do:

- Utilities need to increase productivity
- And become more efficient

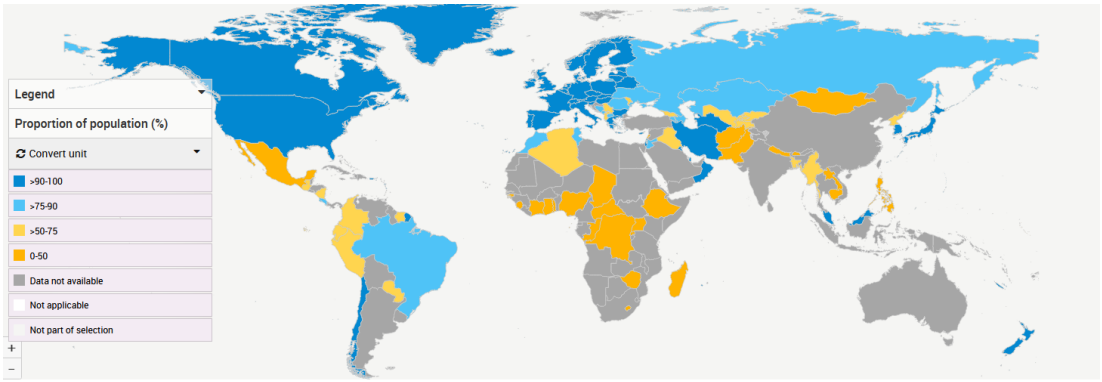
New technologies and approaches

New and diverse workforce needed

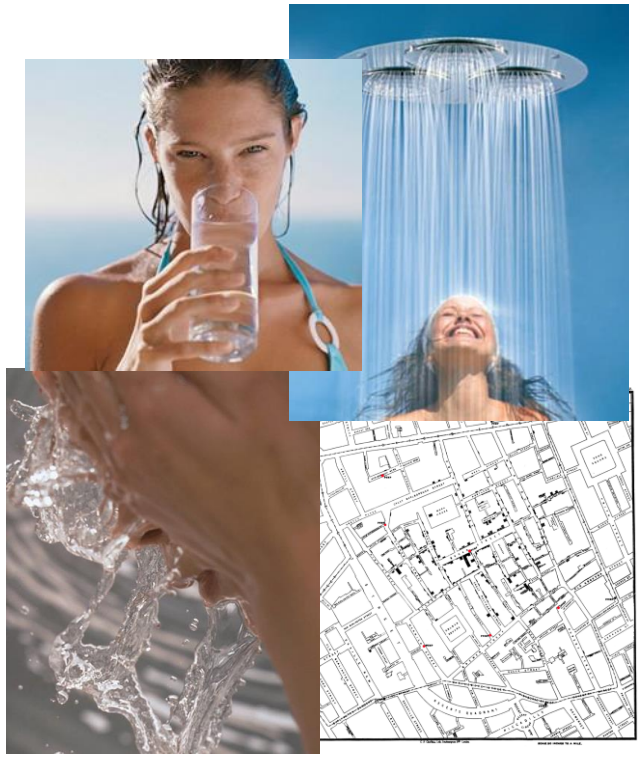
Proportion with access to managed sanitation



Proportion with access to managed water supply



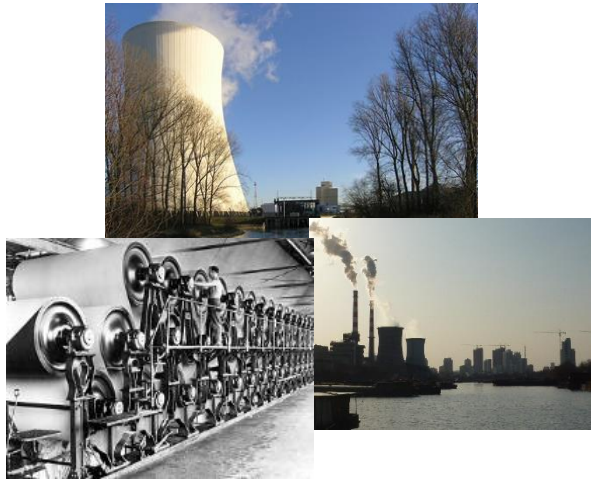
Value of water



Public health

Ecosystems (services)

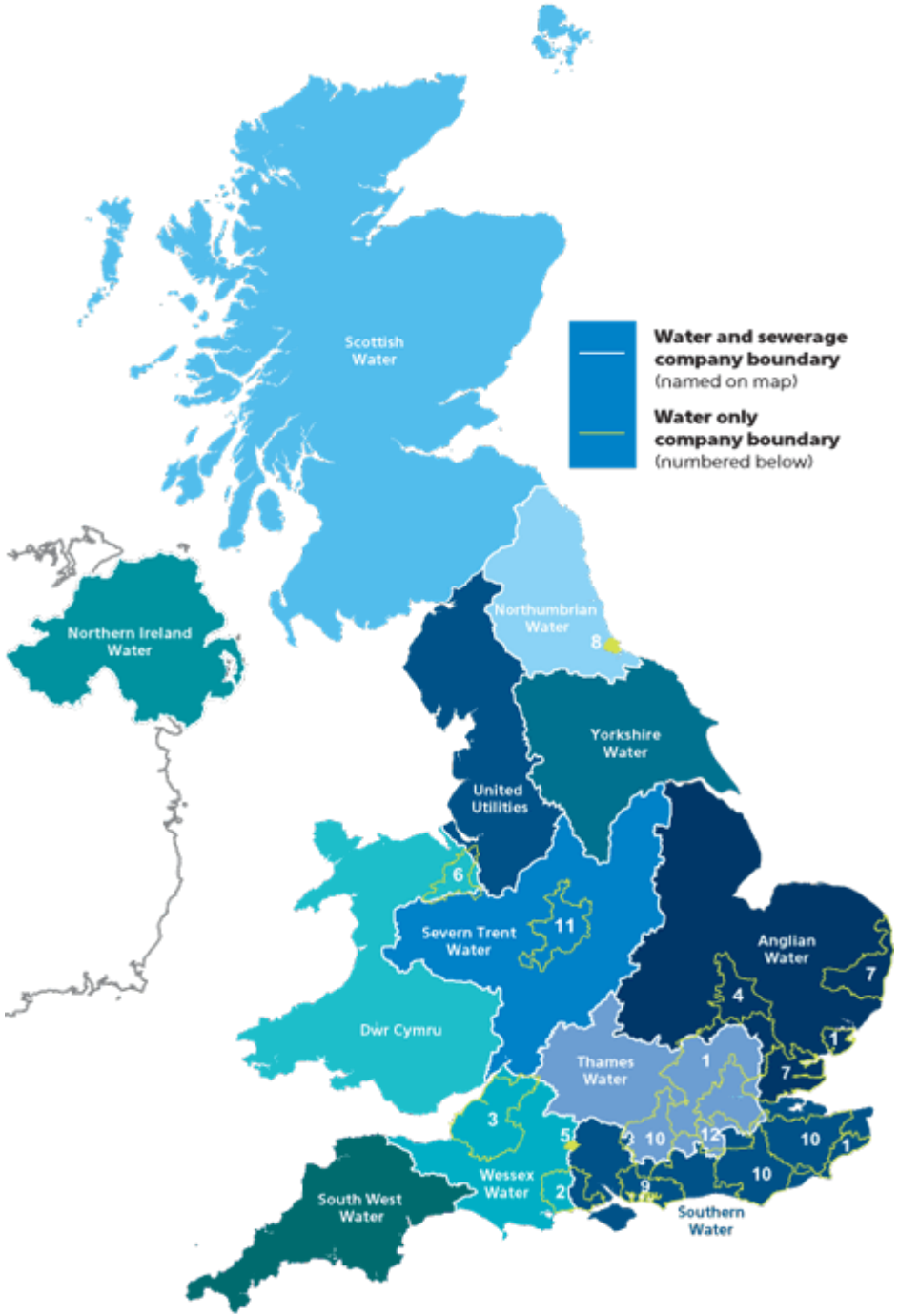
Business/manufacturing



Food production

UK Water Industry

- Local government service provision before 1973.
- Public regional companies (1973-1989).
- Privatisation of the 10 public regional water authorities (1989).
- Water Industry Act (1991).
  - economic regulation of the sector, water supply, sewerage services, drinking water quality, environmental standards, customer service, flood and drought protection and adaptation.
- Retail market for business (2017).



