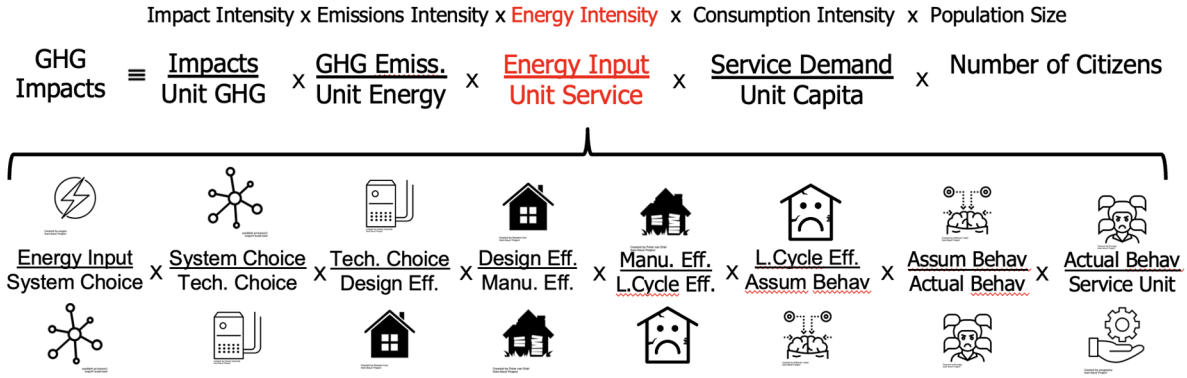
01 Technical experience in the TCP area

01a – Understanding of the sector in the UK and internationally 20%

The Users TCP focuses on how people design and use technologies that turn energy into services including the actions of people within energy systems' supply chains. It is a Technology Collaboration Programme, and as such, the IEA requires it to maintain a focus on the roles of technologies in this process. It sits under the End-Use Working Party, and as such maintains a focus on issues that affect energy end uses. Where it differs from other TCPs is that it looks at energy as a socio-technical system for delivering energy services to end-users. As such it is technology agnostic regarding service provision and so cuts across the technology verticals of many other TCPs.

Scope of the User-Centred Energy Systems (Users) TCP

As Chair of the Users TCP since the reformulation and relaunch from Demand Side Management in 2019 I have developed a range of strategy documents to help define the scope and topics of the TCP to the IEA and other audiences. One approach, based on extending the decomposition analysis of the Kaya Identity, has proved useful in discussions with economists, technologists, and other TCPs. This approach aligns with the techno-economic framework of the IEA and many governments, as well as playing a core role in the IPCC Emissions Scenarios. This framework focuses on the 'Energy Intensity' and 'Consumption Intensity' elements of the Kaya Identity and decomposes these further to demonstrate that within each of these there are many areas where the choices and actions of people determine final energy demand.



The decomposition of the 'Energy Intensity' term illustrates many areas where the choices of people influence energy demand.

System Choice refers to questions of future power systems architecture. This has been addressed internationally by the GridWise Architecture Council formed the US DOE and the IET Future Power Systems Architecture work in the UK. FPSA choices fundamentally shape the purpose and function of markets and the role of actors including end-users in the power system. They involve wide public and industry consultation and are shaped by how technologies are represented, debated, and ultimately socially accepted including distributional social impacts of different system configurations. It in part also determines the extent to which the people allow those technologies to participate in the energy system through the design of incentives and markets shaping provision of energy services including manual and automated demand response - for example time of use, type of use and place of use (nodal) pricing, etc. (PNNL-26098)[i] (ESC 2019)[ii].

Technology Choice refers to decisions made by energy industry professionals and end-users on technologies to deliver specific energy system or end-user services. These are shaped by the technology characteristics, costs, performance standards and regulations regarding their design and use. They are also socially determined by factors such as familiarity, trialability,

existing operator skills, risk perceptions and expert recommendations shaping diffusion and adoption of those technologies in the public and private realm. ([REDACTED] 2018)[iii]

Design Efficiency refers to the technical/theoretical efficiency of systems as modelled/lab tested. It is governed by existing engineering limits, but also by technology path dependence, component price, system value, regulatory requirements, the innovation landscape, R&D funding and tax incentives ([REDACTED] 2016)[iv].

