



High level net zero scenarios for the Wadebridge and Padstow community network area

NZCom Work Package 2: Milestone 2.2

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1 Introduction

1.1 Background

Project VENICE (Vulnerability and Energy Networks, Identification and Consumption Evaluation) is a Western Power Distribution (WPD) programme funded under the 2020 Network Innovation Allowance (NIA) call 'Energy Transition: Leaving no one behind'. This comprises three related projects, one of which is the Net Zero Communities (NZCom) project.

NZCom is looking to better understand how the needs of WPD's vulnerable customers (domestic and non-domestic) will change in the future, creating novel ways to support a whole community through the transition to net zero, and understand the role community energy groups can play.

WP2 of NZCom is specifically concerned with the development of future scenarios for Wadebridge. By articulating qualitative narratives of potential energy futures, these scenarios will articulate the context to a set of 'solutions', i.e. combinations of technologies and business models, developed within WP4 and WP5. Additionally, the degree to which such solutions are aligned with net zero will be quantified by carbon accounting undertaken in WP3.

The scenarios developed in this work package are not meant to be predictions or forecasts, but rather should be used to stimulate discussion about the speed and shape of trajectories towards net zero, and the implications for vulnerable customers.

1.2 Purpose of this document

This document sets out a set of *high level* net zero scenarios for NZCom. An earlier WP2 Working Paper (1) summarised a range of relevant scenario exercises, at national, regional and local scales, which were found to vary widely in terms of geographical boundaries, technological and infrastructural scope, intended audiences, degree of stakeholder participation in developing scenario frameworks and challenging assumptions, and emphases on top-down versus bottom up approaches. Together, these factors determine the degree to which scenarios open up or close down discussion about the speed and shape of plausible trajectories towards net zero.

Of particular relevance to NZCom are two specific scenario exercises. First, the National Grid Future Energy Scenarios (NG FES) 2021 framework (2), drawing on established quantitative models and an ongoing process of stakeholder engagement, and has come to represent something of an industry standard for energy system analysis at a national level. Second, the WPD/Regen Distribution Future Energy Scenarios (DFES) (3), which themselves adopt the NG FES framework to develop regional net zero scenarios for WPD's South West license area which includes Cornwall. Both processes are carried out annually and are expected to continue to do so, so provide a useful foundation on which to develop more nuanced local scenarios.

This document has two main focal points. First, it transposes the regional WPD DFES scenarios down to the NZCom area of interest – the Padstow and Wadebridge Community Network Area, in doing so creates a series of indicative local trajectories for technology adoption to net zero.

Second, it proposes a tailored NZCom scenario framework. Our framework adapts the DFES framework which understands net zero as being shaped by: a) speed of decarbonisation and b) level of societal change, and elaborating it to consider how local trajectories might interact with local vulnerabilities.

High level scenarios will be validated in discussion with the NZCom project team and via an online webinar with key stakeholders in Spring 2022. This will provide an opportunity for stakeholders to challenge our overall approach, the proposed NZCom framework, and our key assumptions.

2 Scope and key assumptions

In order to distil an infinite number of possible futures into a manageable set of plausible scenarios, it is important to clear about the scope of NZCom scenarios. ‘Scope’ here relates to the degree to which scenarios are ‘fit for purpose’ in terms of plausibility, relevance, and usefulness in guiding decision making by WPD, Wadebridge Renewable Energy Network (WREN) and other stakeholders. The scope of NZCom scenarios is partly defined by project objectives and partly by the resources available. In setting out the scope of our scenarios we also highlight some key assumptions relating to scenario development.

2.1 Wadebridge and Padstow Community Network Area in the wider energy system

The primary focus of NZCom is on how interventions in the Wadebridge and Padstow Community Network Area can help the local energy system shift to net zero. Such a shift is only possible in the context of a transformational shift in the wider UK energy system, which includes changes to technologies, infrastructures, and regional and national institutions (network operators, markets, policy design and implementation, regulations). Key assumptions include that:

- The electricity grid becomes completely decarbonised by 2050
- Petrol and diesel vehicles are completely phased out by 2050
- Domestic and non-domestic heat is provided by zero carbon sources by 2050

These (large) assumptions are in turn dependent on assumptions about ongoing cost reductions across key technologies (generation, electric vehicles and low carbon heating) as well as support and acceptance of such technologies across society.

