Notes from the Edinburgh Heat Summit - 15 September 2016

CXC and UKERC co-hosted a Heat Summit in Edinburgh on 15 September, bringing together invited participants from research, policy and practice. This note provides a record of the discussion at the Summit, and signals areas where participants agreed on the need for further research-policy-practice engagement on low carbon heat.

Ideas for further work & opportunities for collaboration

During discussion, the following areas for future collaboration and further engagement emerged. Participants (or a sub-group) could:

- Take forward action around demonstrators. We need to gather as much data as possible so we can demonstrate, measure and evaluate interventions in real time and retrospectively. Robust analysis and data sharing are key. For example, information should be shared on the SEEP evaluation, forthcoming Catapult work large ASHP demonstrator in Glasgow, which will provide data on performance. We need also to test consumers' perceptions and appetite for change and test-beds for operators/suppliers to improve their services. There are opportunities from smart meter data but other data are needed too e.g. environmental conditions or achieved thermal comfort.

- Provide well-evidenced expert opinion. This is needed to counter lobbying from proponents of particular pathways. Evidence is needed to respond to maximalist scenarios that promote single solutions, and to better understand what rates of change are consistent with high-level energy policy goals

- Work together to fill knowledge gaps. We have a lot of information on heat pumps and district heating (DH) but very little evidence on hydrogen and gas repurposing (e.g. that pins down the cost of disruption). Other gaps are around financing, how we drive improvement in technologies' performance and in installation / retrofit skills, and how we make better use of actual rather than modelled performance data.

- Support better understanding of the economic and social co-benefits of low carbon heat transitions, as well as of the wider winners and losers (e.g. how can we do something fiscally neutral whilst tackling the 'able-to-pay' sector?)

- Help address current gaps in modelling capability, including through provision of empirical data and questioning of assumptions and optimism bias.

Record of the Discussion

1. Scottish Policy Context

The forthcoming Climate Change Plan will define infrastructure priorities (with assurance of direction of travel to provide investment certainty). Heat will be at the heart of the new Energy Strategy as part of a whole systems view and a growing emphasis on local energy solutions. The long-term infrastructure commitment signalled by Scotland's energy efficiency programme (SEEP) is key for attracting significant private sector financing. SEEP is a single programme response for all sectors across energy efficiency and heat. It will be delivered via: a publicly funded programme; tighter regulation and building standards; and, financial support mechanisms. One policy option is local Heat Planning, building on more spatially explicit modelling. The multi-year funding signalled by SEEP is critical here.

The Scottish TIMES whole systems model supports a structured conversation about the challenges, complex trade offs, key sensitivities, and potential game changers in the low carbon transition. Assumptions are being constantly revised and improved – feeding in information and knowledge from academia is very important. Academic input is also needed to help link the whole energy system model to macro-economic models

Instead of thinking about technology mix, we should think about the carbon trajectory from TIMES, then consider the mix that could deliver it – i.e start with the scenarios and then get to the specifics, and be flexible about the fact that the plan may change as we learn more. But there are risks associated with 'keeping all options open' – some things are mutually exclusive and we do need to make decisions, picking the appropriate things in appropriate places. We need to determine the appropriate balance between incentivising heat pumps and supporting development of collective heat supply.

Hydrogen should not just be thought of in terms of heat – it may play roles at a systems level across transport and electricity for example. Does understanding issues like this require deeper knowledge than is currently accessible to policy makers? We need a porous boundary between officials and academia.

2. Wider policy challenges

We need Government clarity on objectives, and a strategic approach. Scotland is leading the way on heat and energy efficiency policy whilst the UK as whole has stalled since 2012. The UK Committee on Climate Change (CCC) has collected evidence on: heat pumps; hydrogen; regulatory and governance challenges for the gas grid; critical paths for heat network roll-out; and, a suite of 'what works' policy reviews (heat, energy efficiency (EE) policy, and domestic EE). The CCC is due to propose a policy package, with decision points and priorities.

Key decisions must be taken in the mid-2020s to put in place the governance framework needed: pre-2030, we need a whole-building EE retrofit approach, a framework for decarbonised heat supply, and a cross-sectoral appraisal of the interdependencies and trade offs between buildings and infrastructure. There are in fact limited options given the incumbent system, particularly for existing on-gas homes: biogas potential is limited, for example (to 10% of demand?).