UK Water Industry Regulation

- **OFWAT** – the water price regulator. The UK water sector is a privatised industry delivering a public service, where domestic customers can not chose their supplier.
- **Environment Agency** – water resources, water quality, waste treatment (solid, liquid and gaseous).
- **Drinking Water Inspectorate** – drinking water quality and reliability.

Some facts and figures

- Utilities operate 1,433 water treatment works and 5,950 service reservoirs in the UK.
- The UK has over 416,175 kms of water mains and more than 393,460 kms of sewers – combined, that's enough to stretch to the moon and back.
- The UK delivers 16.6 billion litres of high-quality water every day to 63.9 million people.
- 66% of the world's inhabitants could live in water-stressed conditions by 2025.
- The UK's water and sewerage utilities provide some of the cleanest drinking water in the world. 99.97% of water samples in England and Wales met the Drinking Water Inspectorate's standards in 2013.
- There are 7,078 sewage treatment works in England and Wales, and 10,814 sewage treatment works and community septic tanks in Scotland and Northern Ireland.
- 98% of urban and rural households connect to the UK's sewerage service.
- £88 billion - Forecast global capital spending on sewage by 2018.

UK 2050 Water Innovation Strategy Themes

- Achieving net zero carbon.
- Delivering resilient infrastructure systems.
- Enabling diverse future-ready people and partnership working.
- Protecting and enhancing natural systems.
- Providing clean water for all.
- Providing the services society needs, expects & values.
- Taking a whole life approach to responsible consumption and production.

Water industry, technology / equipment and chemicals / energy supply chain, researchers and academics, regulators.....

Value of water

Women are primary managers, users and providers of water at domestic and community level

Women and girls are often responsible for collecting water, often in long distances and harsh conditions

Women and girls make up only 17% of the labour force in water and sanitation service providers in developing countries

Women in Water Workforce

Survey of 64 water and sanitation service providers in 28 economies

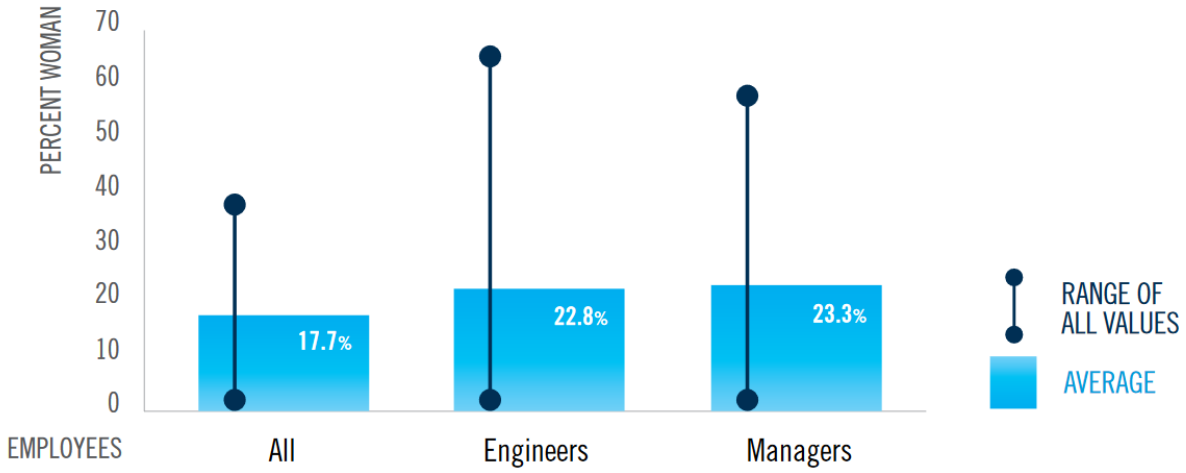
Heterogeneity in the field:

32 % had no female engineers

12 % had no female managers

Barriers:

- Gender norms and stereotypes
- Occupational segregation
- Low share of women in STEM



Source: World Bank Utility Survey 2018–19.

https://openknowledge.worldbank.org/bitstream/handle/10986/32319/140993.pdf

Water Industry - Skills gap

ENERGY & UTILITIES SKILLS PARTNERSHIP

Total Employment

THE UK WATER INDUSTRY EMPLOYED:

58,800 IN 2016

64,700 IN 2019

66,700 IN 2020

Change 2016-2020 +13%

Change 2019-2020 +3%

IN THE FOLLOWING AREAS IN 2020:

	45,500	21,200
Water collection, treatment & supply	Sewerage
change 2016-2020	+9,200 (+25%)	-1,300 (-6%)
change 2019-2020	+2,200 (+5%)	-200 (-1%)

% OF VACANCIES THAT ARE SKILLS SHORTAGES 2019:

Water 58%

UK 24%

Business Register and Employment Survey, ONS & NISRA.

Top three occupational groups

	Professional	Associate Professional & Technical	Operatives
2016	24%	20%	18%
2019	26%	18%	16%
2020	24%	24%	18%

Energy & Utility Skills estimate based on Labour Force Survey (ONS) 4-quarter average (January-December 2020).

Forecast number of vacancies 2020-2029

27,000 All occupations

3,000	Managers, Directors and Senior Officials
4,000	Professional Occupations
4,000	Associate Professional and Technical Occupations
2,000	Administrative and Secretarial Occupations
8,000	Skilled Trades Occupations
1,000	Sales and Customer Service Occupations
3,000	Process, Plant and Machine Operatives
2,000	Elementary Occupations

Workforce Renewal and Skills Strategy 2020-2025, Energy & Utility Skills.

Water Industry Diversity and Inclusion Profile

ENERGY & UTILITIES SKILLS PARTNERSHIP

% of Workforce Female

Sector 28%
UK 48%

2019-2020 Sector: -1% UK:+1%
2016-2020 Sector:+9% UK:+1%

Managers, Directors and Senior Officials

Sector 16%
UK 37%

2019-2020 Sector:+2% UK:+1%
2016-2020 Sector: 0% UK:+2%

Professional Occupations

Sector 33%
UK 50%

2019-2020 Sector:+4% UK: 0%
2016-2020 Sector:+10% UK:+1%

Associate Professional and Technical Occupations

Sector 25%
UK 46%

2019-2020 Sector:-5% UK:+1%
2016-2020 Sector:-3% UK:+2%

Administrative and Secretarial Occupations

Sector 62%
UK 73%

2019-2020 Sector:-14% UK:-3%
2016-2020 Sector:-18% UK:-3%

Skilled Trades Occupations

Sector 8%
UK 12%

2019-2020 Sector:+5% UK:+1%
2016-2020 Sector:+4% UK:+2%

Sales and Customer Service Occupations

Sector 63%
UK 62%

2019-2020 Sector:+12% UK: 0%
2016-2020 Sector:+6% UK:-1%

Process, Plant and Machine Operatives

Sector 4%
UK 12%

2019-2020 Sector: 0% UK: 0%
2016-2020 Sector:+1% UK: 0%

Elementary Occupations

Sector 3%
UK 46%

2019-2020 Sector:+1% UK:-1%
2016-2020 Sector:-1% UK: 0%

Annual Population Survey, January to December of each year, ONS (accessed through NOMIS).

