Transition to Low-Carbon Heat Workshop

18 July 2017

Project timetable

Today	Workshop: test analysis
September	High-level roundtables on key issues
October	Review of draft report
	Launch event

Overview of project

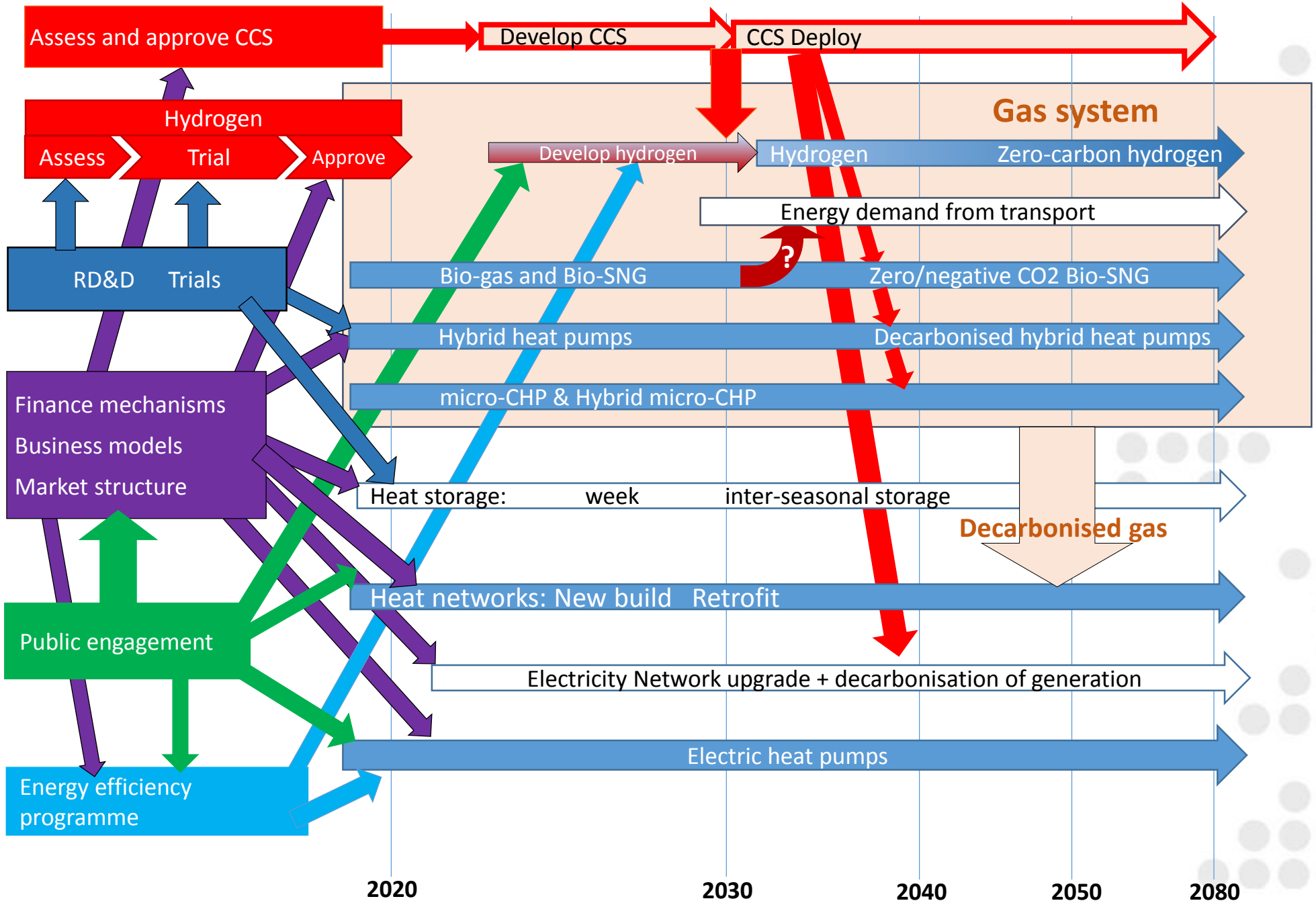
- Insight into governance and timeframes of trajectory to 2050 and beyond (with assumption that there will be a need for a zero-carbon economy by at least 2080)
  - decarbonising domestic and commercial heat and hot water.

- Investigating how top-down and bottom-up aspects join up
  - Implementation: retrofit, supply chain, logistics for customers and utilities, and user acceptance.
  - Systems Implications: including infrastructure and network requirements, and primary energy demand.

Decarbonisation options

- Demand reduction
    - Insulation and energy efficiency
    - Behaviour change

- Low-carbon energy supply
    - Decarbonise gas supply: hydrogen, bio & synthetic methane
    - Decarbonised Heat Networks
    - Electrify: heat pumps, hybrids, micro-CHP, storage heaters
    - Niche technologies: e.g. biomass & solar thermal



Timelines and interdependencies for deploying options indicate that the next few years will have a significant impact on deployment potential.

Several generic issues will need to be addressed to enable the options.

How to decarbonise various options post 2040 is likely to require consideration in the next few years.

(Note – several important interactions and dependencies between options have been removed for simplicity.)

Context

'Meeting the overall 2050 target will be expensive, if not impossible, without a near complete decarbonisation of heat'

