Modelling social and political factors in energy transitions

Early findings from the O-STET project (Operationalising Socio-Technical Energy Transitions)

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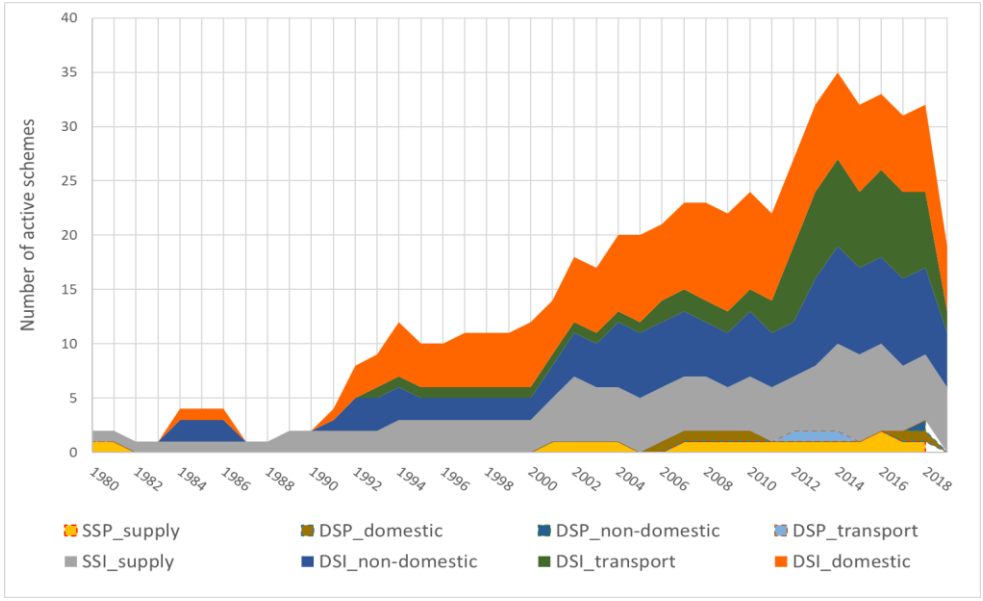
UK emissions targets, policies, 1980 to 2019

- Increasing climate change mitigation targets over last 3 decades
  - UNFCCC ratification (1994)
  - Kyoto protocol (2008-2012)
  - Climate change programme (2000)
  - Climate Change Act (80% by 2050) (2008)
  - Net zero target by 2050 (2019)



Active schemes per year

(Potential = early TRLs, before commercialisation

Implementation = mid TRLs, close or past parity, e.g. incentives)