With reference to grid decarbonisation in particular, Planet A propose a reduction in carbon intensity following the curve illustrated in Figure 1. It is noted that this assumption strays somewhat from other (national) scenarios. For example, NG FES 2021 suggests that carbon grid intensity in all three of its net zero scenarios will reach zero by 2034 (4), while the CCC’s Balanced Net Zero pathway suggests similarly that the grid will be mostly decarbonised by 2035 (5). These trajectories are based on assumptions around the role of so-called negative emissions technologies – primarily Bioenergy with Carbon Capture and Storage (BECCS). However, NZCom takes a more conservative view of the potential role of such options either at a system level or at a local level. While our focus is therefore on decarbonising the local electricity system without relying on negative emissions, we accept that some negative emissions options may be required to help decarbonise the system as a whole.

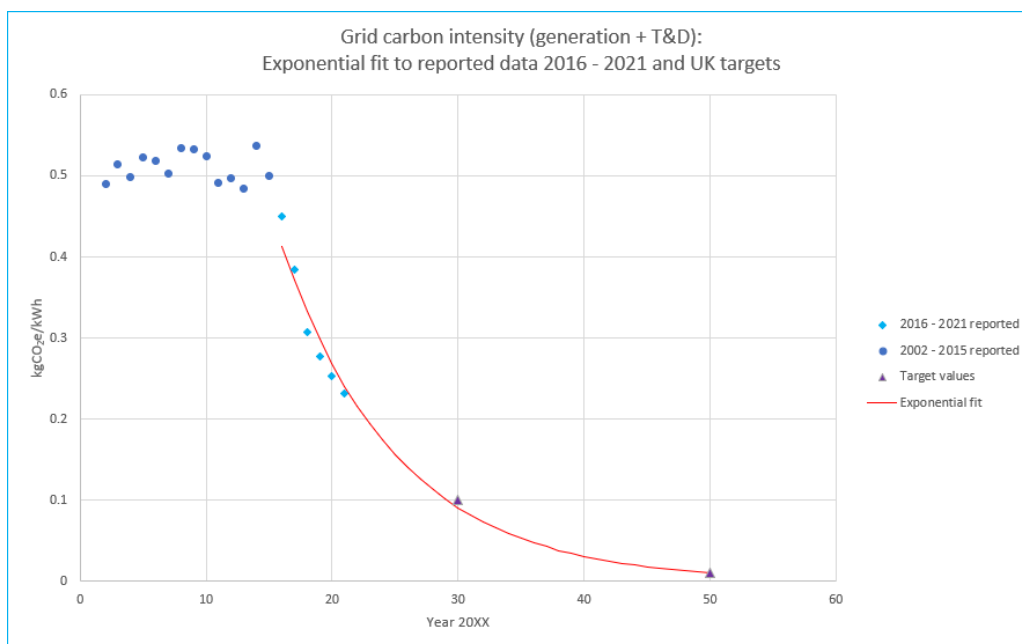


Figure 1. Electricity grid decarbonisation trajectory

2.2 Wadebridge and Padstow's contribution to net zero

Our starting position is that the Wadebridge and Padstow area's contribution to net zero should be – at the very least – commensurate with that of other localities. However, we suggest that the Wadebridge and Padstow area is in a good position to be ambitious and demonstrate leadership in meeting net zero, not least because of WREN's presence in the area and a history of engaging the local community in energy issues.

Higher than average penetration of renewables may mean however that the potential is more for further expansion in these areas may be more challenging than elsewhere in the region.

In focusing in on a local net zero target we assume that the negative emissions and offsetting widely incorporated into national net zero models take place outside of the Wadebridge and Padstow area. There may also be opportunities for negative emissions and offsetting within the local area in terms of afforestation, and the growth of biofuels for feedstock, although NZCom does not focus explicitly on these interventions.