Manufactured Efficiency refers to as manufactured/built performance. This is governed by economic factors, but also regulatory compliance testing, worker skills, misaligned incentives, site conditions, etc – much of which is determined by non-technical factors ([REDACTED] 2021)[v]

Life-cycle efficiency refers to operation and maintenance of assets over their lifecycle. This is mainly determined by non-technical factors such as costs of labour and materials, information on system and product performance, contract structures, financing models, worker skills, etc. ([REDACTED] 2017)[vi]

Assumed Behaviour refers to the mental model designers have of users. This frequently includes assumptions of economic rationality, physical competency, technical knowledge, socially constructed roles and responsibilities, etc and shapes the design of algorithms as well as technology interfaces. This is a critical knowledge gap that effects product usability and frequently encodes implicit biases for and against different social groups (for example in smart-home technologies) (Users TCP 2021)[vii].

Actual Behaviour refers to how users domesticate technologies, rescript them to do what they want (as opposed to what the designer wants), and build them into their daily routines.

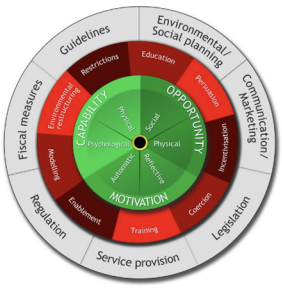
Impact Intensity x Emissions Intensity x Energy Intensity x Consumption Intensity x Population Size

$$\text{GHG Impacts} \equiv \frac{\text{Impacts}}{\text{Unit GHG}} \times \frac{\text{GHG Output}}{\text{Unit Energy}} \times \frac{\text{Energy Input}}{\text{Unit Service}} \times \frac{\text{Service Input}}{\text{Per person}} \times \text{Number of People}$$

- Service choices & service volumes = f{Capabilities, Opportunities, Motivations}
- f{possible, plausible, preferable}

$$\frac{\text{System options}}{\text{Services choices}} \times \frac{\text{Services choices}}{\text{Services volumes}} \times \frac{\text{Services volumes}}{\text{Per person}}$$

- Service demand depends on social and psychological structures
  - **Temporal structures:** Work times; School times; holidays; etc
  - **Physical Infrastructures:** Cycling lanes; heat networks; etc
  - **Social structures:** Social norms; cultural expectations; social practices;
  - **Psychological structures:** Habits and routines; role modelling; etc
  - **Legal structures:** speed limits; property ownership; collaborative economy; etc
  - **Economic structures:** taxes & charges; subsidies; etc
  - **Knowledge and skills:** Information campaigns; skills training; etc



The decomposition of the 'Consumption Intensity' term illustrates wider non-energy sector societal and infrastructural factors shaping end-users' Systems options, Service choices and Service volumes. This framework mirrors other widely used behavioural frameworks such as the COM-B model for behaviour change of peoples' Capabilities, Opportunities and Motivations for shaping behaviours and the role of social structures in determining these ([REDACTED] 2021)[viii]

01b – Developing research tasks and leading working groups 15%

Two research topics for Users TCP Tasks.

Establishing new Tasks is challenging. It requires four countries to participate and requires negotiation and compromise between member countries' interests. Users TCP Tasks should:

1. Address issues where people influence the technologies and energy needed for services.
2. Be technology neutral and pre-competitive.
3. Have the potential for rapid scalability of outcomes and impacts.
4. Have policy and regulatory relevance at the national and international scales.
5. Demonstrably benefit from international collaboration.

Research Topic one: Adoption and domestication of heat-pumps.

Heat-pumps are deeply sociotechnical. From the users' perspective they are very different from gas boilers - with impacts on space, noise, heating profiles and capital costs. Installation can be significantly disruptive - requiring larger radiators and the associated plumbing, painting, and furniture rearrangement – and this is without any of the accompanying insulation and draft-proofing measures often recommended.

The UK has low uptake, but high policy ambitions for heat pump adoption. Studies have repeatedly shown poor user experience, and few studies have been done on how to help households adjust to the changes in heating practices needed. Other countries, particularly those in northern Europe which are well represented in the Users TCP, have far higher penetrations of heat pumps and wider end user experience and acceptance of the technology. The UK could benefit considerably from shared international best practice on user experience design and domestication of heat pumps in different countries.

