

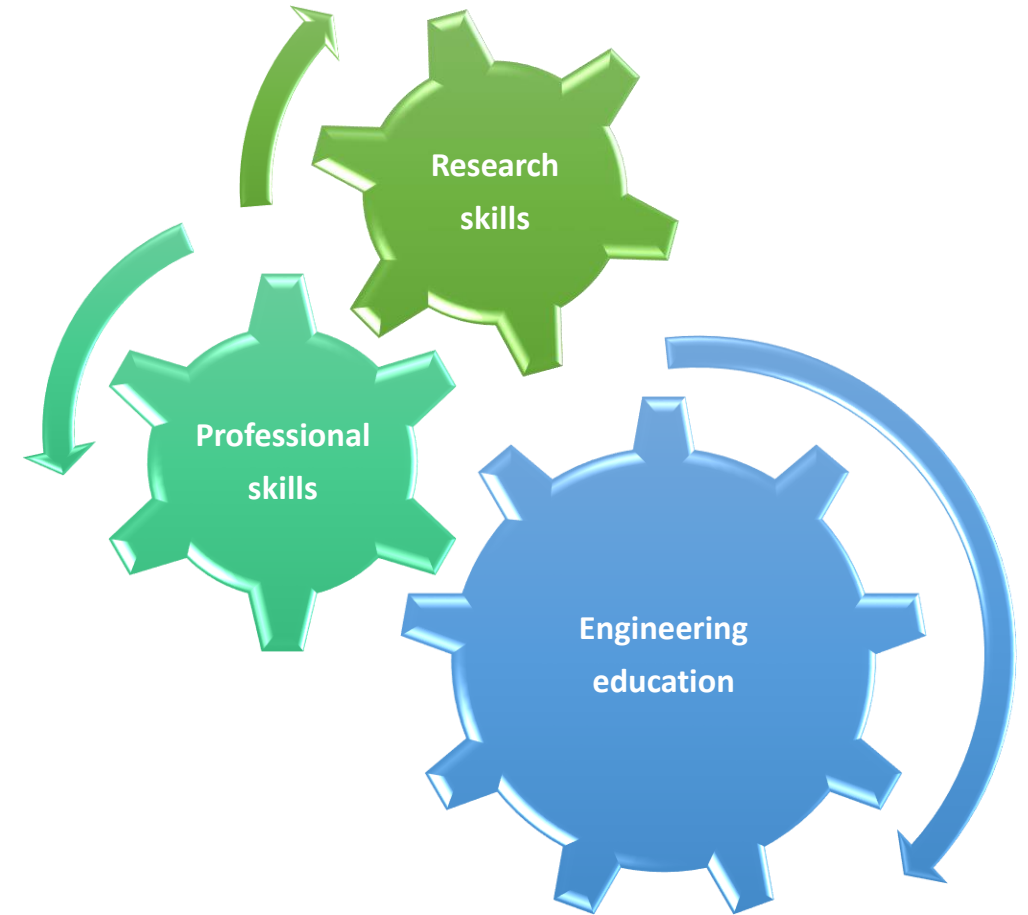
# Insights and Practice on Embedding Sustainability in Engineering Education

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Advance HE Sustainability Symposium: Top-down or bottom-up?  
30<sup>th</sup> March 2023

# Background on engineering education

- Engineering education is based on developing skills and knowledge according to a core foundation of science and mathematics as well as engineering analysis, design and practice
- But engineering students also need research skills for completion of the research project in the near-term combined with professional skills for more long-term development
- The Technical, Research and Professional Skills (TRAPS) Module is delivered at LSBU to provide MSc and MEng students with both research and professional skills



# Redesigning the TRAPS module

- The challenge was to redesign the Technical, Research and Professional Skills (TRAPS) module to meet the revised MSc accreditation requirements of the IET (Institution of Engineering & Technology)
- Overall scope would remain as a 13-week module focused on developing both research and professional skills and knowledge
- Needed to develop new content for the module covering 'sustainability' and the sustainable development goals (SDGs)
- It was decided that this would also link to the wider area of 'research impact'