Water Industry Diversity and Inclusion Profile

ENERGY & UTILITIES SKILLS PARTNERSHIP

Percentage of Water Industry Workforce - Ethnic minority

Sector 7%

UK 13%

2019-2020	Sector: +1%	UK: +2%
2016-2020	Sector: +3%	UK: +2%

Percentage of Water Industry Workforce - Disabled

Sector 19%

UK 16%

2019-2020	Sector: +2%	UK: 0%
2016-2020	Sector: +7%	UK: +2%

Percentage of Water Industry Workforce - Aged 16-24

U24

Sector 7%

UK 11%

2019-2020	Sector: -2%	UK: 0%
2016-2020	Sector: 0%	UK: -1%

Percentage of Water Industry Workforce - 60+

60+

Sector 6%

UK 11%

2019-2020	Sector: +2%	UK: +1%
2016-2020	Sector: - 2%	UK: +1%

Percentage of Water Industry Workforce - EU nationals

Sector 3%

UK 7%

2019-2020	Sector: +1%	UK: 0%
2016-2020	Sector: +1%	UK: 0%

Percentage of Water Industry Workforce - Non-EU Nationals

Sector 0%

UK 5%

2019-2020	Sector: -2%	UK: +1%
2016-2020	Sector: -2%	UK: +1%

Sector workforce = Energy and Utility Skills estimate based on Labour Force Survey (ONS) 4-quarter average (January-December 2020).

UK workforce = Annual Population Survey, January to December of each year, ONS (accessed through NOMIS).

Wastewater Based Epidemiology

Barbara Kasprzyk-Hordern & Environmental chemistry & Public Health Group

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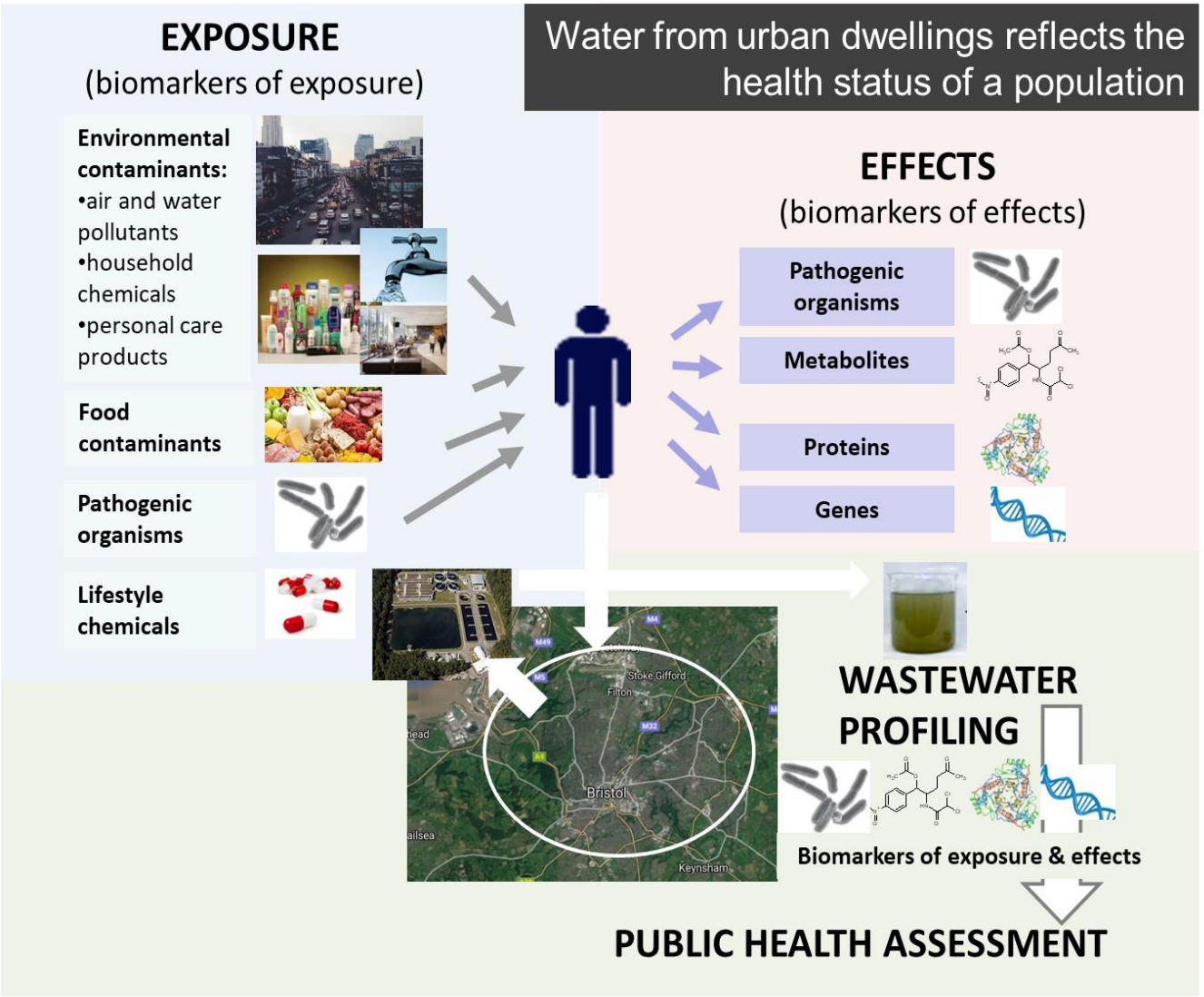
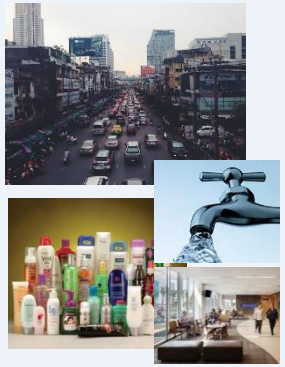


Water from urban dwellings reflects the health status of a population

EXPOSURE
(biomarkers of exposure)

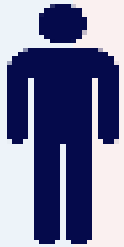
Environmental contaminants:
- air and water pollutants
- household chemicals
- personal care products



Food contaminants

Pathogenic organisms

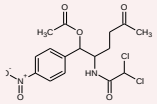
Lifestyle chemicals



EFFECTS
(biomarkers of effects)

Pathogenic organisms

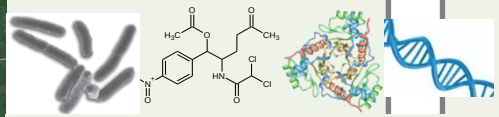
Metabolites



Proteins

Genes

WASTEWATER PROFILING



Biomarkers of exposure & effects

PUBLIC HEALTH ASSESSMENT

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WBE
Wastewater-Based Epidemiology