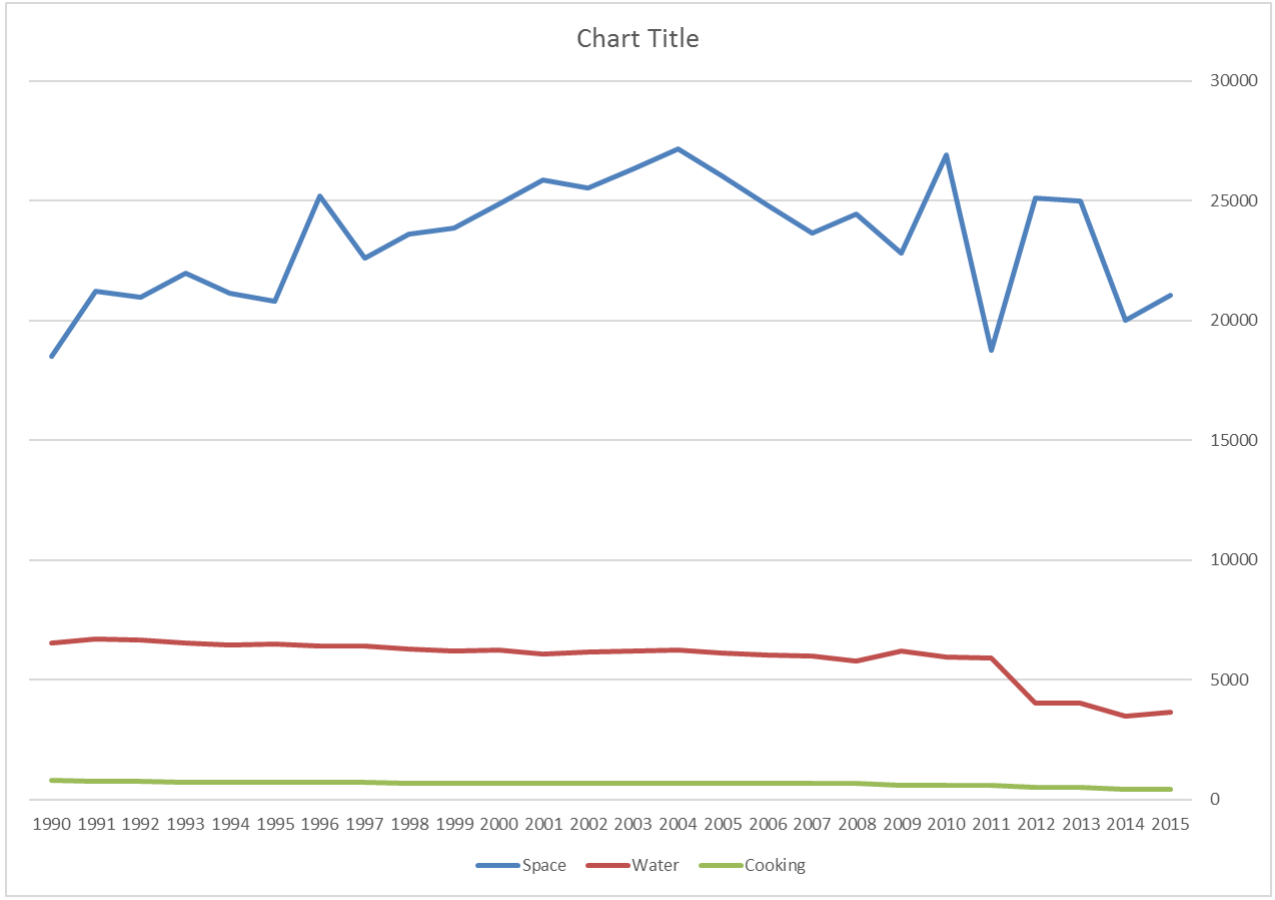
Committee on Climate Change 2015

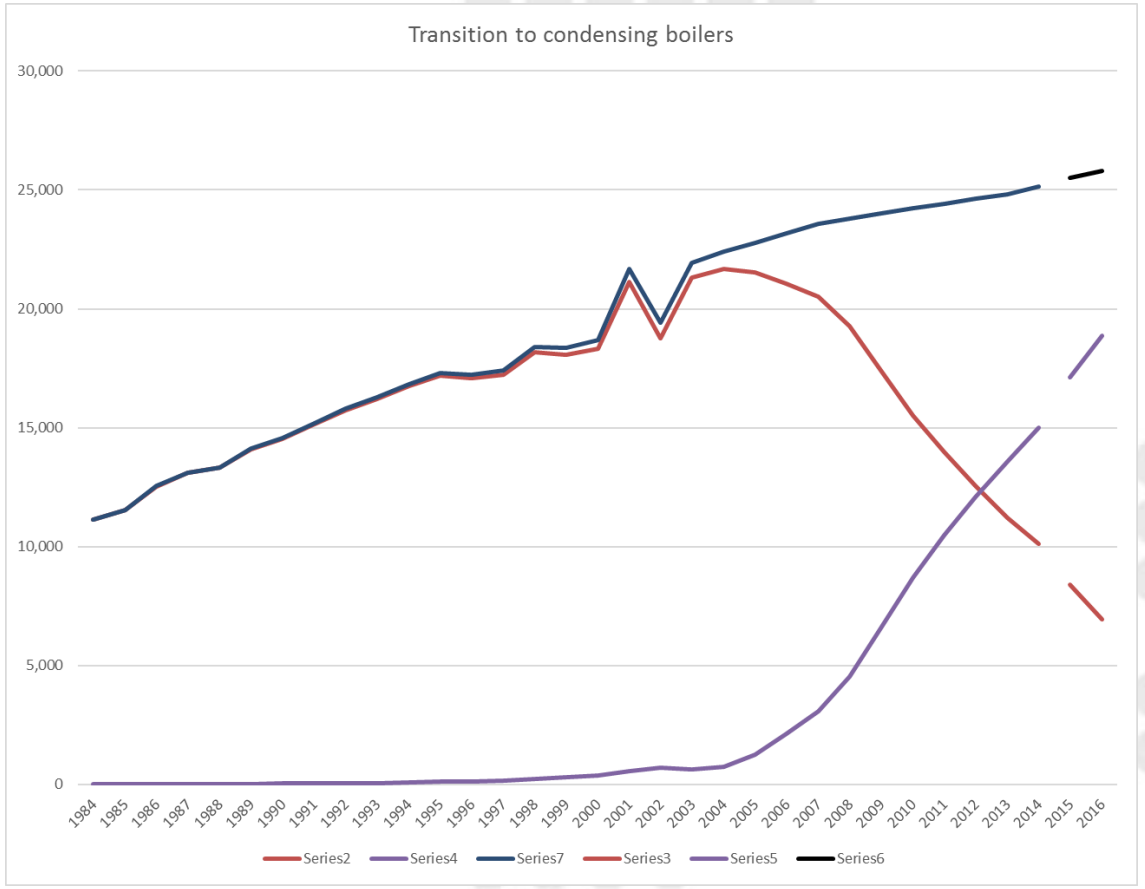
Scale of challenge

- 16,000 homes & 1,000 Commercial bldgs / week for 30 years – some options may be restricted to summer only?
    - currently 5,000 boilers fitted every day – this equates roughly to changing the whole stock 1.5 times between 2018 and 2050
    - will new build properties need to be revisited?
    - degree of intervention will be vary by option

Context

Direction of travel: domestic gas - decline due to efficiency. Notable is the decline in energy use for hot water. There are still about 8 million boilers that are not condensing. About 75% of condensing boilers are combination, whereas for non-condensing it was about 35%: means a loss of water tanks.





Context: Energy system interaction

Transport

- HGV energy demand ~ 100 TWh
- Gas connections for transport – interaction with networks?
- Electric Vehicle charging infrastructure – how will distribution system respond?

Industry

- Will demand from industry lead different options?