## New learning outcome added to the module

*Ability to assess how technologies and engineering applications support sustainable development including use of numerical techniques where appropriate.*

# Plan of action and key steps for the module redesign

- 1) Produce new lecture material dedicated to research impact and sustainability (& the SDGs)
- 2) Support learning on research impact and sustainability through formative assessment
- 3) Integrate research impact and sustainability into the module assessment framework (summative assessment)



**Step 1 – Produce new lecture material dedicated to research impact and sustainability**

# Lecture contents

- 1) Understanding research impact:
  - a) Importance of academic research
  - b) Types of research impact
  - c) Measuring research impact
  - d) Research outputs, bibliometrics and altmetrics
  
- 2) Introduction to sustainability:
  - a) Sustainability and sustainable development
  - b) The triple bottom line
  - c) The Sustainable Development Goals (SDGs)
  - d) Circular economy
  
- 3) Tutorial session
  
- 4) Weekly reading exercise

# An example of the impact of academic research in society

THE LANCET

ARTICLES | VOLUME 397, ISSUE 10269, P99-111, JANUARY 09, 2021

Safety and efficacy of the ChAdOx1 nCoV-19 vaccine (AZD1222) against SARS-CoV-2: an interim analysis of four randomised controlled trials in Brazil, South Africa, and the UK

Merryn Voysey, DPhil \* · Sue Ann Costa Clemens, PhD \* · Shabir A Madhi, PhD \* · Lily Y Weckx, PhD \* · Pedro M Folegatti, MD \* · Parvinder K Aley, PhD · et al. [Show all authors](#) · [Show footnotes](#)

Open Access · Published: December 08, 2020 · DOI: [https://doi.org/10.1016/S0140-6736\(20\)32661-1](https://doi.org/10.1016/S0140-6736(20)32661-1)

Check for updates

PDF [368 KB]

Summary

Introduction

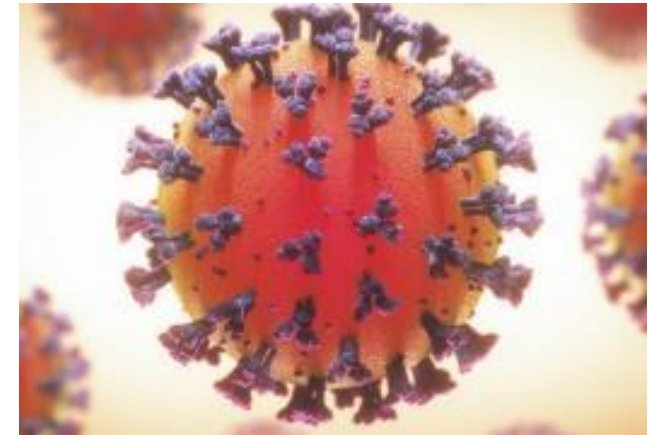
Methods

Results

## Summary

### Background

A safe and efficacious vaccine against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), if deployed with high coverage, could contribute to the control of the COVID-19 pandemic. We evaluated the safety and efficacy of the ChAdOx1 nCoV-19 vaccine in a pooled interim analysis of four trials.



Source: Voysey, M., Clemens, S. A. C., Madhi, S. A., Weckx, L. Y., Folegatti, P. M., Aley, P. K., ... & Bijker, E. (2021). Safety and efficacy of the ChAdOx1 nCoV-19 vaccine (AZD1222) against SARS-CoV-2: an interim analysis of four randomised controlled trials in Brazil, South Africa, and the UK. *The Lancet*, 397(10269), 99-111.