Conceptually simple
Methodologically highly sophisticated

B.Kasprzyk-Hordern@bath.ac.uk

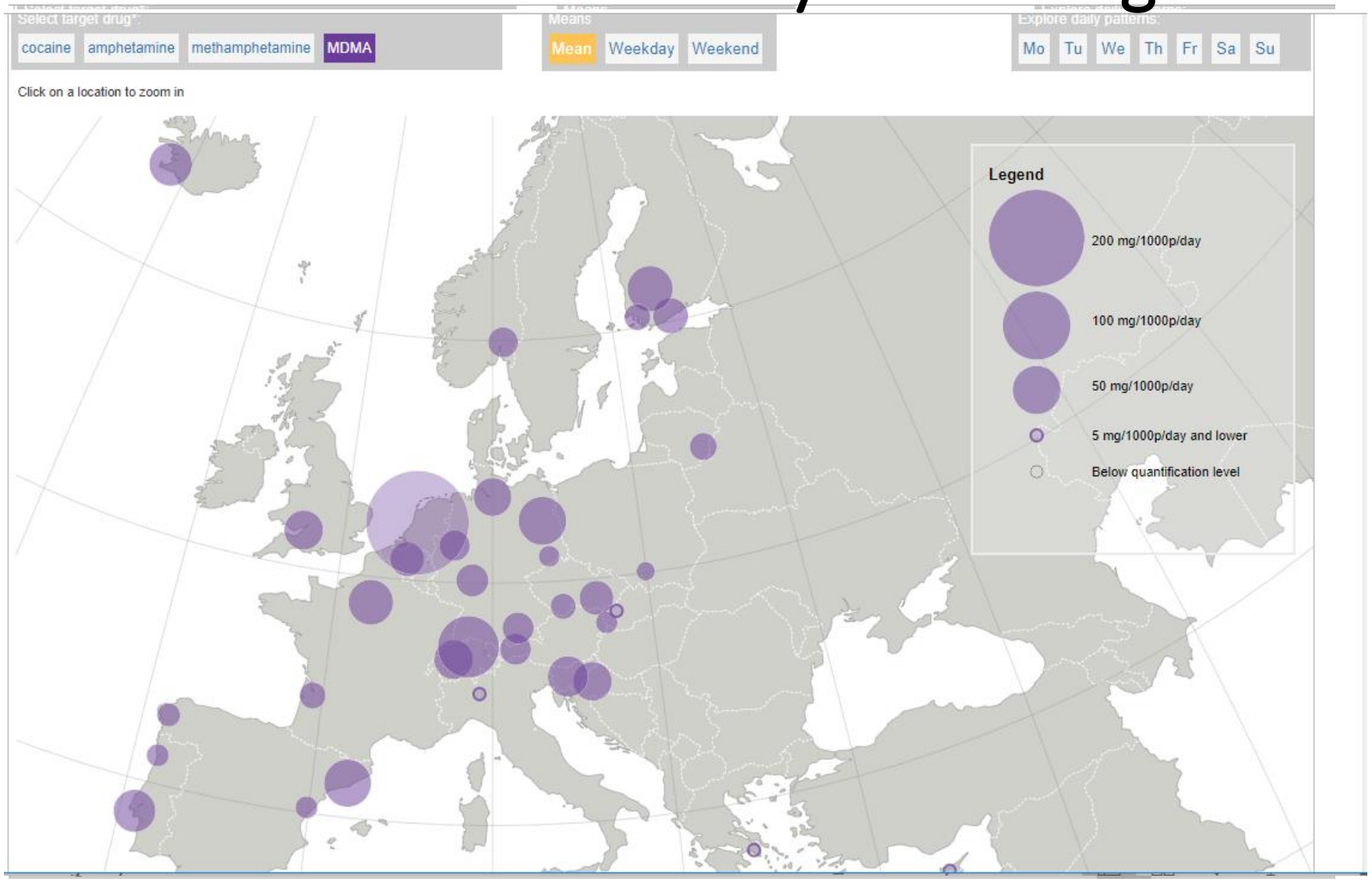
Urine samples from thousands of people would have to be tested to verify community-wide health status. This is expensive and logistically impractical.

...BUT only one wastewater sample is needed to assess community's health with high certainty, at low cost and in real time!

Wastewater – diagnostic medium for community-wide health status assessment

B.Kasprzyk-Hordern@bath.ac.uk

Wastewater-based epidemiology – estimation of community-wide drug use



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score
www.score-cost.eu

European Monitoring Centre for Drugs and Drug Addiction

2017 Europe-wide study: 60 cities in 19 countries revealed a picture of distinct geographical and temporal patterns of drug use across European cities.

GO TO:
http://www.emcdda.europa.eu/topics/pods/waste-water-analysis

B.Kasprzyk-Hordern@bath.ac.uk

GCRF EPSRC ReNEW

Developing Resilient Nations – Towards a Public Heath Early Warning System via Urban Water Profiling

ReNEW

GCRF
Global Challenges Research Fund

Natural Sciences

Dr Edward Archer
University of Stellenbosch
Post-Doctoral Researcher
Environmental Microbiology

Dr Marelize Botes
University of Stellenbosch
Senior Researcher
Environmental Microbiology

Prof Ed Feil
University of Bath
Co-Investigator
Microbial Evolution

Prof Chris Frost
University of Bath
Co-Investigator
Organic Chemistry

Beth Holton
University of Bath
PhD Student
Analytical Chemistry

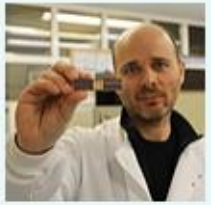
Prof Barbara Kasprzyk-Hordern
University of Bath
Principal Investigator
Analytical Chemistry

Dr Leonardos Mageiros
University of Bath

Prof Gideon Wolfaardt
University of Stellenbosch
Principal Investigator
Microbiology

Dr Tom Watkinson
University of Bath

Engineering



Dr Pedro Estrela
University of Bath
Co-Investigator
Biosensors and Bioelectronics

Dr Shu Jiang
University of Bath
Post-Doctoral Researcher
Biosensors and Bioelectronics

Dr Thomas Kjeldsen
University of Bath
Co-Investigator
Civil Engineering

Dr Tobie Louw
University of Stellenbosch
Co-Investigator
Process Engineering

Prof Willem Perold
University of Stellenbosch
Co-Investigator
Electronic Engineering

Social Sciences

Prof Julie Barnett
University of Bath
Co-Investigator
Psychology

Emma Burroughs
University of Bath
PhD Student
Psychology

Dr Monique Huysamen
University of Bath
Post-Doctoral Researcher
Psychology

Dr Charon Marais
University of Stellenbosch
Co-Investigator

Prof Danae Stanton-Fraser
University of Bath
Co-Investigator
Psychology

UNIVERSITEIT STELLENBOSCH UNIVERSITY

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B.Kasprzyk-Hordern@bath.ac.uk