Research Topic two: The distributional impacts and social acceptance of different electricity pricing models. The BEIS is currently consulting on the review of electricity market arrangements. Ofgem is moving towards half-hourly settlement of domestic customers by 2025 and is currently seeking to understand the distributional impact of different electricity pricing models across sociodemographic segments. While economic analysis has been done on the impacts of different electricity pricing models, little work has been done on the factors influencing public perception and social acceptance of different pricing structures. Varying the ratio of fixed to variable costs, along with introduction of time-of-use, type-of-use, and location-based charging are all under active consideration in the UK. All are seen as important in aligning demand with the cost structure of intermittent renewable generation. Many examples of different electricity pricing structures exist internationally in trials, in regions, or across whole nations. For example, Colombia has socially progressive tariffs with unit price dependent on consumers social strata. This is widely seen as fair, just as the progressive UK tax rates based on income, rather than service use, are seen as fair here. The social framing and communication around the equity of changes in electricity pricing models will be important in their political acceptability in all countries.

Capability to Chair at a level commensurate with the role.

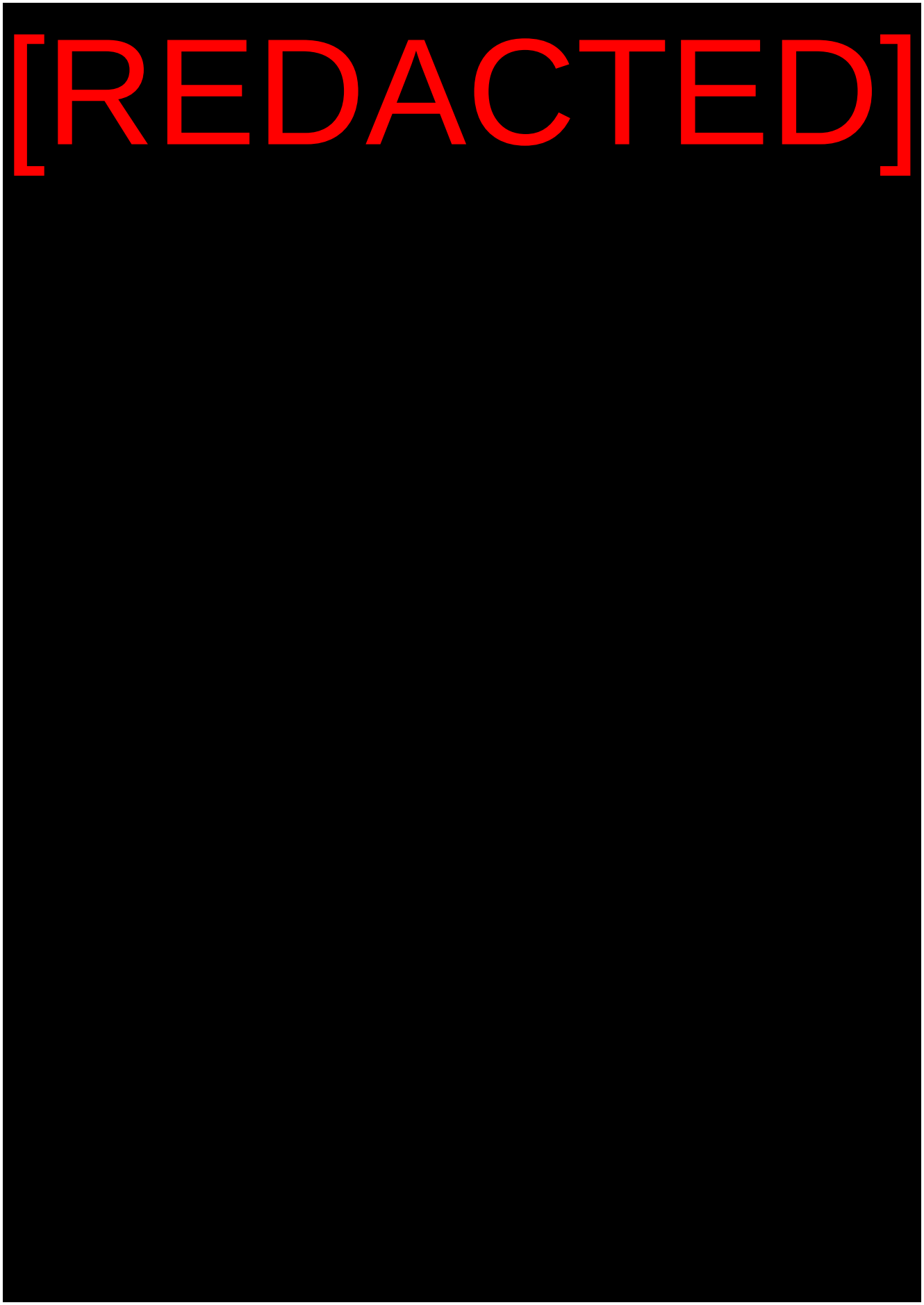
[REDACTED]