Further research is needed to understand the barriers (including the social). In the meantime, no- and low-regrets options must be rolled out where they are appropriate (energy efficiency, heat networks, off-gas heat pumps) and new path dependencies must be avoided, e.g. to avoid technology lock-in or new builds needing retrofit in ten years.

The step-change in UK policy we need requires a cross-sector, inclusive governance process and strategic piloting to stimulate the supply chain and policy learning. The UK government could use a White Paper to set the necessary strategic focus and get buy-in from Whitehall departments and devolved administrations. An action plan is needed that:
(i) has a highly visible narrative to convey the scale of the opportunity and the government's commitment, which addresses 'what organisations and people want' and gets away from a technology, supply-side focus;
(ii) uses regulation and standards alongside incentives, focussing on ends not means - efficiency of networks, performance of buildings e.g. CO_2g per m^2 - and avoiding competing incentives[1];
(iii) measures actual performance of improvements and does not simply model them;
(iv) includes a major training programme to professionalise the construction and heating trades[2]; and,
(v) creates a heat regulatory authority, with powers devolved as far as possible.

[1] Regulation is not necessarily a burden on business; it can be used as a judicious instrument to create cross-sector momentum and signal market opportunities.
[2] The Sweden option (Heat Pump Court) - installers are trained by suppliers and suppliers suffer reputational damage if they don't perform.

3. Managing heat system decarbonisation

Winter heat demand is 6 times the winter electricity peak. We need to lower consumption both through EE, and operational efficiency e.g. district heating, then decarbonise heat generation – infrastructure is at the heart of both. But there are limitations to, and competition for, those low/zero carbon sources. Different reports are producing different scenarios on mixes, but all are based on network solutions. And that means digging up roads (we could be talking about tackling 20,000 properties a week for 20 years UK-wide).

Each solution has a role to play and there's no single silver bullet. The choice is not just economic – there are significant non-cost considerations, particularly traffic disruption and customer acceptance. Governance is therefore key: this needs to be seen as a major infrastructure programme and planning must start early. But there is currently no single body or even local network of bodies, or regulator. Gas, electricity and in the future potentially heat are different regulated entities. We need a national and/or regional plan to offer clear solutions for each area, then local authorities need to be empowered to be agents of change with capacity, ownership structures for ESCOs and zoning powers. We need strong city- and local authority-level involvement, coordination of knowledge and skills, and multiple pilots and demonstrators. Our knowledge of the costs of putting in the infrastructure is good, but there are other costs that are not robust. E.g. on hydrogen, cost uncertainty is around the actual supply of the gas; on heat networks, there is uncertainty about the availability and cost of low carbon supply options at sufficient scale.

On the 'Hydrogen v. Heat Pumps' debate, we need to be able to roll out **both** options. Some say hydrogen is the best option, but it requires CCS. We need to improve EE before there can be mass take up of heat pumps. And subsidy may be required to get past well-off early adopters. Heat pumps may be the only long-term technology currently on the table; and we need to be wary of CCS locking in fossil fuels. Heat pumps are also not just a 'per building' option, e.g. they can be used with surface and mine waters to create renewable heat for heat networks. There's a role for lower temperature heating systems with on-gas-grid homes, which makes sense for hydrogen eventually too. The Leeds City Gate (hydrogen) study focused on one solution and then asked: 'is it low cost and is it low carbon?' in order to explore financial and engineering feasibility. From a financing point of view we need to think about alternative future uses of infrastructure. Hydrogen is a potential enabler for transport emissions savings and wider innovation opportunities. We need a new strategy for CCS and hydrogen needs to be part of that.

The TIMES model is currently unable to account for the wider economic impact of disruption of infrastructure development.

4. 'What works' – heat pumps and district heating

The UKERC TPA team has done an international review and considered policy drivers, external context, policy design and types of subsidy. They found that early enthusiasm, collapse and resurgence is a common pattern. Resurgence seems to be stimulated by certification schemes, information, standards and hence trust. The Denmark example shows that subsidy removal and market uncertainty caused uptake of heat pumps to collapse. There's a Scandinavian story about taxes on fossil fuels and technology neutrality (also tax deductions for installation), plus regulations to mandate a market in particular geographical locations (e.g Denmark: mandatory connection to heat networks, which helps make the economics of the DH infrastructure work for the system as a whole).

Important issues are: agency, and what powers are available to local government through planning and zoning; availability of finance; up-front capital costs; allocation of costs; low consumer confidence and awareness; consumer satisfaction with the current system; taxation of (fossil fuel) incumbents and subsidies for replacement. How feasible are these latter two in the UK?