2.3 NZCom interventions

NZCom has a focus on designing a set of interventions to meet net zero while addressing the needs of vulnerable customers. However, decarbonising the local energy system will require households and businesses to adopt a raft of technologies and behaviours, enabled by a broader set of changes to infrastructures, systems of provision and social norms. NZCom interventions need therefore to be considered in this context of transformational change within (and beyond) the Wadebridge and Padstow area.

2.4 The role of people and communities

Existing work on future energy scenarios tend to overemphasise the importance of supply-side interventions. The primary focus of the National Grid's FES and WPD/Regen's DFES exercises is on the energy technologies and infrastructures required to reach net zero, with social and behavioural factors playing an increasing but secondary role. The interactions between net zero pathways and vulnerability have been hitherto ignored. There is therefore an opportunity to explore these

interactions to better understand the impacts of net zero on vulnerabilities, but to also discuss how more or less equitable interventions might influence net zero trajectories.

2.5 Impact of Covid 19

This project draws on pre-pandemic analyses by National Grid and others, and the long-term impacts of Covid 19 on energy demand and economic growth – and thus on our assumptions - are unclear. Although National Grid’s analysis suggests that the long-term impact is likely to be small (2, p.7), local scenarios should reflect up to date analysis as it becomes available, such as in the next iteration of NG’s Future Energy Scenarios in 2022.

3 Regional net zero trajectories

The indicative carbon pathways presented here are not generated wholly from bottom-up modelling, but are derived from two sources of secondary data. First, National Grid’s regional Building Blocks (4), which disaggregate national energy system emission contributions down to specific GSPs. Second, WPD/Regen’s bottom-up data and stakeholder views on energy system changes within the South West (3) and Cornwall (6), which are reconciled with NG Building Blocks.

Drawing down regionally and nationally-derived data from third parties means that we adopt a raft of assumptions implicit built into these analyses and the models upon which they are based. These include assumptions about the contribution of key technologies and associated infrastructures including, for example, nuclear, carbon capture and storage (CCS), hydrogen and offshore wind. However, such technologies are likely to be a) connected to transmission rather than distribution networks and b) shaped by influences at national rather than regional or local politics and policies.

Figure 2 illustrates a range of indicative plausible emissions trajectories for Cornwall as a whole, across a range of scenarios. Cornwall’s total emissions for 2016 were 2,812,905 tCO₂e. In the absence of any decarbonisation policies, emissions could potentially rise to 3,454,214 tCO₂e (red dotted line in the figure (7). At the other end of the spectrum, the Centre for Alternative Technology propose an optimistic scenario of meeting net zero by earlier than 2050 (green dotted line in the figure) (8).