[REDACTED]

CURRICULUM VITAE

[REDACTED]

[REDACTED]


[REDACTED]

02 Links with community in the technology area 20%

I have been deeply involved in academic, industry and government work related to the users in the energy system since 2002 [REDACTED] This work exposed me to the importance of markets, market actors, and business models in scaling solutions across the multiple actors in the different sectors of demand.

[REDACTED]

Industry

I have consistently been involved in Industry led projects on the role of users in the energy system. I have done extensive work on joint industry funded research projects, sat on advisory boards, and have been [REDACTED]

[REDACTED]

Academia

Government/Regulators

03 Knowledge transfer plan 10%

The work of the Alternate Delegate can be broadly broken into two categories. Firstly, representation of BEIS and the UK in the work of the TCP – primarily through representation on the ExCo and participation in Tasks. Secondly, knowledge distillation and transfer between interest groups in the UK. A[REDACTED]

The output of TCPs, while valuable, is limited compared to the breadth and depth of outputs from research bodies such as UKRI, the EU Horizon programme, NSF and work funded by other research bodies globally. All parties interested in Users TCP outputs are equally interested in outputs from other bodies on the role of users in the energy system. For this reason, I propose holding a Users TCP Annual Workshop to which are invited 25 to 30 representatives of Government, Industry, NGO and Academic sectors focused around a specific current topic on users in the energy system and run under the Chatham House rule. The group would form the 'core' National Team of the Users TCP, but membership would be fluid and vary by the specific focus topic of each meeting. As preparatory reading for these workshops I will prepare the National Annual Report for the IEA on the state of research, technology deployment, policy support and projects in the UK, as well as the TCP Annual Report for BEIS summarising activities of the TCP. Both these reports would be presented as working papers to the Users TCP Annual workshop and any feedback from participants, along with key insights from the annual workshops incorporated into them before final submission of the reports to the IEA and BEIS.

In addition to this annual workshop, a Users TCP LinkedIn group will be established through which a larger group of interested parties can be developed and maintained. This will build on my existing LinkedIn profile and will be used to maintain communication with a large memberships base. This would include all those participating in Users TCP Tasks, as well as others academia, industry, government and the NGO community in the UK and beyond with an interest in the role of users in the energy system. This will be used to manage and develop a broader National Team of interested experts from which to draw expertise into new Tasks and to which findings can be disseminated.

Knowledge transfer from the TCP to BEIS through the BEIS delegate will done through meetings in addition to participating in the annual workshop and the Users TCP LinkedIn account. Meetings will be held after circulation of the ExCo pre-meeting documentation and prior to each ExCo meeting. This will allow the Primary and Alternate delegate to agree on UK positions on matters before the ExCo. In addition, meetings will be held between each ExCo on issues of broader interest to BEIS around the role of users in the energy system and on specific work my team and I are doing with government and industry on this topic outside the scope of this contract. Informal contact with the BEIS Primary Delegate and others in BEIS or Ofgem is always welcome.

04 Service delivery 20%

Plan for fitting the role with existing responsibilities

The role of Alternate Delegate to the Users TCP is closely aligned with my research and roles at UCL. [REDACTED] The UCL Energy Institute is research led, impact focused, and is looking to grow its international profile beyond the UK and the EU. This aligns well with actively participating in the IEA TCPs.