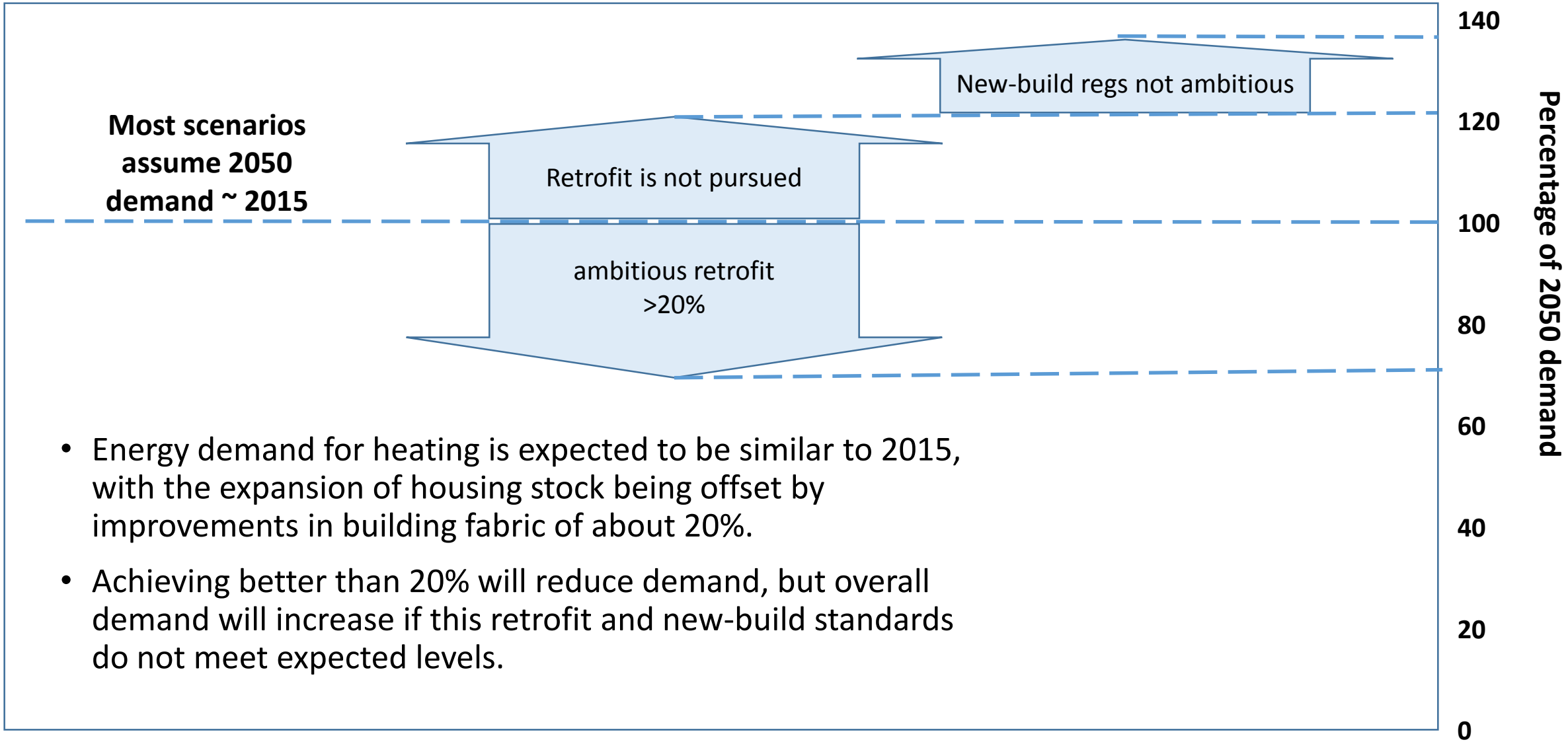
Context: the customer

- How deal with customer investment if a better option emerges, e.g. undertake an expensive conversion to install a heat pump and then a heat network or hydrogen is deployed in the street.

- Cost to customer of each option

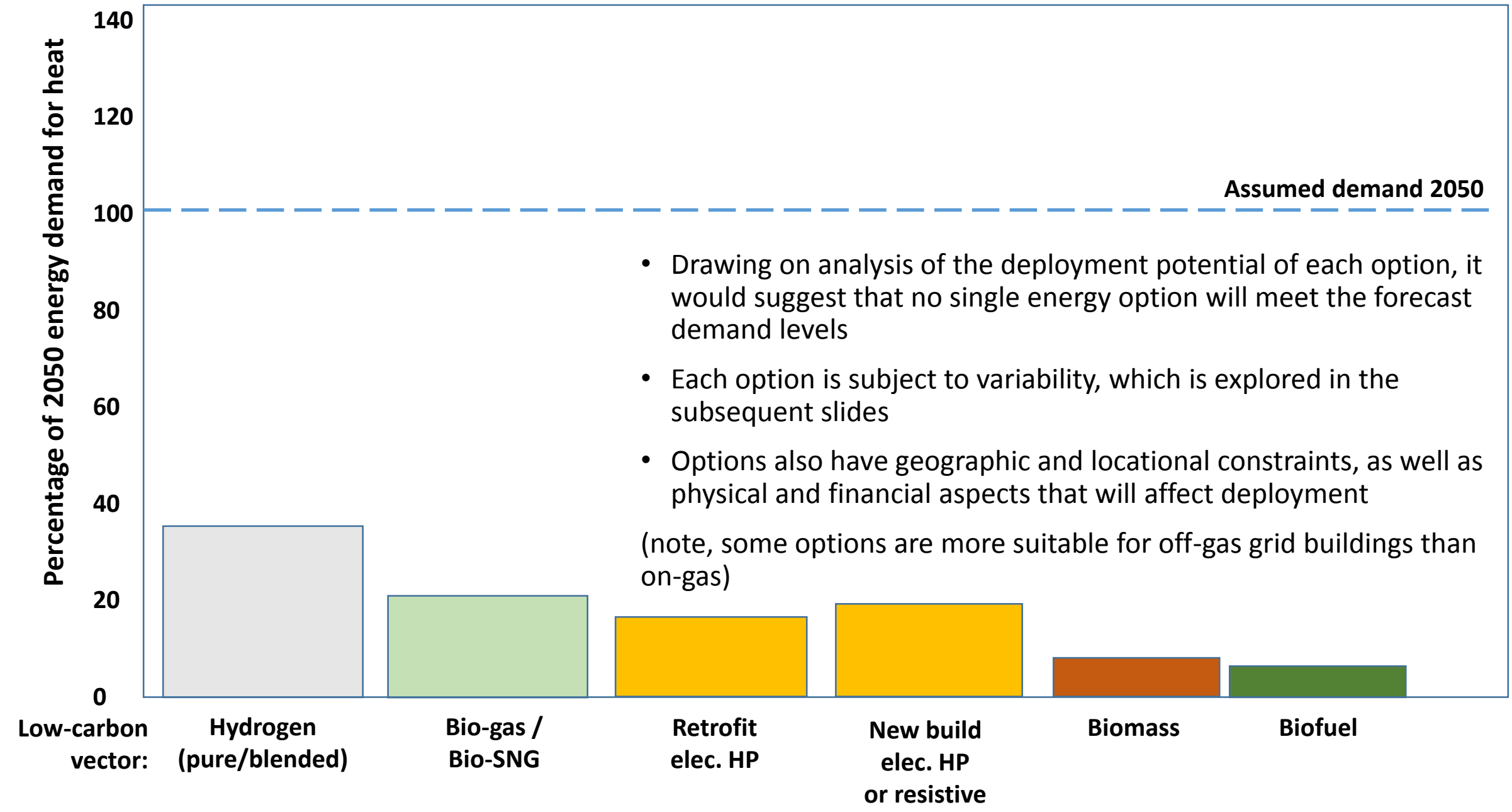
- Suitability of properties and constraints on space or other characteristics

Pareto analysis: 2050 energy for heat demand



- Energy demand for heating is expected to be similar to 2015, with the expansion of housing stock being offset by improvements in building fabric of about 20%.
- Achieving better than 20% will reduce demand, but overall demand will increase if this retrofit and new-build standards do not meet expected levels.