[https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(20\)32661-1/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)32661-1/fulltext)

# REF 2021 Impact Case Study

REF 2021 Impact Case Study, London South Bank University, School of Engineering

Based on doctoral research by Dr. Paul Mansell

Source:  
<https://results2021.ref.ac.uk/impact/9367cef7-ab10-4433-b996-99cc976b922a?page=1>

Impact case study (REF3)

REF2021

Institution: London South Bank University		
Unit of Assessment: 12 – Engineering		
Title of case study: Measuring Sustainable Development Goal (SDG) impact for infrastructure projects		
Period when the underpinning research was undertaken: 2018 – 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Professor Simon Philbin	Director of the Nathu Puri Institute for Engineering and Enterprise	August 2018 – present
Period when the claimed impact occurred: January – August 2020		
Is this case study continued from a case study submitted in 2014? N		
<b>1. Summary of the impact</b> (indicative maximum 100 words)		
Achieving the United Nations' Sustainable Development Goals (SDGs) is difficult in many industries since targets have been set at the national level rather than project level. To rectify the problem, this research has created a range of models, processes and analytical tools to measure the impact of infrastructure projects. This allows SDGs to be measured at the project level and across economic, environmental and social requirements. Application of the results from the research study are being actively used by the Environment Agency to manage impact assessment across its GBP5,250,000,000 (£5.2bn) portfolio of infrastructure projects and by the Thames Tideway Project (GBP4,900,000,000 (£4.9Bn)).		
<b>2. Underpinning research</b> (indicative maximum 500 words)		
Achievement of the United Nations' Sustainable Development Goals (SDGs) by the year 2030 is of paramount importance and the construction industry has a major role to play through enabling a measurable impact against the SDG targets. However, linking of infrastructure project success to SDG targets is problematic because the targets were designed to be at the national level and not at the project or programme level [R1]. Furthermore, while the so called 'triple bottom line' (i.e. economy, environment and society) approach to understanding sustainability remains important, there is a need to understand how this can translate to the full project lifecycle as well as a need for improved project governance. This is consistent with the findings of a key UN investigation (UN Roadmap for Localising the SDGs), which calls for localisation of SDGs and the need for cooperative governance to establish shared priorities.		
The research study was led by the Nathu Puri Institute (NPI) for Engineering and Enterprise at LSBU. The empirical research was conducted with collaborative partners and enabled development of a new framework, comprising a range of models, processes and analytical tools for use by government and industry. This approach provides a forward-looking method for the measurement of sustainability and wider impact on infrastructure projects. The framework supports the measurement of United Nations' SDGs at the project level [R1].		
<b>Research description</b>		
The research involved two main stages. The first stage comprised a mixed method that involved a survey of 350 engineers to derive quantitative data [R2] along with interviews with 40 CEOs and corporate Heads of Sustainability to capture qualitative data [R3]. The second stage involved the application of the main findings from the empirical stage to a case study involving the Environment Agency and the Thames Tideway Tunnel. This work was also informed by research that evaluated the scope to measure SDG performance for infrastructure projects at a		

*“Following on from the MISI Project, we will be able to embed the knowledge that was generated by the project to support the measurement of SDG performance across our new portfolio of Environment Agency projects to be launched on 1st April 2021, which will total £5.2billion and include around 15 major projects in excess of £50million”.*

Deputy Director Allocation & National Programme Management, Environment Agency



# Climate change and the impact of global warming



Pedersen Glacier, at Aialik Bay in Alaska's Kenai Mountains, in 1917 (left) and 2005 (right)