Several countries have gone quite far with heat pumps including Finland where contextual factors may be important (large, dispersed and detached properties, off gas and very good EE plus cheap electricity?). This suggests there's a fleet of properties for which a fleet of heat pumps is a potential solution. But we need to

consider locality and type of housing - e.g. if housing is really energy efficient then it's not worth the embedded carbon in heat pumps as heat use is already so low – as well as the existing electricity supply.

5. Consumer perspectives

90% of people don't want to replace their gas boilers; low carbon (LC) heating is more expensive and less attractive. We need to improve LC heat experiences, improve and simplify installation experiences and enhance control. People use heat to get clean and be comfortable in very varied ways. Lots of people have draughts and dampness issues. People are using heat to remedy/improve health outcomes. Half of homes use heat to care for other people. People use heat to protect their property – to stop pipes freezing, to deal with damp. 30% replace their boiler if it breaks and an additional 30% if they think its about to break. Many LC solutions need you to prepare the building before installation but people aren't necessarily going to wait for this; they need a LC solution fast. The ideal time is during renovations but most renovations are to improve the property and not to lower running costs. Boilers allow you to rapidly heat up a room. LC heating systems need to provide this level of control too. About half of people top up with local radiant heating. There is a great variety of things people want - fast reaction might be important; 'cosiness' or ambiance might matter more. These are important things that the LC heating sector needs to exploit. The focus needs to be on making LC alternatives better than incumbents as a heat service.

Research shows 1/3 of people are interested in their bill (these are the switchers); 1/3 are interested in comfort only; the final 1/3 have just never thought about their bill, or are hardly at home or live in a very small property. The vast majority of people aren't interested in LC heat and certainly not enough to invest.

6. Gas network futures

The sustainable Gas Institute has ongoing work on gas network infrastructure futures. The current replacement of old iron pipes with plastic ones will have implications for what can be done with them in future. Future options include: stranding and dismantling (with cost implications, particularly having just upgraded); supply biogas; provide gas to support electricity – e.g. hybrid heat pump systems; and gas network repurposing.

7. Electricity system implications

Building from a series of assumptions about heat demand in Scotland, Delta-EE has worked up a scenario for what the winter peak might look like through to 2050. The current winter electricity peak is approx. 6GW. The scenario shows slow, steady increase in domestic heat pump deployment, modest growth of CHP in non-domestic buildings and slow, steady growth to mid 2040s for CHP in industry. By 2050 the winter peak for electricity might be about 10GW with implications for grid reinforcement, especially from 2035.

Further work may be needed on distribution and LV network upgrade costs, where there are also fewest smoothing opportunities and some bottle-necks. Also, heat pumps can introduce flickering that has impacts even before any thermal load impact. And there are non-network costs from the roads you need to dig up to get to the non-overhead cables.

8. Building performance

Built environment EE has been improving but research consistently shows: higher than anticipated energy consumption in buildings (e.g. compared to EPCs); poorer performance of technologies; and, poorer quality of internal comfort. The underpinning SAP model is flawed and there is not enough validation against real building types. There is a lack of data on how EE interventions and LC technologies work in practice once installed. Performance is not just about energy but also things like air quality - i.e. meeting the needs of occupants. This may cause wrong investment decisions at building scale and potentially at policy level: if you're measuring performance incorrectly then decisions on measures will be wrong/poor.

We need to improve: tools for predictions of performance; assumptions in models - are they up to date and validated against 'real' buildings; the knowledge and skills of modellers; construction skills (a step change is

required in skills and processes - e.g. offsite construction - with more stringent standards and quality control); and, post occupancy modelling (we need to get data flowing back from buildings through widespread monitoring of buildings).

9. Commercial sector

Commercial buildings' performance has been stagnant. We design to comply but not for performance. We need instead to focus on the non-carbon benefits to businesses and developers. The NABERS scheme in Australia is an interesting example. It started as a voluntary benchmarking star-rating scheme and ramped up over time. Government used policy to help push it including disclosure of ratings, procurement standards for the public estate and standards to remove the worst performers once the scheme had proven itself (and then this was done only once). Government's assessment of the scheme's benefits includes clear uplifts in asset value and a 50% performance improvement in new offices since 2000. The scheme got industry buy-in early on and celebrated early wins.