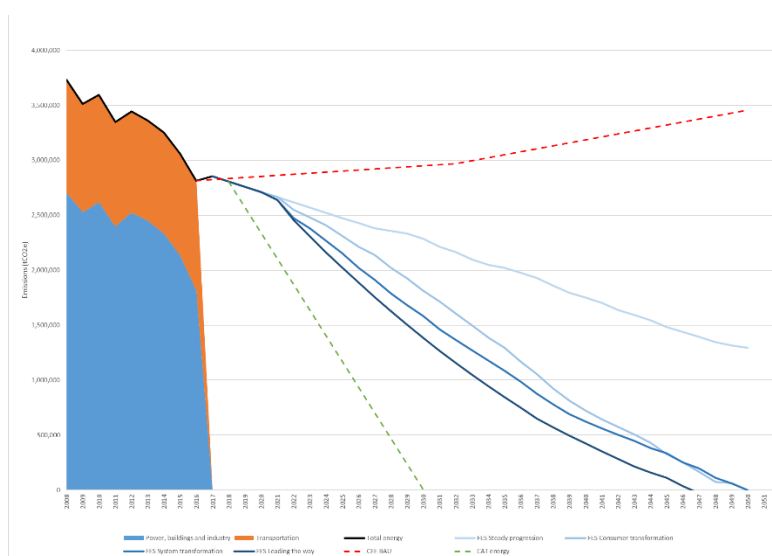


Figure 2. Subset of indicative emission pathways for Cornwall

Between these extremes are a range of plausible carbon pathways developed by WPD/Regen derived from NG FES 2021 analysis (Blue lines). Of these, one scenario (Steady Progression) fails to reach zero by 2050. The other three, namely Consumer Transformation, System Transformation and Leading the Way, all reach net zero by 2050, with the latter reaching zero the quickest. In summary, **Consumer transformation** focuses on changing the way energy is used; **System Transformation** focuses on changing the way in which energy is generated and supplied; and **Leading the Way** delivers NZ by 2047 through a combination of high consumer engagement, technology and investment. These scenarios provide a foundation for NZCom scenarios. Rather than generating comprehensive carbon trajectories for the Wadebridge and Padstow area, we assume that trajectories within the area will broadly follow those laid out in NG FES 2021. In order to understand what specific scenarios mean for technology adoption in the area however, our aim is to set out plausible technology adoption curves - see Section 6 for more details.

4 NZCom scenario framework

4.1 The FES scenario framework

National Grid's FES Framework, and the Regen/WPD DFES framework on which it is based, suggests that net zero will be shaped by two key factors: 1) speed of decarbonisation and 2) level of societal change (Figure 3). Speed of decarbonisation is affected by rates of technology adoption and replacement of fossil-fuel based technologies, infrastructural investments, as well as supportive government ambition, policy design and implementation.

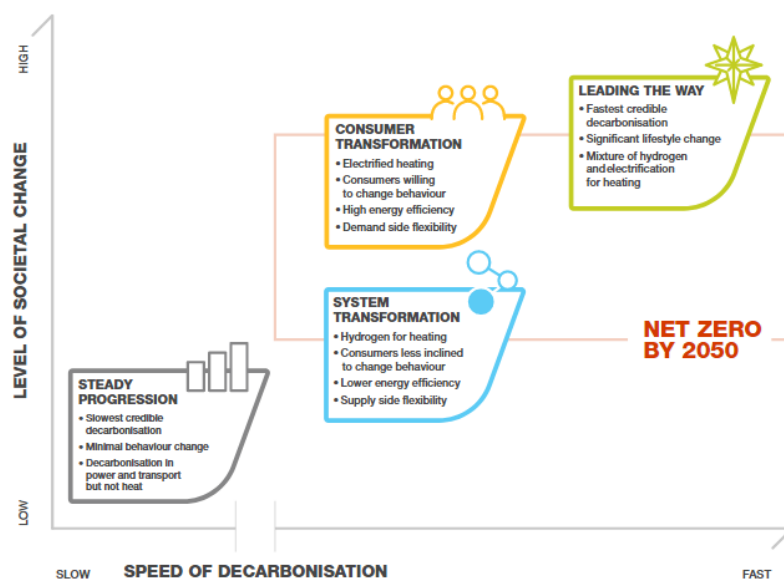


Figure 3. National Grid's FES 2021 framework and scenarios

Level of societal change in turn relates to innovation, understanding and behaviour relating to avoiding, reducing and shifting energy consumption, reducing dependence on fossil fuel-based technologies and adopting low carbon alternatives.

These factors are interlinked. For example, the ability to shifting electricity consumption behaviours will be constrained by the rate at which smart meters, appliances and associated infrastructure can be made available. Similarly, technological cost curves and infrastructures will be influenced by rates of public engagement/support/acceptance with technologies and infrastructures.

We agree that the interplay between these two factors is useful in informing discussion about net zero pathways at national and regional levels, and also provide a broad context for decarbonising local communities.

4.2 NZCom scenario framework

In order to be of relevance to NZCom, the NG FES 2021 framework must be tailored to reflect a) local constraints and opportunities in the Wadebridge and Padstow area, as well as b) implications for local vulnerabilities. This will ensure that our scenarios can stimulate discussion and guide decision-making within WPD as well as within the local community and wider set of stakeholders.

Building on and adapting the FES 2021 framework, we propose adapting the y-axis from ‘level of societal change’ to ‘societal engagement’. Our reasoning is twofold. First, while we accept that ‘level of societal change’ is a key uncertainty, we see societal change as being impossible without societal engagement. Explicitly focusing on engagement allows us to open up discussion about a) the depth of societal engagement, i.e. whether one-off or more prolonged, and whether one-way or multidirectional, and b) the breadth of societal engagement, i.e. whether engagement efforts are spread across the whole community, or targeted towards specific parts of the community. These dimensions are captured in Figure 4. This will allow us to articulate how different technological propositions require different forms of engagement, and interact with different types of vulnerability.