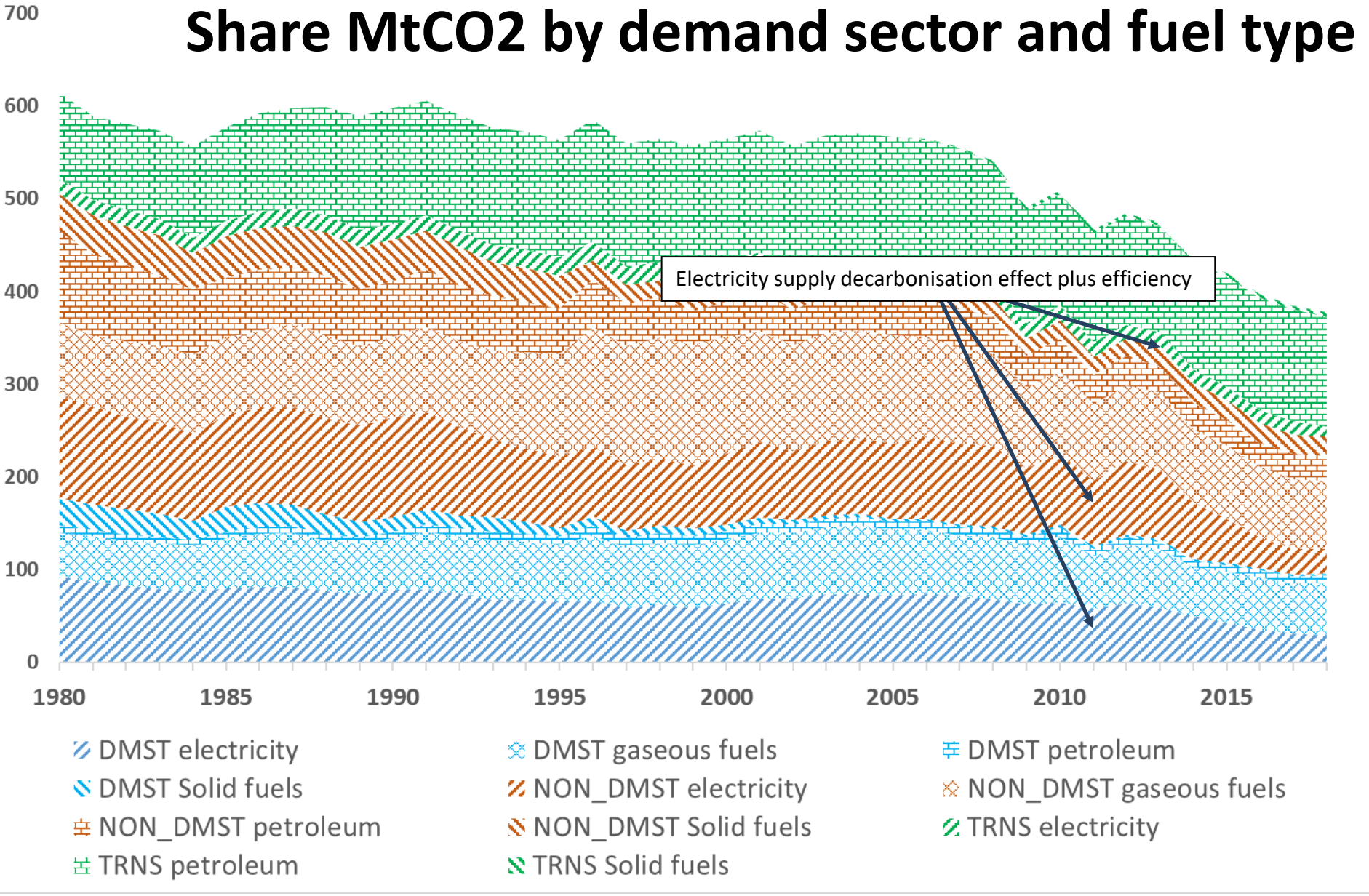
SSP = supply side potential

SSI = supply side implementation

DSP = demand side potential

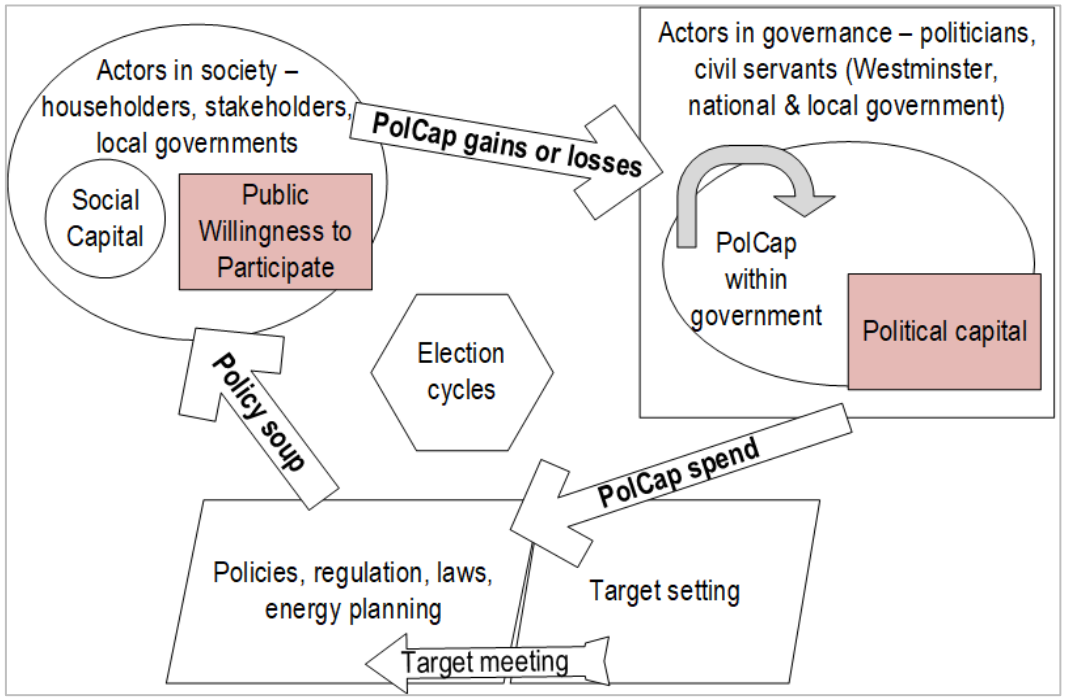
DSI = demand side implementation

Share MtCO2 by demand sector and fuel type



Political capital and societal responses

- Government can't act (except in its own estate) to bring about energy transition; it can govern those in society who do act (households, energy industry, public sector, private sector
- Political capital (PolCap) can be spent on leadership in energy transition
- Social capital ("ability to act") plus an "imperative to act" creates "public willingness to participate" (PWP)



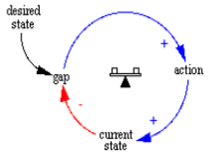
Imperative to make changes on demand side

- Imperative to act can arise through regulation/taxes/market restructuring, a desire to take voluntary actions, other non-energy factors (e.g. economy)