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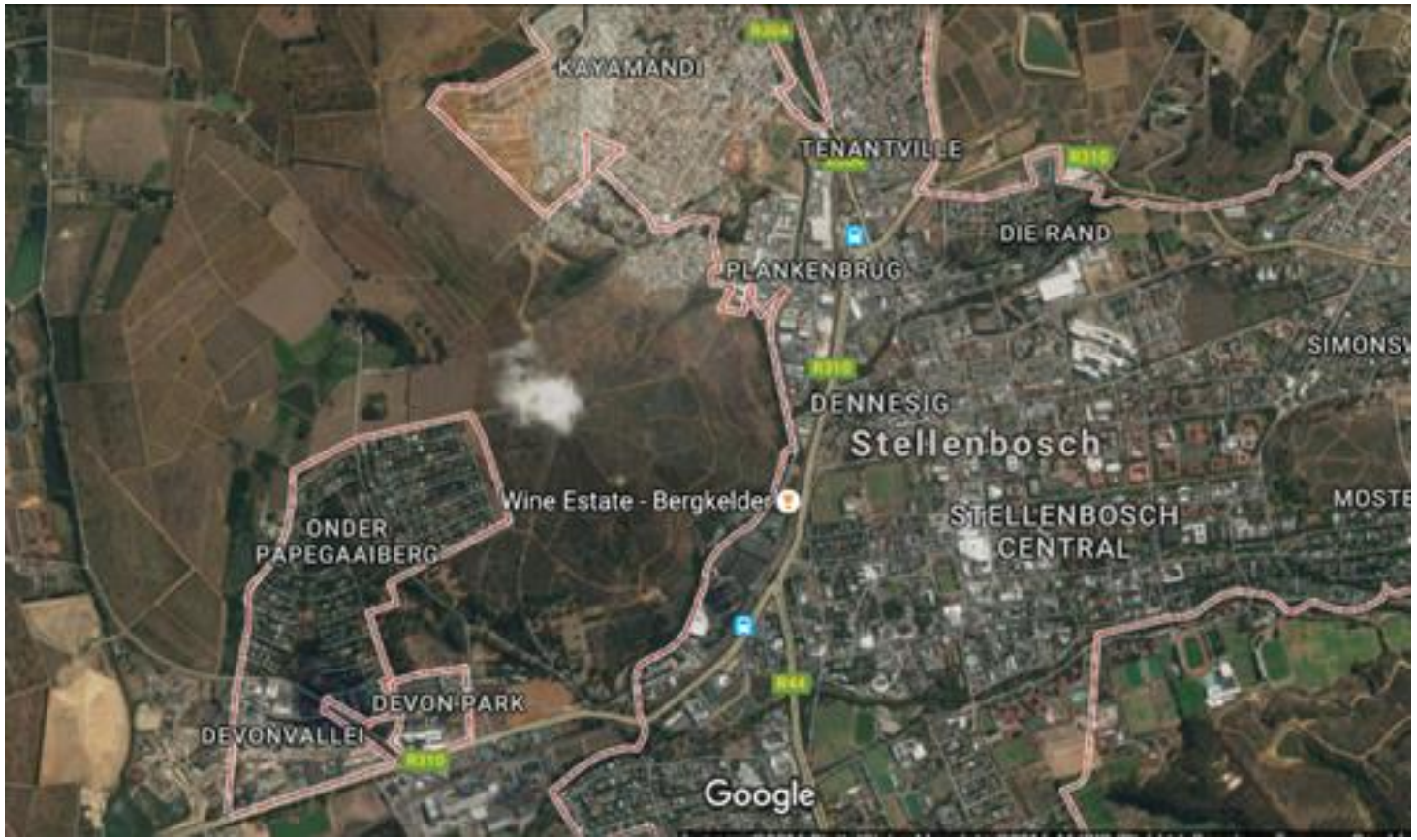
Developing Resilient Nations – Towards a Public Heath Early Warning System via Urban Water Profiling



We are undertaking a scoping study in Stellenbosch to understand the requirements for the development and implementation of a multi-hazard EWS in SA and beyond.

EARLY WARNING SYSTEMS: SPREAD OF DISEASE & AMR

https://www.gcrf-renew.co.uk/

We will identify existing constraints in the city-system of SA (i.e. infrastructure-rich areas coexisting with informal settlements lacking infrastructure)

B.Kasprzyk-Hordern@bath.ac.uk

GCRF EPSRC ReNEW

Developing Resilient Nations – Towards a Public Heath Early Warning System via Urban Water Profiling

Environment fingerprinting using:

- Mass spectrometry
- Sequencing
- Sensing

TB & MDR

O1: Biomarkers - bioanalytical approaches towards public health diagnostics at the community-level via urban water profiling.
O2: Sensors - low cost biosensors for real-time monitoring of public health indicators.
O3: Monitoring - Spatial and temporal monitoring study.
O4: Modelling multiple hazard indicators and predicting changes within the urban system.
O5: Engagement with key stakeholder groups.

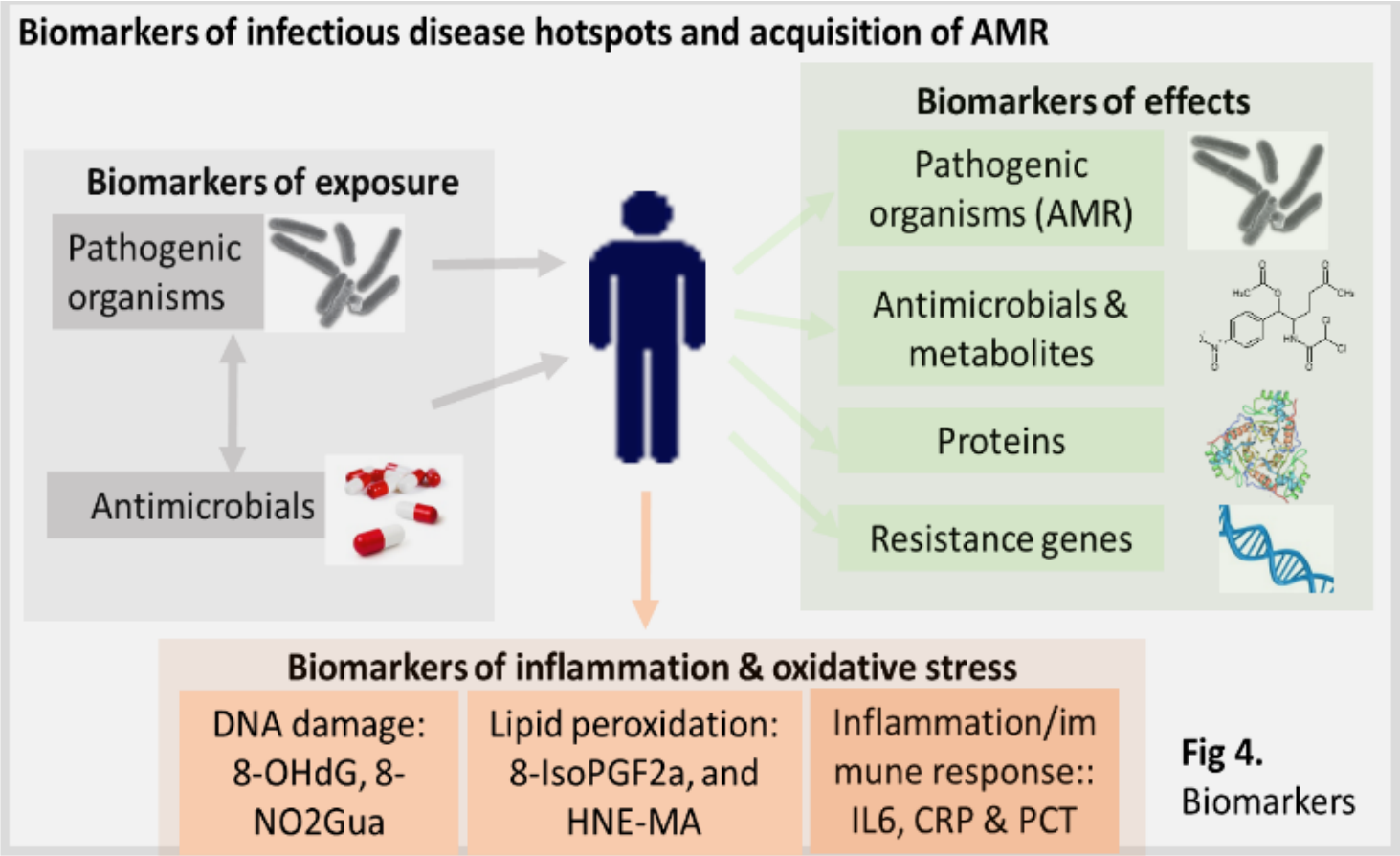


Fig 4. Biomarkers

B.Kasprzyk-Hordern@bath.ac.uk

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Developing Resilient Nations – Towards a Public Heath Early Warning System via Urban Water Profiling