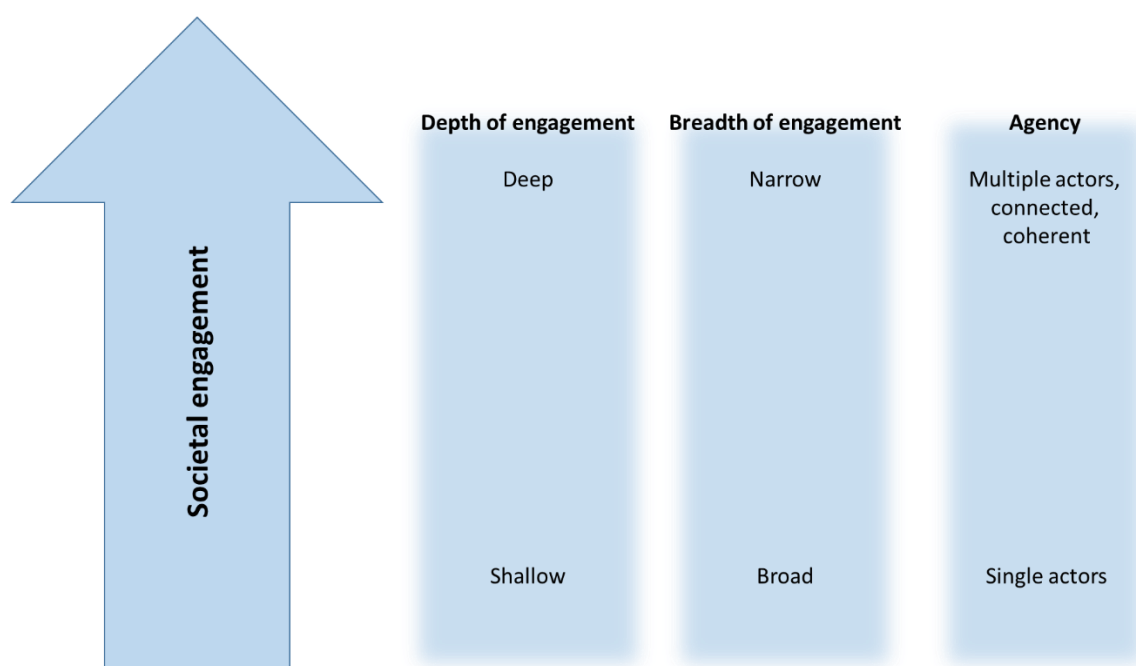


Figure 4. Breadth, depth and nature of societal engagement within the NZCom framework

Second, FES 2021’s framing of ‘levels of societal change’ suggests a binary choice in who takes responsibility for net zero: society (which for the most part in FES analysis means consumers), or wider system actors. Our focus instead on ‘societal engagement’ seeks to remove the onus of responsibility on system actors or end-users and emphasises the importance of engagement as a two-way process in which users, communities and other actors have agency to work together to identify and develop mutually beneficial value streams. This will allow us to articulate local actors’ agency in supporting, mediating and enabling action on the part of users as well as from national and regional policies. This perspective also acknowledges the risks of relying on national level

changes (such as hydrogen heating infrastructure and CCS) which may not happen without societal engagement.

4.3 Depth of engagement

We propose that depth and breadth of societal engagement in relation to specific technology interventions can be captured by a continuum of low, medium and high levels of engagement. This is not to say that ‘deep’ engagement is somehow better, more effective, or more appropriate than ‘shallow’ forms of engagement, but simply that opportunities and challenges for engagement will be affected by the characteristics of proposed technologies.

Table 1 illustrates how different forms of intervention align with different forms and intensities of engagement. Three broad levels of engagement are identified. ‘Low’ includes those interventions that might reasonably be carried out ‘behind the scenes’, i.e. with engagement with the community limited to the provision of information to the community.

‘Medium’ includes interventions that might cause some minor disruption to users. This might include the marketing of technology options/tariffs to potential users, or installing infrastructure such as smart meters or EV chargers.