Source: <https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level>

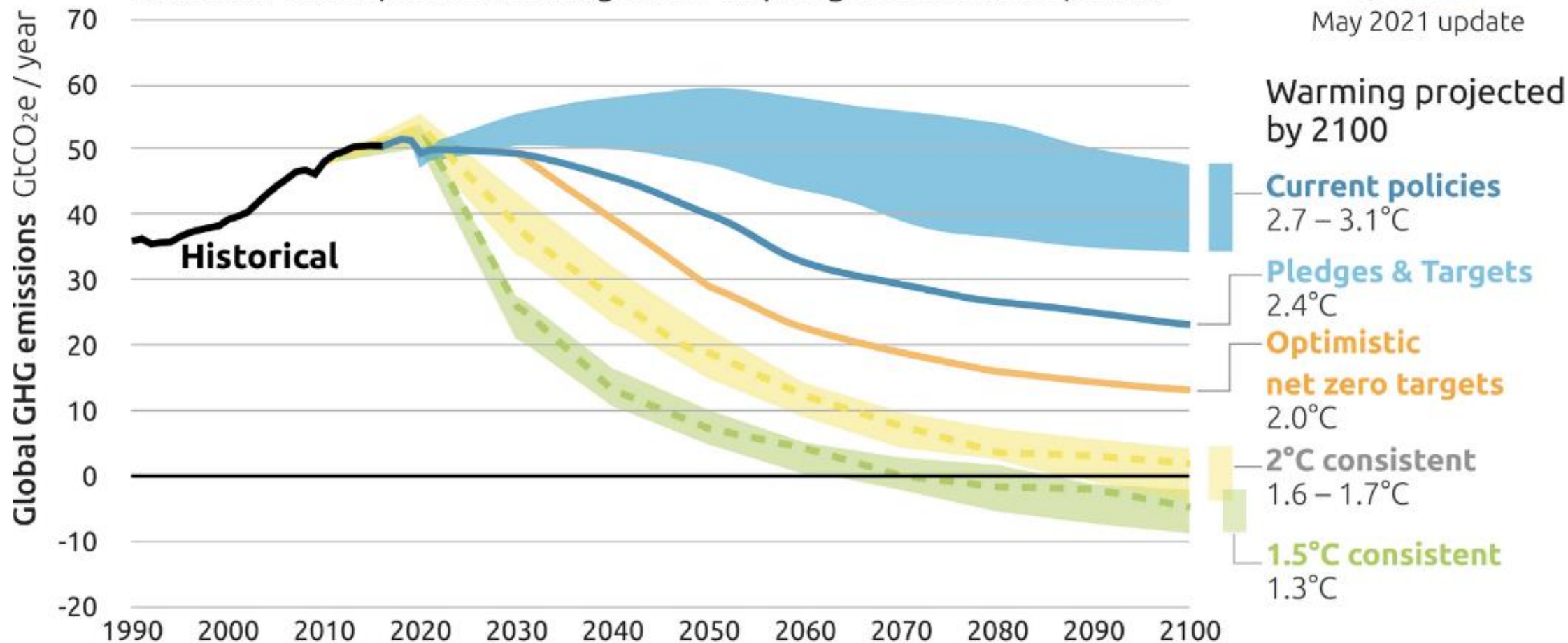
# Global warming projection

## 2100 WARMING PROJECTIONS

Emissions and expected warming based on pledges and current policies



May 2021 update



# Sustainable Development Goals (SDGs)

- The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity
- There are 17 SDGs along with 169 specific targets and 244 indicators

## SUSTAINABLE DEVELOPMENT GOALS



Source: <https://www.undp.org/sustainable-development-goals>

# The circular economy

- The circular economy is a new way of creating value and ultimately prosperity
- It works by extending product lifespan through improved design and servicing, and relocating waste from the end of the supply chain to the beginning—in effect, using resources more efficiently by using them over and over, not only once



**Step 2 – Support learning on research impact and sustainability through formative assessment**

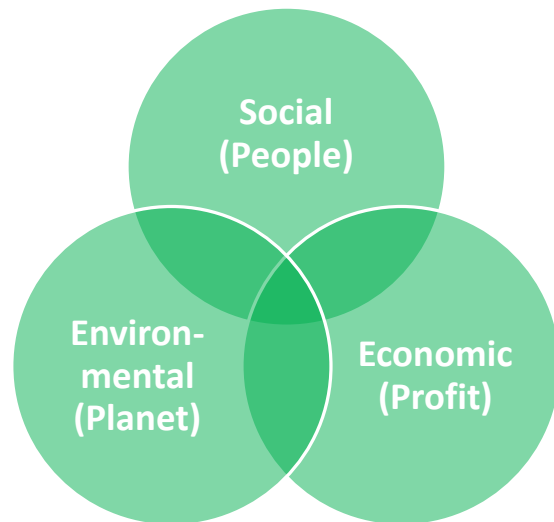
# Short exercise on the triple bottom line (formative assessment)

## Background

- You are the General Manager for a new factory that will be producing automotive machine parts, such as gear trains, chain drives, cam systems, brakes and clutches.
- In order to receive permission for the new factory to be built, there is a need to identify the impact on the local area in terms of economic, environmental and social outcomes?