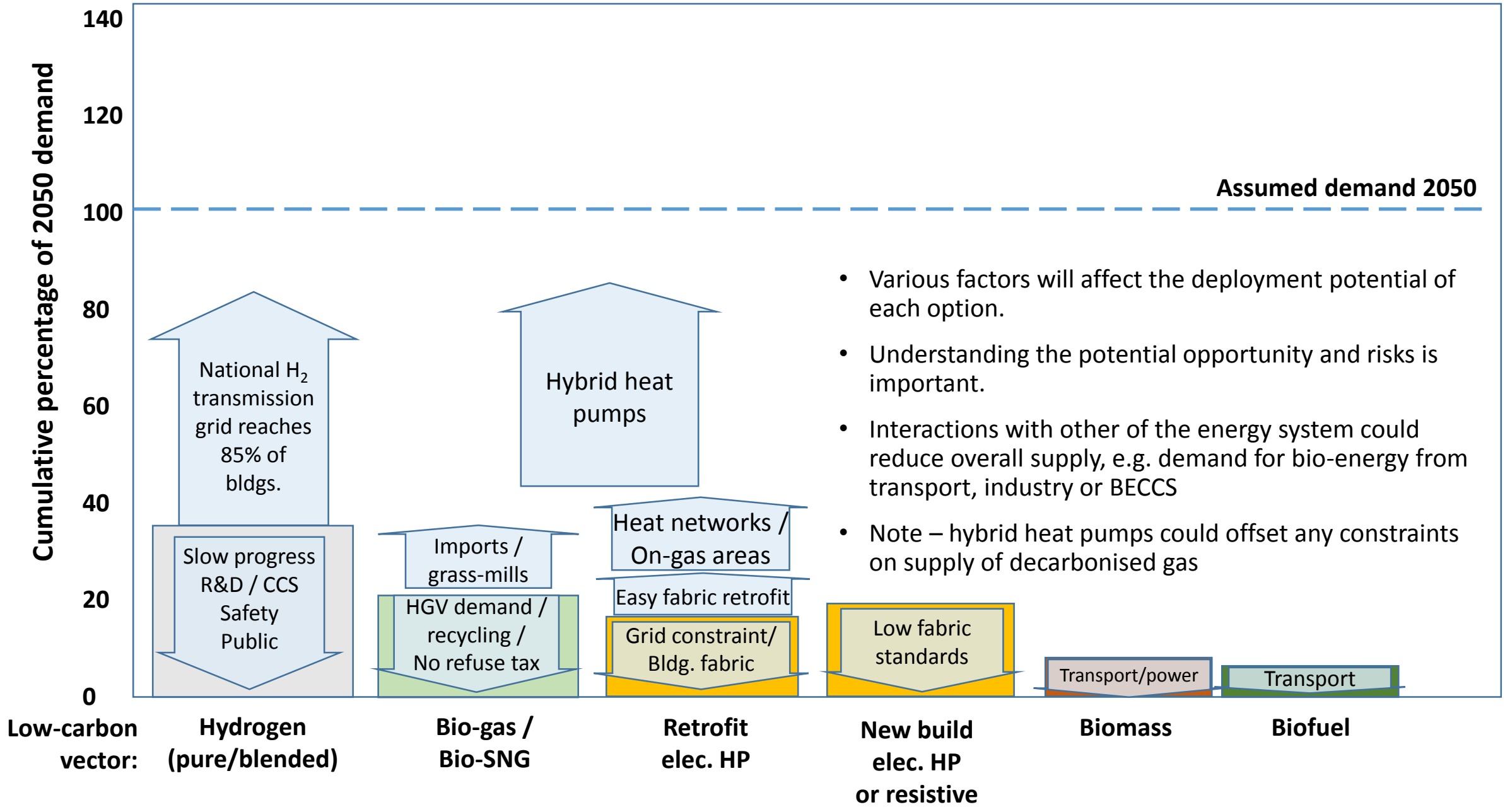
Pareto analysis: 2050 energy sources



- Drawing on analysis of the deployment potential of each option, it would suggest that no single energy option will meet the forecast demand levels
- Each option is subject to variability, which is explored in the subsequent slides
- Options also have geographic and locational constraints, as well as physical and financial aspects that will affect deployment

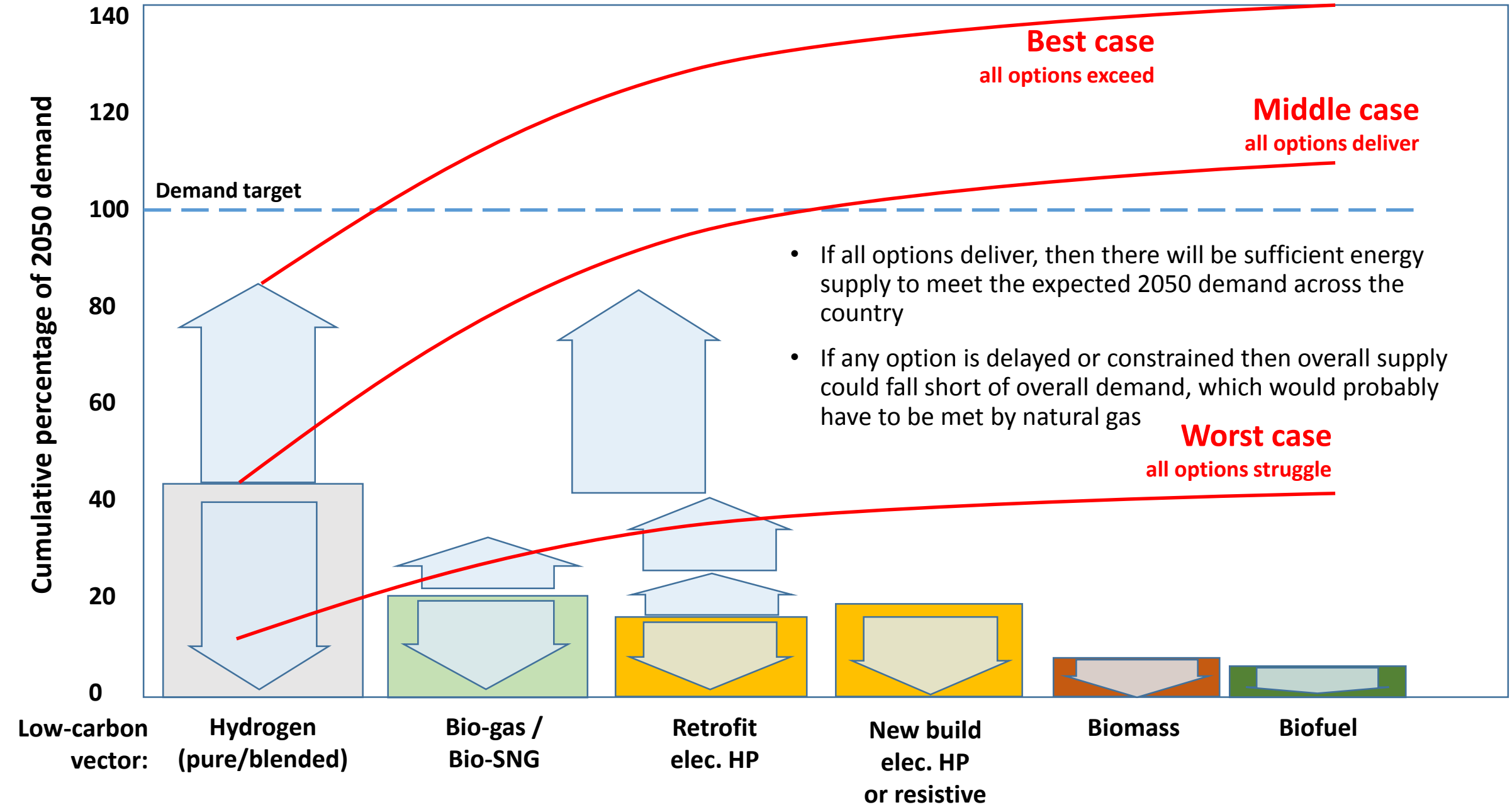
(note, some options are more suitable for off-gas grid buildings than on-gas)