Our characterisation of a ‘High’ level of engagement acknowledges that some interventions will require more prolonged relationships with users and the wider community. This may include home retrofits in which the process of planning, design and execution may require ongoing relationships with beneficiaries.

Table 1. Varying depths of engagement

Level of engagement	Nature of engagement	Frequency of engagement	Intervention example
Low (shallow)	Disengaged; information	Once, if at all	Primarily upstream technical interventions
Medium	Information; marketing; infrastructure	One-off; fit and forget	Adoption of time of use tariffs (tariff introduction and ongoing advice)
High (deep)	Managed disruption	Ongoing, prolonged relationship with users in terms of advice, planning, design and upgrade works.	Energy upgrade of fuel poor home; support around changing energy behaviours

Engagement will also look different for different parts of the population, catering to differing needs and differing capabilities. In general, higher levels of engagement will be needed for those classified as vulnerable – often complex circumstances and needs, and shortage of time. This may require support and advice – delivered face to face or in home (9) – when new technology is introduced, and in the form of ongoing support to learn how to best use the technologies. Furthermore, the level of engagement needed may be influenced by the degree to which different parts of the population are involved in the design.

4.4 Breadth of engagement

Breadth of engagement is also a key dimension in determining the trajectory to net zero as well as the ways in which vulnerable parts of the community are affected. Technology interventions may be of interest, or value, to different parts of the community. Different interventions (e.g. tariffs, off-street charging) might also be actively designed with, and marketed to, different consumers in mind. Breadth of engagement interacts with depth of engagement, as discussed above.

4.5 Agency

Our focus on societal engagement emphasises how a broad range of actors can have roles and responsibilities in affecting energy system change, and offers a nuanced perspective to the mechanics of change by highlighting potential roles and responsibilities of actors in engaging society. Key actors are summarized in Table 2.

Table 2. Energy system actors and potential roles of relevance to NZCom

Actor	Example	Engagement roles	Level of support
Energy supplier	Conventional supplier / ESCO	Providing feedback on energy usage; information about tariffs	Blanket approach, tailored feedback via bills and smart meter
Tradespeople / installers	SMEs, builders, plumbers etc.	Offering advice about materials, retrofit options during routine repairs and maintenance	1-1, tailored to resident's need
Energy advisors / intermediaries	CEP, WREN	Information; Specialist or general advice about local energy options	1-1, general and sector-specific information
Local community groups	Schools, residents' associations, village halls, shops, clubs & societies, foodbanks, Parish council	Pooled investments; information sharing; influencing decisions; signposting	Tailored to groups and opportunities
Wider community groups	Local Authority, Citizens Advice, primary care providers		Tailored
Social networks	Friends, colleagues, family, neighbours	Sharing information with wider networks	1-1
People / citizens / consumers		Decisions about electricity and heat demand; appliance and building fabric upgrades, tariff choices; information sharing with wider networks; influencing decisions; signposting	Informal, 1-1 or via groups

At a local community level, actors related to energy include energy companies, intermediary organisations, such as sources of advice or a community energy group, tradespeople and those in wider society. Actors who influence residents' engagement with energy include social networks (who may share know how or advice), interactions with social agencies (who may signpost to forms

of help and advice for affordable warmth or payment of bills). At a national level, forms of broadcast and social media influence perceptions of energy infrastructure, tariffs and technology innovations.

In summary, a wider range of actors play a multitude of roles in influencing engagement with energy systems in general, and the local energy system more specifically. This perspective moves beyond traditional views of energy systems being shaped simply by supplier-consumer relationships, and emphasises how diverse actors can be mutually supportive in engaging society with the challenges and opportunities presented by energy system decarbonisation.

5 Summary of NZCom scenarios

Within the framework outlined above, and adapting FES 2021 scenarios, we envisage three scenarios of relevance to the Wadebridge and Padstow area, two of which reach net zero by 2050 and one missing that target. The key distinguishing features of these scenarios are sketched out here. Figure 5 illustrates these scenarios in the context of the NZCom framework.