## Question

- What are the economic, environmental and social measures for the new factory?



# Tutorial exercise on the sustainability of plastics

## Background

- Plastic pollution has become one of the most pressing environmental issues, as the rapidly increasing production of disposable plastic products overwhelms the world's ability to deal with them
- Plastic pollution is most visible in developing Asian and African nations, where waste collection systems are often inefficient or nonexistent. But the developed world, especially in countries with low recycling rates, also has trouble properly collecting discarded plastics
- Production increased exponentially, from 2.3 million tons in 1950 to 448 million tons by 2015. Production is expected to double by 2050
- Every year, about 8 million tons of plastic waste escapes into the oceans from coastal nations



## Questions

- 1) How do plastics currently impact achievement of the SDGs? For at least six of the SDGs, try to identify a possible area of impact.
- 2) Identify a research project designed to address one of the areas, including three research objectives for the research project.

**Step 3 – Integrate research impact and sustainability into the module assessment**



# Overall module assessment (summative): 100% Coursework

## Assignment report:

- Formal report on the feasibility study of the proposed research project
- 70% of the final mark for the module

## Presentation:

- Presentation covering the feasibility study of the proposed research project
- 30% of the final mark for the module

### Learning outcomes across the following areas

- Science and mathematics
- Engineering analysis
- Economic, legal, social, ethical and environmental factors

# Recommended feasibility study report sections

- 1) **Abstract** (brief summary of the proposed research project)
- 2) **Introduction** (background information about the research area)
- 3) **Aim and objectives** (aim and objectives of proposed research project)
- 4) **Literature review** (review of the technical/academic literature)
- 5) **Research problem or question** (clearly identified)
- 6) **Research methodology** (type of research you will be conducting and why)
- 7) **Data collection and analysis** (specific data collection methods and analysis to be adopted)
- 8) **Ethical considerations** (relate to engineering ethics and professional standards)
- 9) **Research impact and sustainability** (identify proposed research impact and any sustainability outcomes)
- 10) **Project management plan** (work breakdown structure and Gantt chart/project schedule)
- 11) **Risk assessment** (identifies risks and mitigation measures)
- 12) **Conclusions** (concluding remarks)
- 13) **References** (references in LSBU Harvard style)
- 14) **Appendix** (any supporting material)

# Specific report guidance and summative assessment

**Task: Identify proposed research impact and any potential sustainability outcomes of the research**

**Description:** *This section should detail how the research project relates to wider research impact and any sustainability outcomes. The envisaged research impact (such as academic knowledge, economic and societal aspects) should be identified, including discussion of how such impact could potentially be achieved. Additionally, where the research has the potential to link to sustainability outcomes should be identified and described according to the sustainable development goals (SDGs).*

**Assessment:** Marks awarded for evaluating the research impact and identifying specific links to the SDGs for the proposed research project



# Final remarks

- Engineering education is based on developing skills and knowledge across the core areas of science and mathematics as well as engineering analysis, design and practice – But students can benefit from gaining a broader perspective on research impact and sustainability
- The concept of sustainability and the SDGs as well as related theory (such as the TBL) can be included in traditional lectures combined with exercises, tutorials and reading tasks to reinforce learning (formative assessment)
- An ability to evaluate the research project and identify links to specific SDGs can be examined in the module assignment (summative assessment)
- Ultimately the goal of sustainability is to improve the quality of our lives, protect the ecosystem and preserve natural resources for future generations – so it is vital that we maintain our educational focus on achieving this goal