- Despite long-term targets and much discussion in the public sphere, little evidence of *voluntary* changes in energy services consumption
- Government unwilling (so far) to interfere in people's lifestyles and businesses *purely* to reduce emissions
- PWP to make changes solely for energy transition is highly uncertain

Reductions in energy/cap on 1980 (historical decomposition)			
	Net Behavioural	Energy efficiency	Net savings
Domestic	-204	291	12%
Surface transport	-191	76	-21%
Air transport	-295	184	-119%

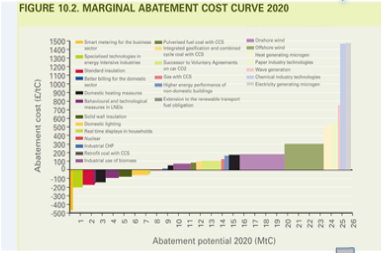
TEMPEST (Technological EconoMic Political Energy Systems Transition)

National:
Target setting and tracking



Balancing loop improves government targets to respond to climate science, reaching a maximum target (NZ)

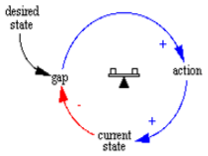
Planners:
Policy making and planning



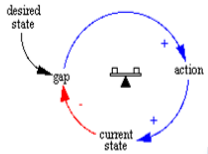
Imperfect choice engine forecasts the potential for mitigation measures and monitors policy outcomes, adjusting policies to meet targets