Planned communication style with the BEIS delegate

Effective communication around TCP matters, particularly those i[REDACTED] In addition to the structured communication outlined in the Knowledge Transfer plan above, maintaining informal email and phone communication with the BEIS Primary Delegate will be important.

Plan for participating in IEA TCP annexes and working groups.

[REDACTED]

Plan for delivering the suggested tasks

General tasks

Attendance to ExCo Meetings (4 days a year). [REDACTED] [REDACTED]

Gathering information for an annual report (2 days per year). This is a new activity. [REDACTED] In producing the UK annual report, I would draw the framing from key documents like the 'UK Research and Development Roadmap', the 'International Research and Innovation Strategy', alongside key BEIS and Ofgem strategy documents. The report would be populated with information from landscape and review documents from UKRI, ESC, major industry bodies like Energy UK, NGOs like Citizens Advice and professional bodies like the IET, as well as the major Academic consortia like CREDS and UKERC.

TCP administration, meeting minutes, invoicing (1 day per year). Time would be allocated to this as scheduled in discussion with the Primary Delegate and BEIS requirements.

Coordinating a National Team and relevant adhoc meetings (3 days per year). Coordination of the National Team is covered under Knowledge Transfer Plan above. At UK AD ExCo

member level, the Users TCP has historically had few adhoc meetings. These have been on-line and easy to accommodate. This may increase in the lead-up to the next RfE to IEA.

Producing a report of TCP activities for BEIS (1 day per year). This is a new activity. [REDACTED] This will need to be augmented with additional material on UK participation in each of the Tasks, and a section reflecting on the continued alignment of the Tasks outputs with broader UK activity and BEIS interests.

Additional tasks (13 days)

Chairing TCP (liaising with secretariat, developing strategy, representing the TCP at external meetings) (4 days per year). I estimate that Charing the Users TCP well takes at least 20 days per year. As Chair there are many papers to prepare as well as meetings to attend to properly represent the Users TCP and ensure alignment with the ongoing TCP Modernisation Programme of the IEA. **Operational issues** include Executive Steering Committee meetings (1.5 hours per fortnight with ~1 hour of actions following each meeting including general email correspondence (~7 days/annum); preparation of Users TCP Strategy papers (~3 days/annum for the next RfE from IEA); requests to write papers for the IEA (~3 days for the recent IEA/BCG report). **Total around 13 days per annum**.
Representational issues include attending the following meetings: All TCP meetings (1 day, annual, in person, Paris); The IEA Annual Global Conference on Energy Efficiency (2 days, annual, in person, Europe); Buildings Coordination Group meetings (1 day, annual, in person, Paris), IESCG meetings (0.5 days, biennial, online), Adhoc cross TCP meetings of IEA programmes (2 days/ annum); major planning meetings such as the Future Buildings Forum (quinquennial in person – 4 days – Canada in Oct 2022), EUWP meetings (2 days, annual, in person, Paris); representing Users TCP at other TCP ExCo meetings (~1 days/annum), EGRD meetings (1 day, biannual). **Total around 11 days per annum**

Developing a Programme of Work for new research project (5 days per year). [REDACTED]

Plan for fitting the tasks with my working pattern

[REDACTED]

Example high level timetable showing periods of unavailability.

I have a large degree of personal autonomy in the allocation of my time. [REDACTED]

[i] Pacific Northwest National Laboratory (2016), Comparative Architecture Analysis: Using Laminar Structure to Unify Multiple Grid Architectures, PNNL-26098, https://gridarchitecture.pnnl.gov/media/advanced/Comparative%20Architecture%20Analysis-Final.pdf

[ii] Energy Systems Catapult (2019), 'Fast Track to Britain's Future Power Systems', Future Power Systems Architecture Phase 3 report, Institution of Engineering and Technology, https://www.theiet.org/media/9408/fast-track-to-britains-future-power-system.pdf

[REDACTED]

evaluation: Development of the Upper Level of the Behaviour Change Intervention Ontology', Wellcome Open Research, 5,123. https://wellcomeopenresearch.org/articles/5-123/v2