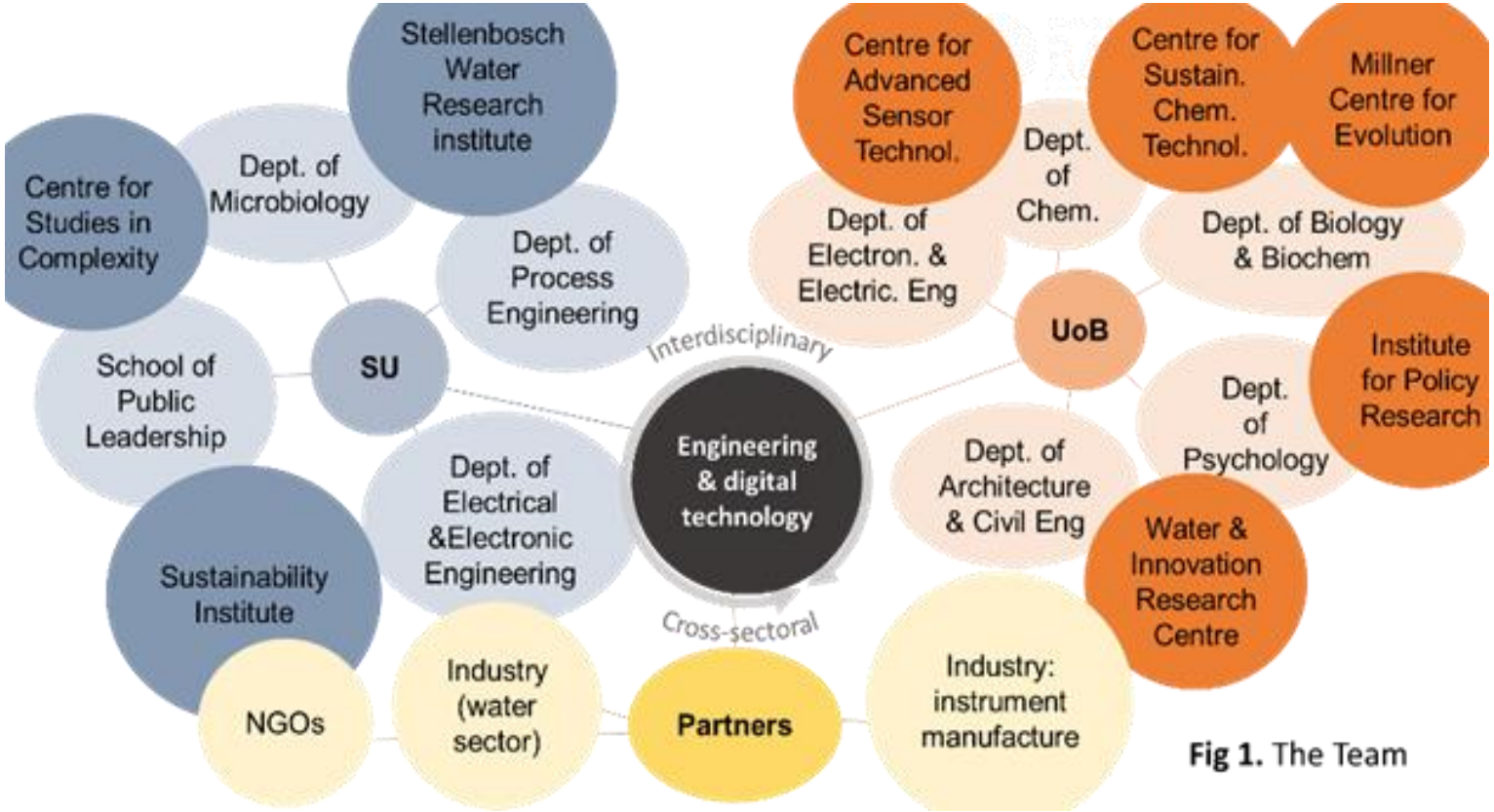
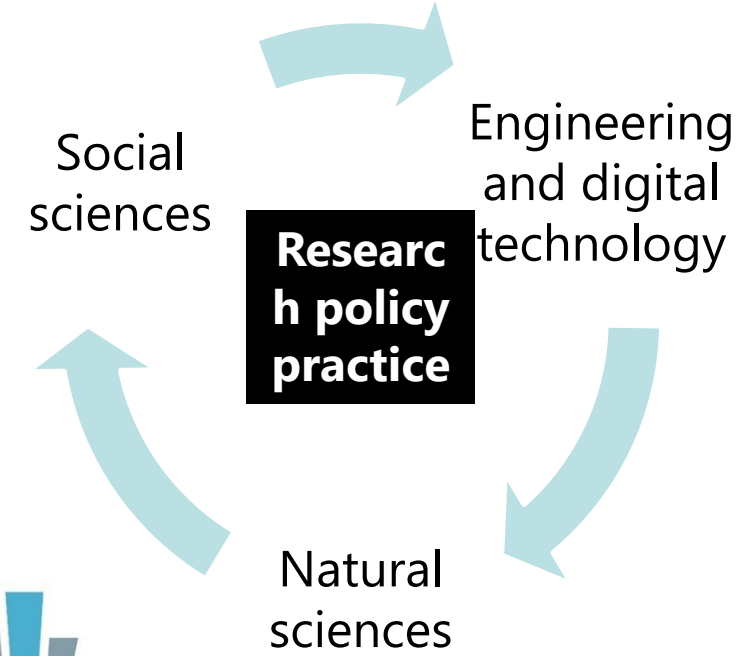


Fig 1. The Team



ReNEW

B.Kasprzyk-Hordern@bath.ac.uk

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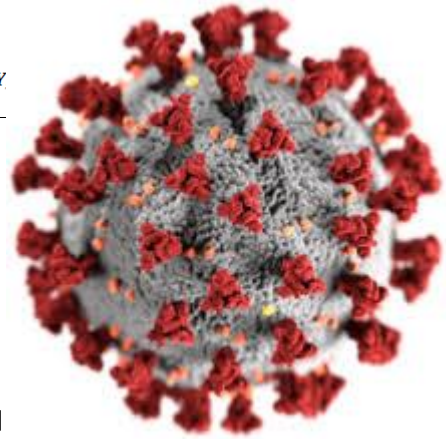
journal homepage: www.elsevier.com/locate/envint

Future perspectives of wastewater-based epidemiology: Monitoring infectious disease spread and resistance to the community level

Natalie Sims, Barbara Kasprzyk-Hordern*

Department of Chemistry, University of Bath, Bath BA2 7AY, UK
Centre for Doctoral Training in Sustainable Chemical Technologies, University of Bath, Bath BA2 7AY



EDGE

Environment fingerprinting via DiGital technology - a new paradigm in hazard forecasting and Early-warning systems for health risks in Africa (EDGE)

EWS-

Building an Early Warning System for community-wide infectious disease spread: SARS-CoV-2 tracking in Africa via environment fingerprinting

B.Kasprzyk-Hordern@bath.ac.uk

Wessex Water- IAA ENTRUST & IPC Projects

Wastewater fingerprinting for public health assessment

WATER & ENVIRONMENT

CHARITIES

PUBLIC HEALTH

PUBLIC HEALTH & SOCIAL INTERVENTIONS

Problem:

- Wessex Water: c.£2.2bn to invest in end-of-pipe technology to reduce pharmaceuticals in wastewater discharges by c.80% in the Wessex Water region.
- NHS: >£11bn to treat conditions related to lifestyle choices (poor diet, drinking and smoking) and an estimated £14bn/year to treat diabetes and its complications.