Balancing loop runs until mitigation actions in society meet planners' goals

Industry, households:
Measure development and implementation

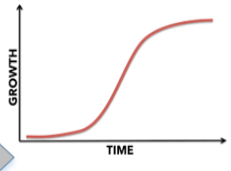


Measure development adds new mitigation potential until no more is required



Potential feeds implementation

Measure implementation of potential leads to emissions reductions across sectors

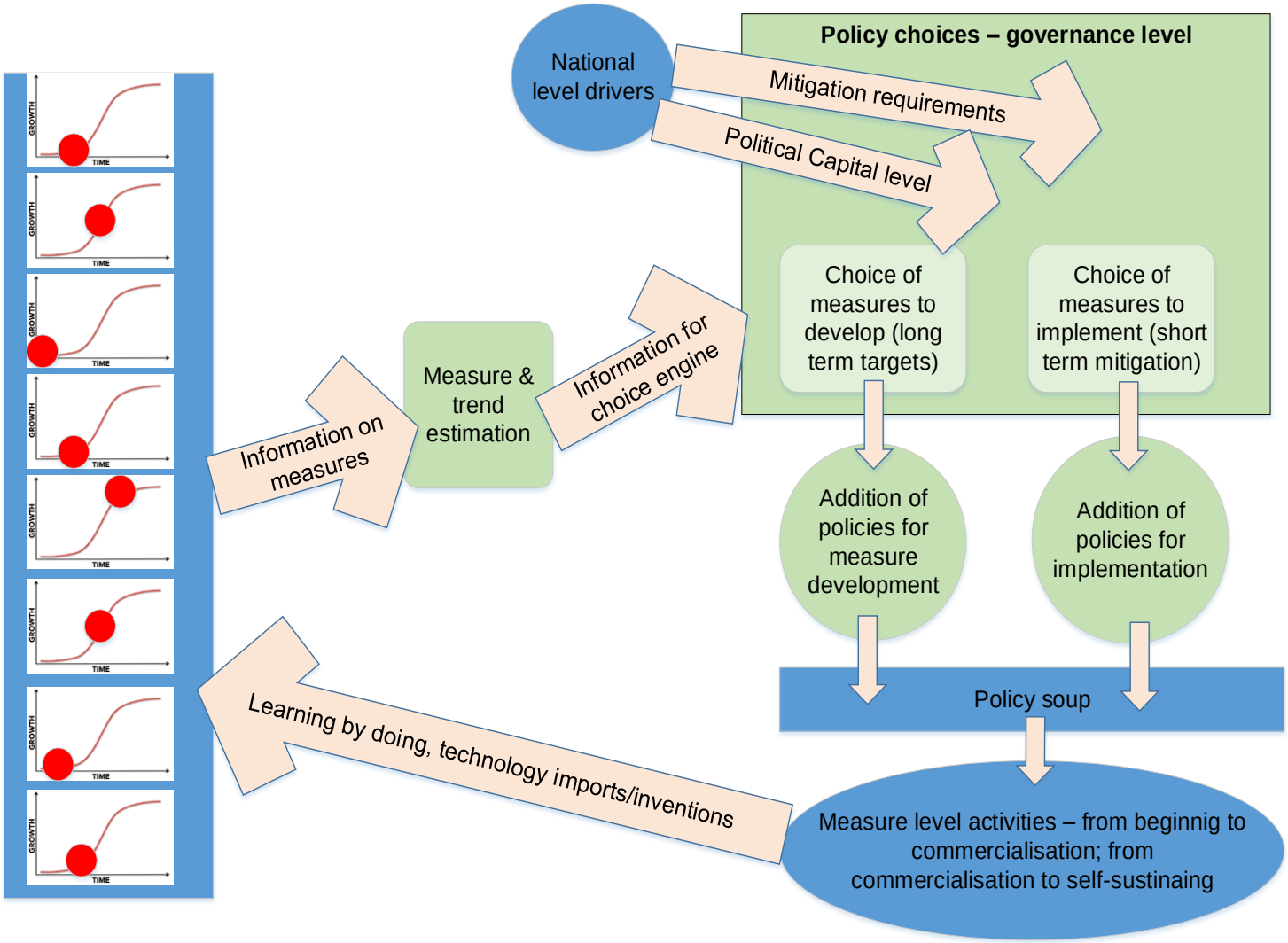


Responses from society can increase or decrease policial capital, based on targets, measures, and policies