Pareto analysis: 2050 energy sources



- Various factors will affect the deployment potential of each option.
- Understanding the potential opportunity and risks is important.
- Interactions with other of the energy system could reduce overall supply, e.g. demand for bio-energy from transport, industry or BECCS
- Note – hybrid heat pumps could offset any constraints on supply of decarbonised gas

Pareto analysis: 2050 cumulative energy sources



- If all options deliver, then there will be sufficient energy supply to meet the expected 2050 demand across the country
- If any option is delayed or constrained then overall supply could fall short of overall demand, which would probably have to be met by natural gas

Questions for consideration of each option

- **Potential** – scale of deployment of the different options
- **Dependencies, interdependencies** and **constraints:**
    - affecting deployment e.g. physical, geographic
    - with other options / networks / infrastructure
- **Risks** – Factors that would accelerate, reduce or delay deployment
- **Actions** – required to bring them to market – R&D, trials, regulation
    - by whom
    - by when, and what is the lead time to inform the decision, and to implement it.
- **Timeframes** – for delivery and implications if it changes

- What impact do CHP and heat networks have on each option
- How would significant demand reduction affect use of option
- Would energy storage (household/local/national) affect the option

Questions from Plenary discussion

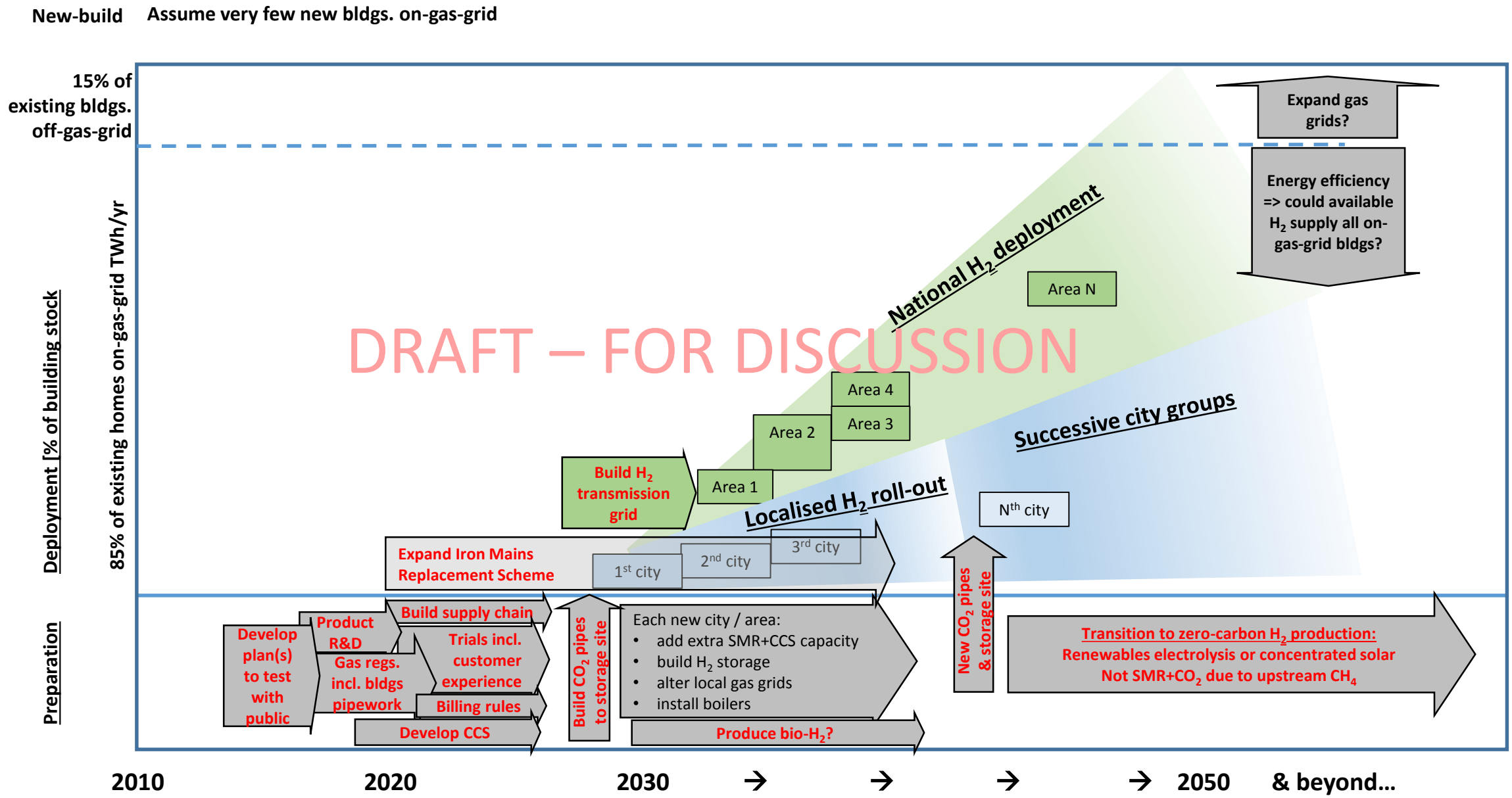
Storage and…

- Why does who care?
- Resilience and flex is based on Fossil fuels – how will this be done in low-Carbon world?
- How deal with inter-seasonal demand swings?
- Who would be responsible for security of supply e.g. 1-in-20 cold winter?

demand reduction

- Definition of demand reduction. Is it:
  - energy efficiency (do the same with less)
  - or demand reduction (using less overall)?
- Is it reduction or management? What is being reduced?
  - Annual average use
  - Daily peaks, or
  - Six-minute peaks?
- New entrants in energy suppliers market are mainly providing innovation in the customer interface. Can they help manage the risks in the energy sector, and provide innovative solutions to the fundamental issues?