Objectives:

1. To test water fingerprinting as a quantitative measure of public health status and tool for evaluating the effectiveness of social interventions
2. To develop and evaluate strategies encompassing social prescribing and messaging aimed at improving public and environmental health

B.Kasprzyk-Hordern@bath.ac.uk

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EDI Platform

Embed and sustain equality, diversity and inclusion in startups and scaleups across the engineering community

Develop an **online platform** to host and enable access to a bespoke EDI platform

Create **new resources** to the fill gaps and improve understanding of EDI in everyday workplace practices

Create a **theory of change** and measure the impact of the EDI Platform

Programme timeline (2022 – 2023)

- Scope the programme
- Design and develop the EDI platform and content
- Engage with testing group
- Launch platform
- Refine and grow

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Graduate Engineering Engagement Programme (GEEP)

- Award winning programme aims to increase the flow of diverse talent into engineering careers
- Developed in response to demand for engineering skills and the serious diversity deficit
- Delivered in partnership with engineering employers. Supported by AFBE-UK and WES.
- Over 1000 students to date from 66 universities, over 90% Black, Asian and minority ethnic backgrounds, 28% women.

GEEP 2019, Birmingham

Royal Academy of Engineering

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- Research and insights programme
  - Hamilton Commission research project
  - **Inclusive culture research**
- Toolkits, guidance and resources
- Diversity Impact Programme:
  - Grant funding of up to 100k for new projects in university engineering departments to address unequal outcomes
- Engaging & supporting Professional Engineering Institutions (PEIs)
  - Progression Framework

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Creating cultures where all engineers thrive 2022

A research study into the current culture of inclusivity in the engineering profession. Aims to give insight into:

- How included do engineers feel within their profession?
- Are there any differences by individual characteristics, sector, seniority or any other variable, combination or intersection of characteristics?
- What progress has been made to increase inclusion in engineering since 2017?

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Research timeline (2022)

- 2022: Desk research, focus groups and large scale survey
- Final report to be published Spring 2023 with recommendations specific to engineering companies of varying sizes.

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Building inclusive cultures

We have worked with engineering companies to produce various toolkits and resources to support the creation of inclusive cultures in engineering:

- **Inclusive cultures toolkit.** Guidance on the main activities that are involved in creating and maintaining inclusive cultures in organisations.
- **Majority allies resources**. A set of resources to support those who wish to be an ally and to support organisations who may wish to have an allies programme or support allies within their organisation.
- **Creating Inclusive Cultures: Team workshop series**. A set of 'out-of-the-box' training modules designed to be run by an engineering project leader or manager when a team or group first come together to foster inclusive team working and achieve stronger outputs as a result.

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Diversity Impact Prog

- Funding to address unequal outcomes experienced by engineering students from underrepresented groups
- Awarded £1M for round 1 in March 2022
- 11 projects funded across the UK. 36% awards to post-92 universities
- Round 2 projects to be announced shortly
- Establishing a community of practice
- Academy ambition to identify and share what works in progressing equal outcomes

https://www.raeng.org.uk/diversity-in-engineering/diversity-and-inclusion-grant

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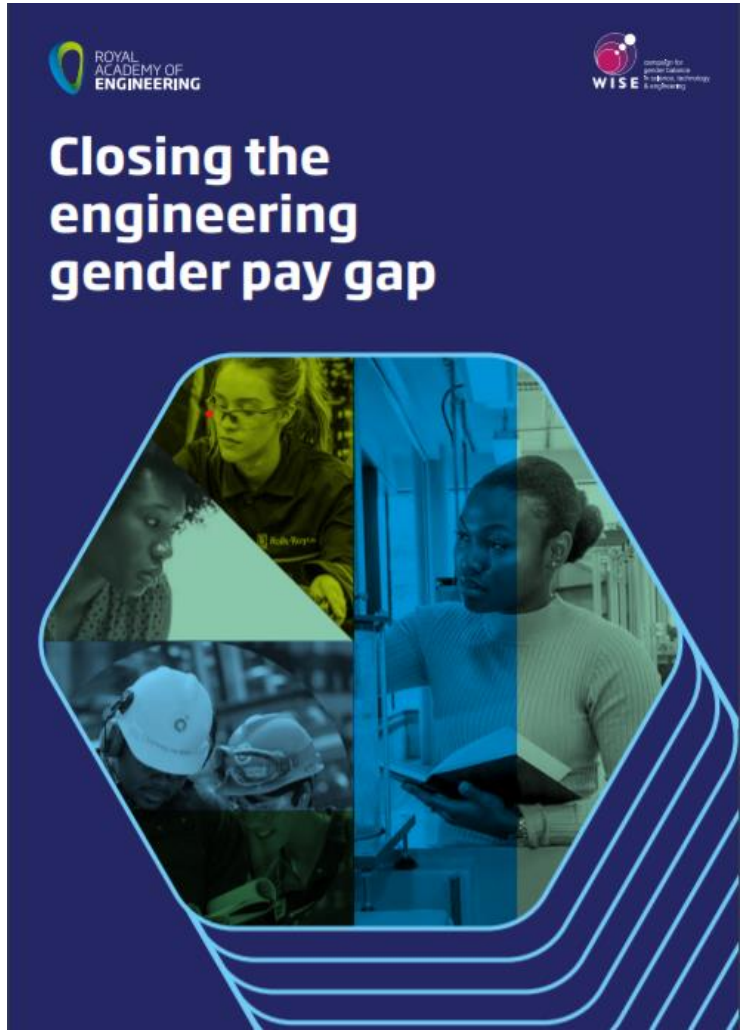
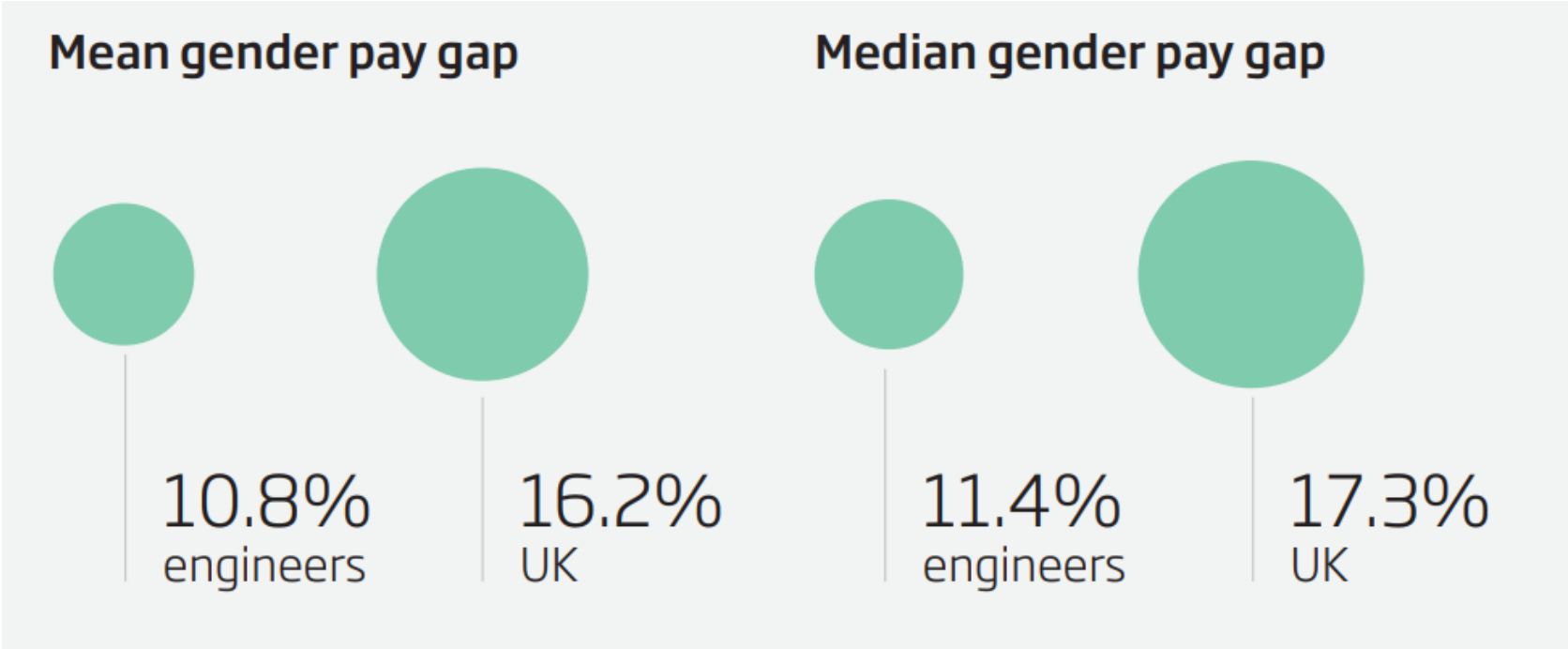
- Insights into the gender pay gap specific to engineering roles in the UK
- Based on pay data for just under 42,000 engineers from 25 companies
- Evidence-based actions in the areas of recruitment, retention and career progression to close the gender pay gap
- **raeng.org.uk/gender-pay-gap**