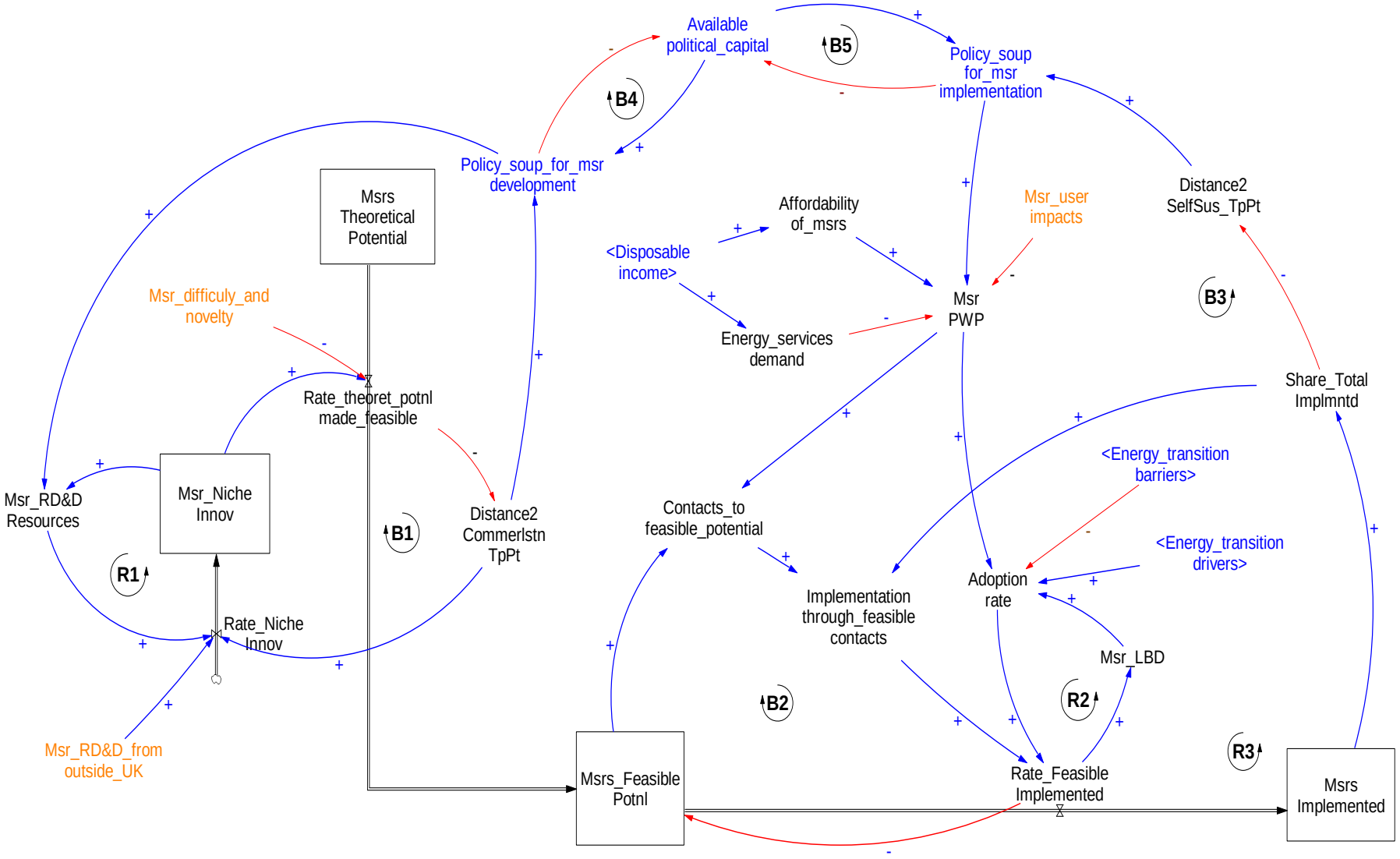
Quantifying factors not previously measured

- Political capital, public willingness to participate, novelty and difficulty of measures, user impacts, not usually quantified
- New ordinal measurement scales set minimum and maximum values as events or trends identified in the historical review as being the most extreme (e.g. the worst or best, the largest or smallest)
- Similar to the Celsius scale based on water: 0°C (freezing) and 100°C (boiling), with units as equal divisions of distance between the extremes
  - Example low PolCap: energy efficiency policies cutbacks in 1987, with interventions constrained to those that didn't interfere with the market
  - Example high PolCap: support for building a nuclear power industry, with over Bln£16 government support (1980 to 2005)
  - Example low PWP: political backlash against the full rate of VAT being added to domestic energy bills, change abandoned
  - Example high PWP: FIT scheme had high participation, had to close early due to lack of funds

Imperfect choice engine



Measure diffusion – S curve model and influences



Conclusions

- A variety of factors exist to create policy for energy systems: industrial competitiveness, energy poverty, energy security, climate change mitigation…
- Political changes affect energy systems as well as technological changes
- The theory and model structure are experimental, intended to be complimentary to techno-economic models and optimisation approaches
- Utilises decades of UK data on energy, emissions, energy services demand, energy policy instruments that have influenced the energy system
- Identifies patterns in how energy systems change, or not, in response to policies, and the role of political and social factors in energy system transition
- Energy and emissions data are combined with previously non-quantified factors, posing new problems for modelling
- Hoped for outcome is the identification of the importance of these factors along the road to net zero emissions, as mitigation cuts deepen
- Model is in development, results later in 2020