Deployment rate & potential: Hydrogen

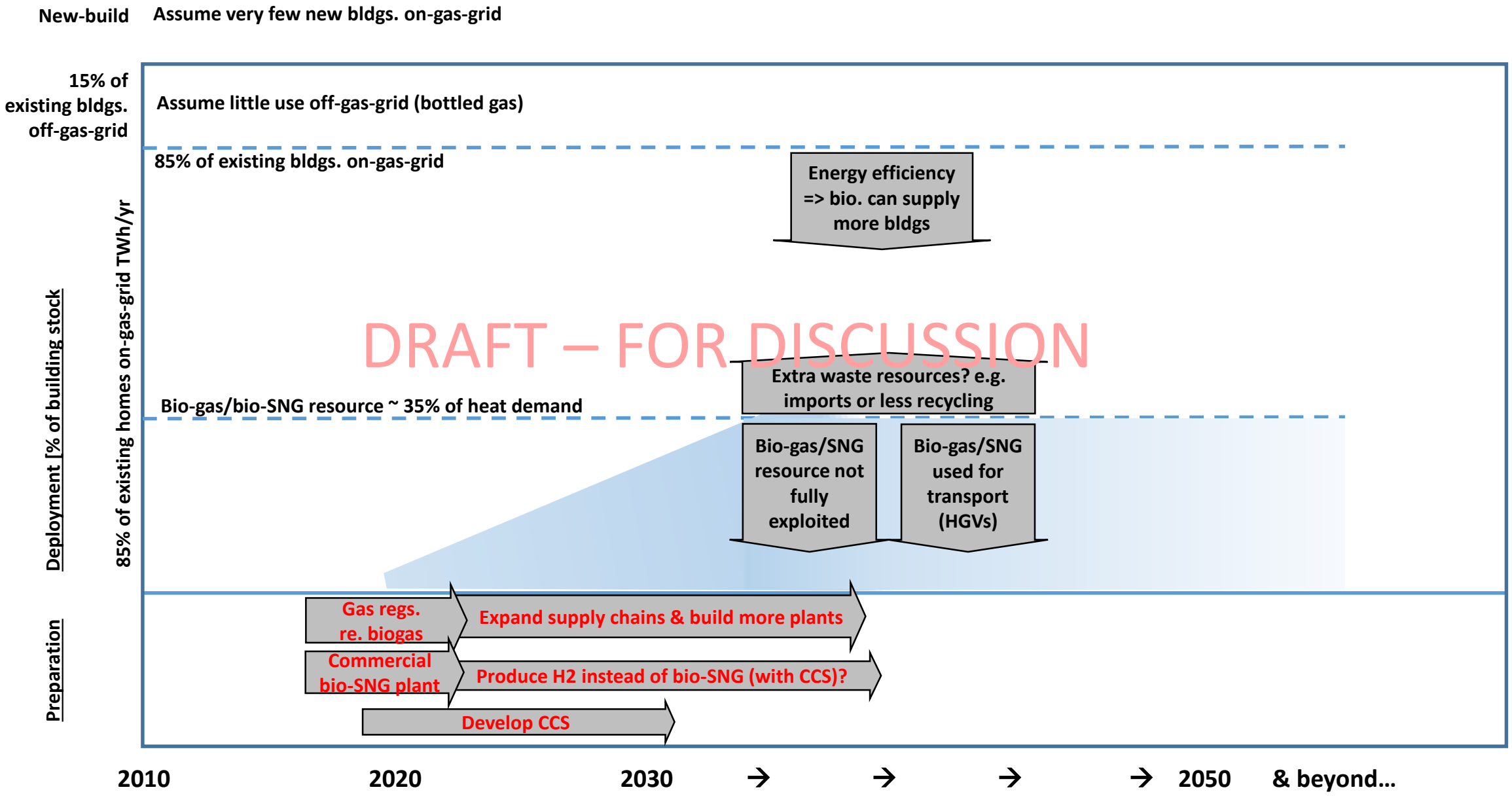


Deployment rate & potential: Hydrogen

- What is best transition strategy for hydrogen boilers?
  - "Soft": deploy flexi-fuel boilers over 15yrs, ready for switch to H_2?
  - "Hard": switch all boilers at once?

- What is long-term future for low-carbon hydrogen?
  - On what timescales would we have to start transitioning away from SMR+CCS to avoid residual CO_2 emissions and upstream methane emissions?
  - What could be the scale of biomass feedstock for bio-H_2 production, and does it need CCS?
  - What are implications of importing H_2 (balance of trade, energy security, etc.)?

Deployment rate & potential: Biogas / Bio-SNG



Deployment rate & potential: Biogas / Bio-SNG

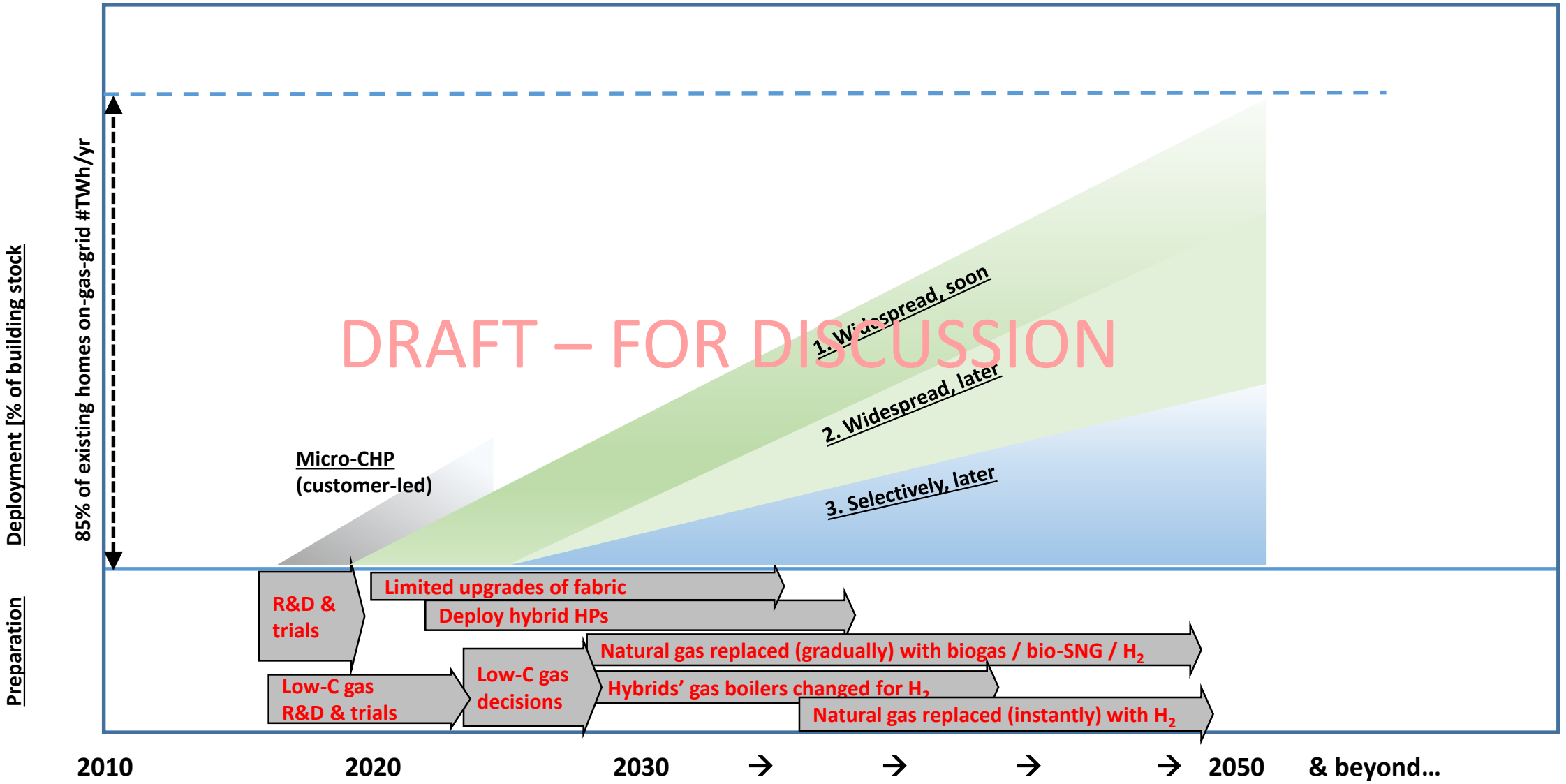
- What is the best strategy for using biogas / bio-SNG?
  - aim for 100% bio. in some local grids (implications for boiler design)?
  - bio-blend in transmission?

- Could biogas / bio-SNG meet demand for all on-gas-grids building?
  - if bio-gas/SNG supplies were increased e.g. through imported waste
  - and if demand reduction was ambitious enough

- What is the long-term future of biogas?
  - Will there be agriculture changes that affect resources for anaerobic digestions?
  - Will transport use the gas fuels?