- The gender pay gap for engineers in the sample **was smaller than the national average**



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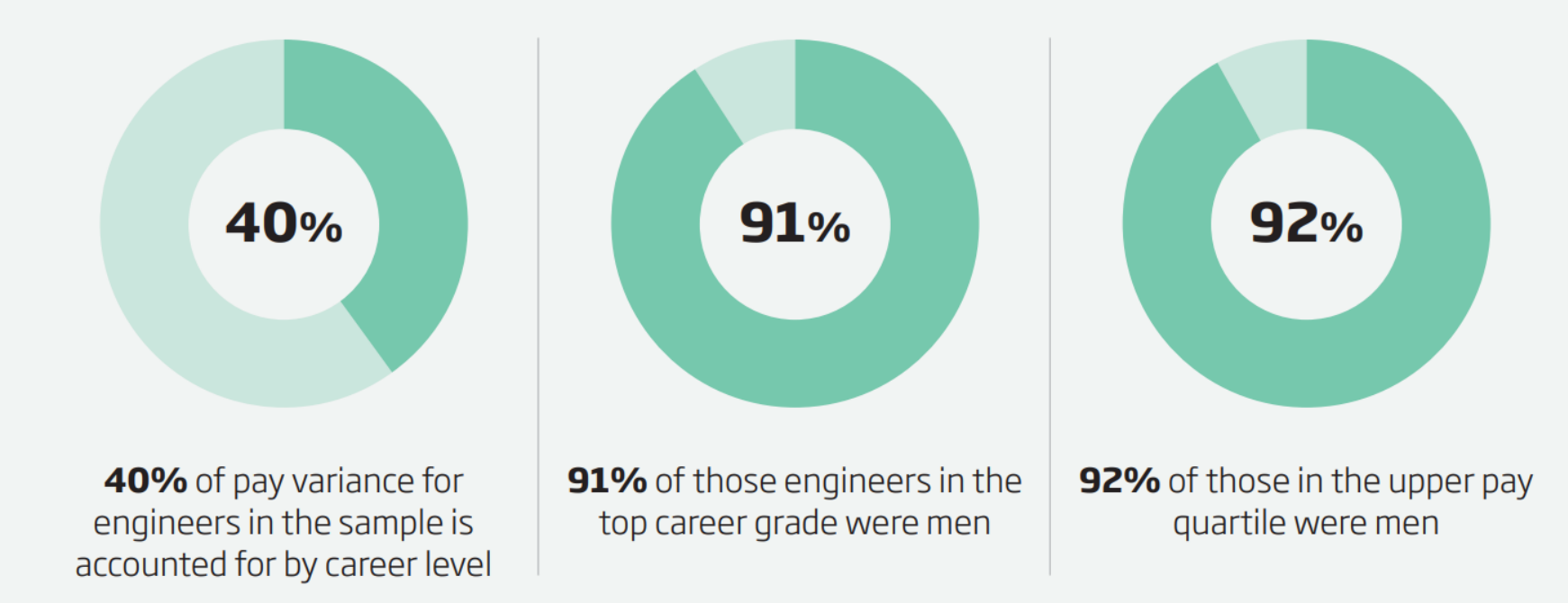
- The gender pay gap for engineers is largely due to the **under representation of women in more senior and higher paid roles**



- Transparency of pay structures and grades has a **big impact on the gender pay gap**

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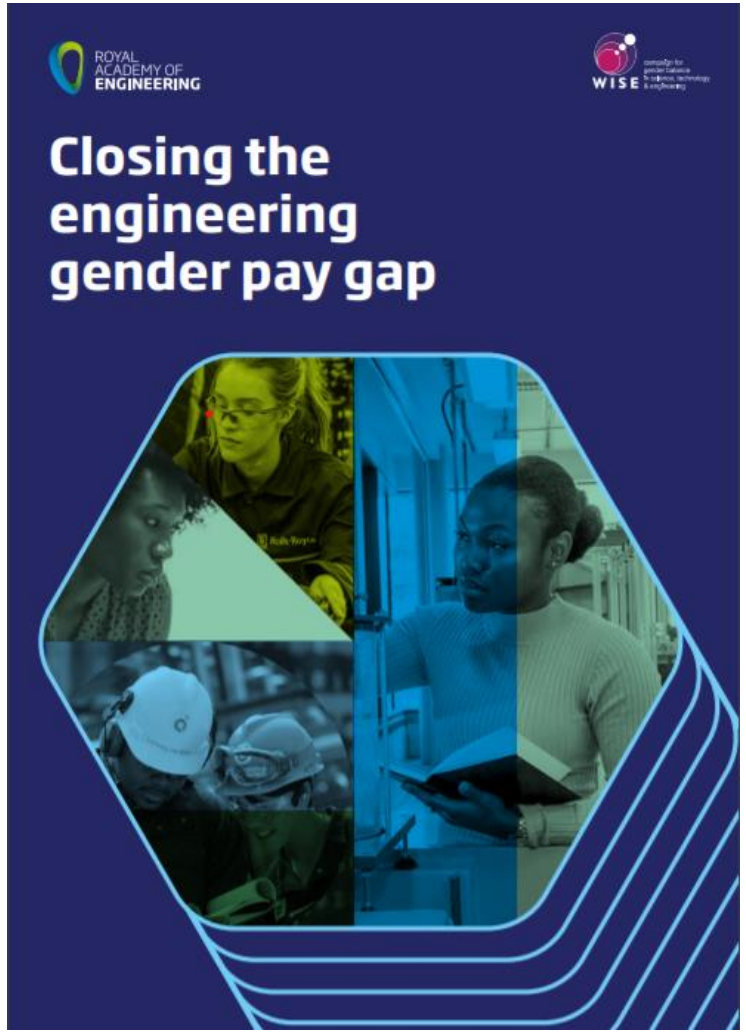
- Understand the causes of the pay gaps and which solutions are proven effective
- Analyse data to identify issues specific to your organisation
- Introduce a transparent pay and progression policy and publish salary ranges
- Go beyond the government's mandated requirements - publish a credible action plan which tackles the underlying causes.
- Focus on actions within your control and are proven to have a positive impact.
- Look beyond gender. Consider monitoring and reporting on ethnicity and disability pay gaps



Thank you

Any questions?

UNIVERSITY OF BATH