- What is the long-term future of bio-SNG?
  - Will waste streams reduce, i.e. will we move to a circular economy?
  - Will transport use the gas fuels?
  - What is best use of black-bag waste, e.g. incineration in CHP / process into bio-SNG?

Deployment rate & potential: Hybrid heat pumps

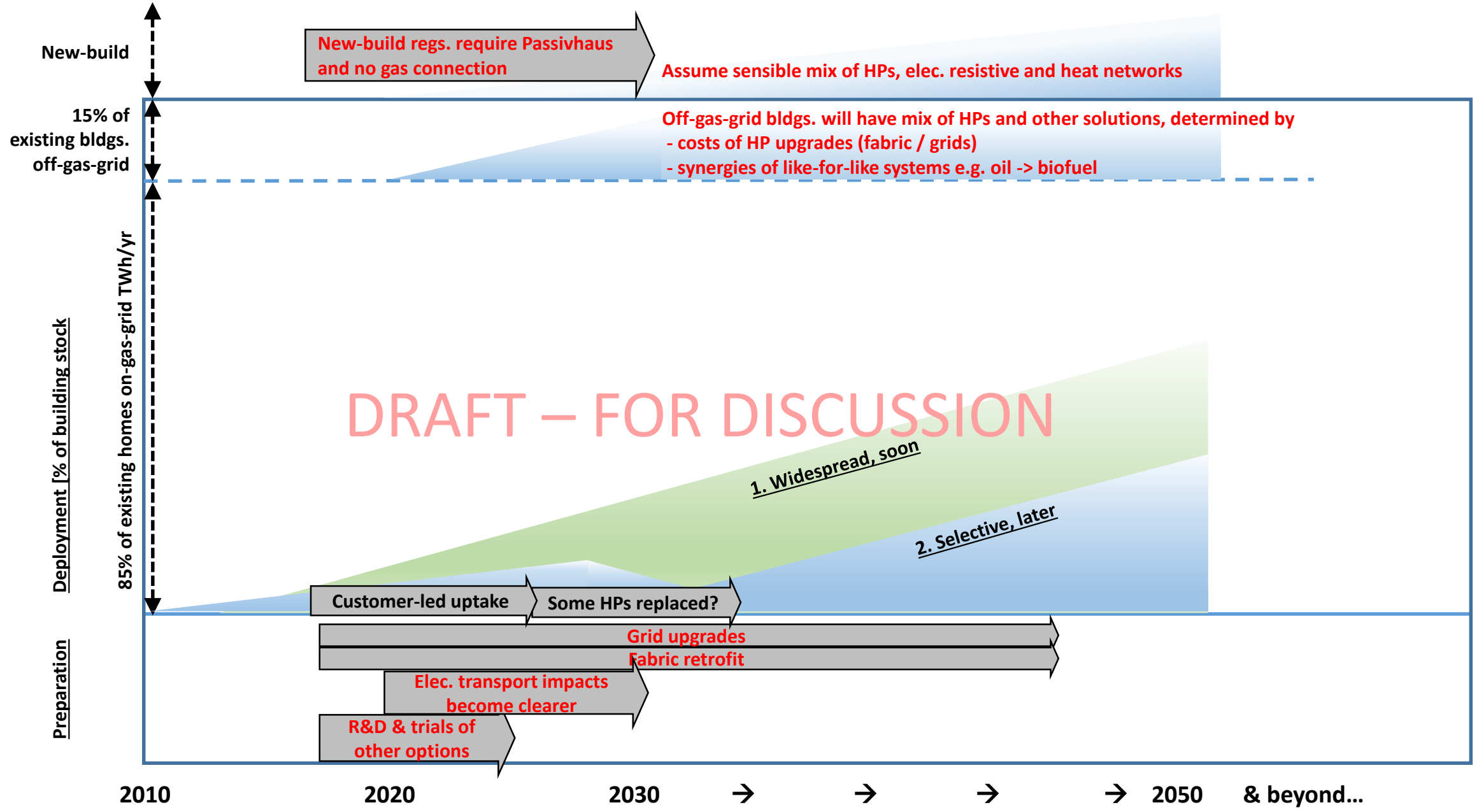


Deployment rate & potential: Hybrid heat pumps

- Is there a preferred strategy for hybrid heat pumps?
  - Widespread, soon: Start deploying hybrid HPs soon, designed for natural gas / bio-SNG, and alter their boilers later if change to biogas / H_2.
  - Widespread, later: Wait until decisions are made on low-C gas and then deploy hybrid HPs that are compatible.
  - Selectively, later: Wait for decisions on low-C gas, and then deploy selectively as one of several options.

- Does micro-CHP have a role, and do they pose challenges?
  - Are they beneficial beyond simply providing low unit cost on-site electricity generation?
  - What are the network implications of micro-CHP units?

Deployment rate & potential: Electrical heating



Deployment rate & potential: Electrical heating

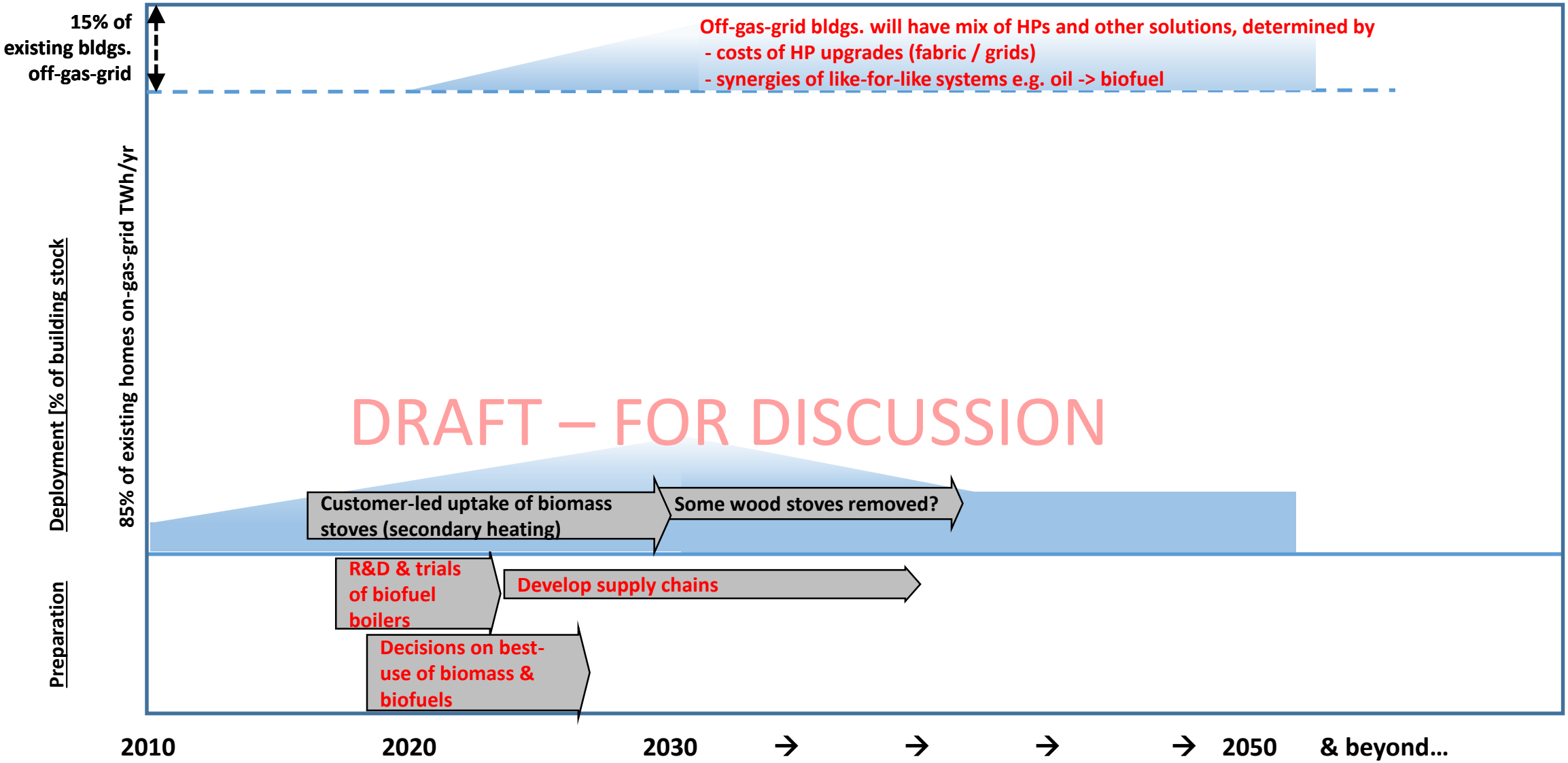
- Are there benefits to particular approaches to off-gas grid?
  - Prioritise by fuel type? e.g. oil heating (high GHG) or elec. (high bills)
  - Or prioritise by infrastructure & fabric? e.g. like-for-like replacements e.g. oil -> biofuel

- Are there benefits to particular approaches to on-gas-grid?
  - Widespread, soon: HP are proven, so start widespread deployment now.
  - Selective, later: Develop other options, and wait to see how electric transport develops, and then later deploy HPs selectively.

- What happens if heat networks are located in areas that are later allocated for another option?
  - Would HPs be removed to give uniform solutions in an area?
  - Would owners be compensated, and who would pay sunk costs of HP grid upgrades?

- How confident can we be that new-build regulations and enforcement will allow / stipulate non-gas solutions?

Deployment rate & potential: Biomass & Biofuel



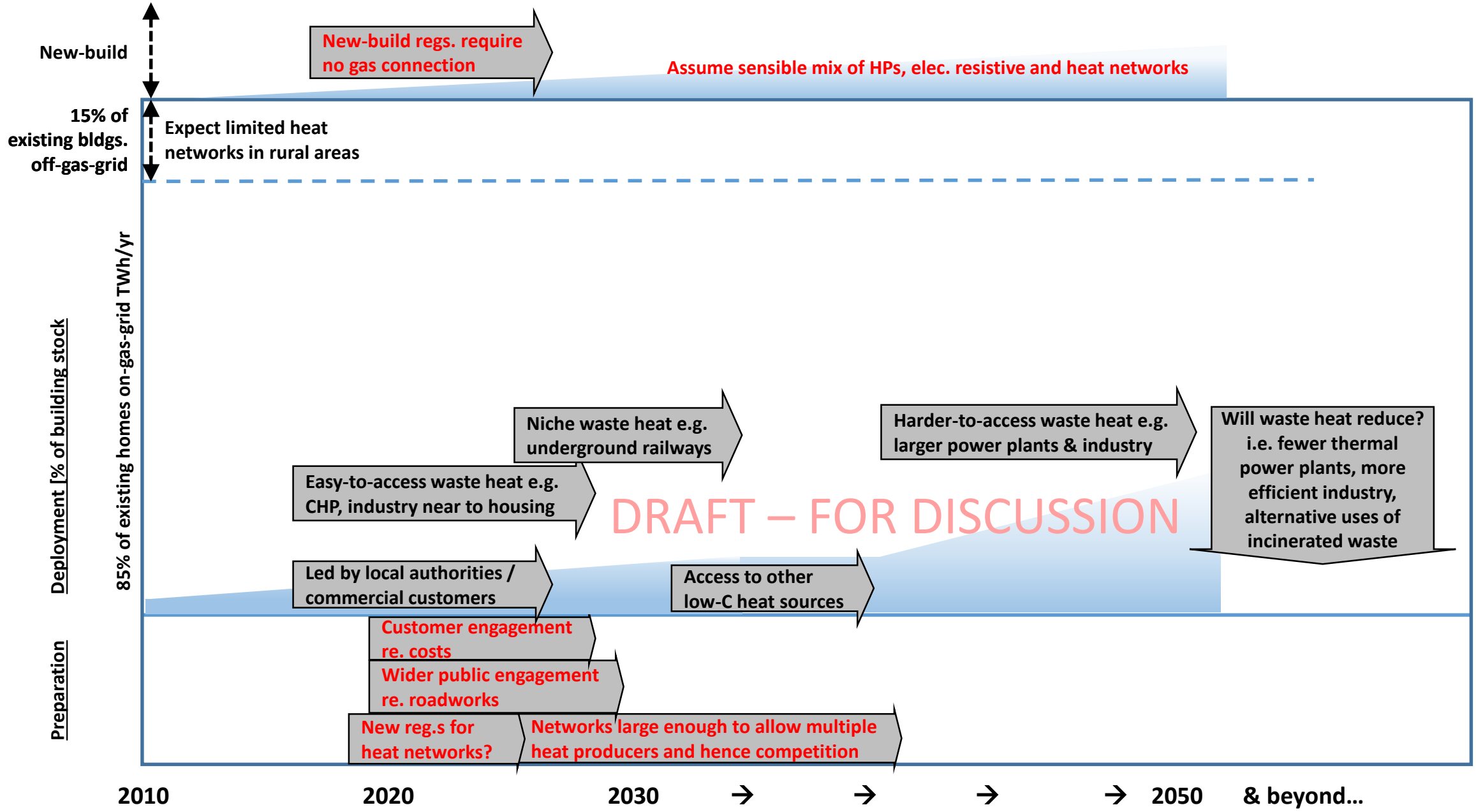
Deployment rate & potential: Biomass & Biofuel

- What is the best use of bio-mass (wood)?
  - Solid fuel for heating / power?
  - Process into (2nd gen.) biofuels for heating / transport?

- What is the best use of biofuels?
  - Transport?
  - Off-gas-grid heating?

- Could optional biomass stoves undermine fuel supplies for off-gas-grid biomass boilers?
  - Could there be deterrents, e.g. regulation / taxation?
  - Could there be incentives to remove biomass stoves?

Deployment rate & potential: Waste heat



Deployment rate & potential: Waste heat

- Where waste heat (via heat networks) is cost-effective (and disruption is acceptable), are there any disadvantages to deploying it?
  - In terms of an overall strategy, is current heat network deployment “low regret”, or should they be deployed only once the role of all options has been established?
  - What is needed to ensure that heat networks out-perform individual buildings’ heating systems, e.g. standards for efficiency?
  - Is waste heat a viable long-term energy source, or could it be reduced by changes in technology?
  - If heat networks had to switch away from waste heat (to another low-carbon source), would this “network lock-in” pose any problems?

- What happens if heat networks are located in areas that are later allocated for another option?
  - Would heat networks be disconnected to give uniform solutions in an area?
  - Or would heat networks be connected to an area’s new low-carbon heat source?
  - Are there any low-carbon options that are unsuited to heat networks?