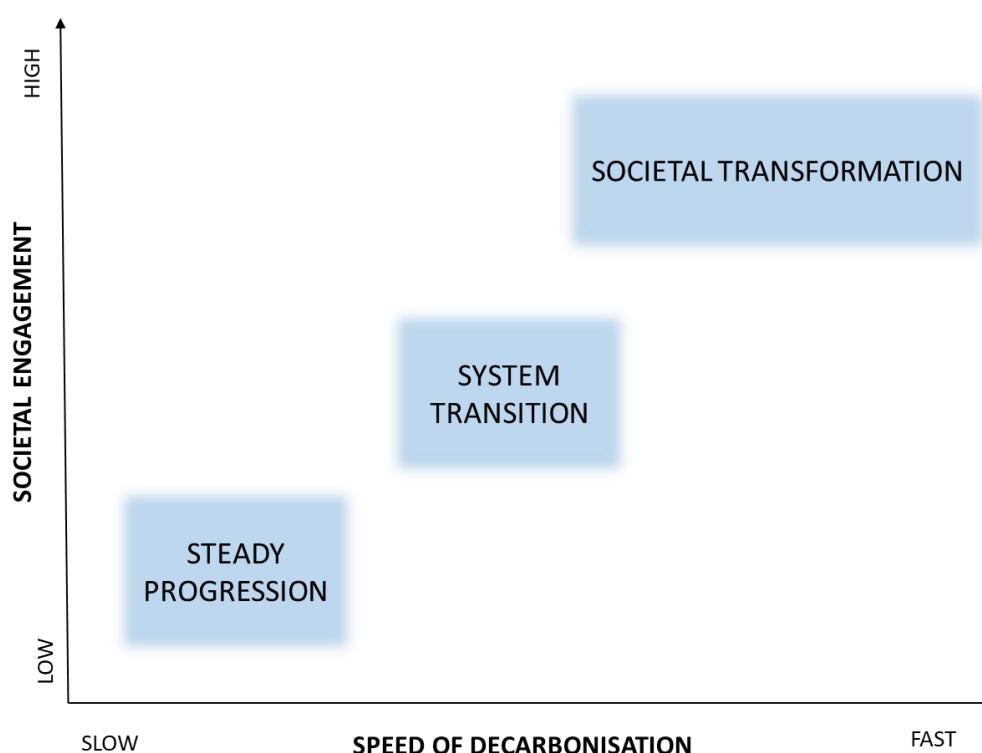


Figure 5. Proposed net zero scenarios within the NZCom framework

5.1 Steady Progression

Steady Progression for the Wadebridge and Padstow area represents a Business as Usual scenario in which low national, regional and local ambition for decarbonisation is low, and **the net zero by 2050 target is missed**. Some progress is achieved in the uptake of low carbon technologies although this is piecemeal and uncoordinated, appealing only to the most affluent consumers who are willing and able to afford investments. Policy gaps remain, and momentum towards reducing emissions is lost. Where adopted, individual technologies are not integrated, resulting in low levels of flexibility and continued network constraints.

5.2 System transition

The System Transition scenario for the area is based on the FES 2021 scenario of the same name. Energy is decarbonised at a quicker rate compared to the Steady Progression scenario. Net zero is achieved by way of system-level interventions, and some system flexibility is created with supply side interventions. Engagement with society is understood as playing a role but is limited to broadcast-style information campaigns, and those customers least willing or able to participate are left out.

5.3 Societal transformation

This scenario is a hybrid of the FES 2021 Consumer Transformation and Leading the Way scenarios. This will draw on key technological assumptions made in these scenarios **while also integrating the technology and business model interventions proposed by Planet A**. Decisions about the blend of technological choices for the area, e.g. hydrogen versus electrification of domestic heating, will be articulated in the final scenarios. National, regional and local ambition for net zero is high, and there are high levels of societal engagement. Decarbonisation by 2050 is achieved. While consumers are supported in decisions to adopt low carbon technologies, there is also targeted deployment of technologies across the community to ensure that no-one is left behind. Opportunities for local participation in decision making means that solutions are tailored to local challenges.

6 Tailoring scenarios to the local context

The scenarios briefly outlined above describe future energy systems in which technologies and infrastructures have coevolved alongside societal and behavioural factors. Technological options will be constrained and enabled by societal engagement, whilst societal engagement – and the ability to engage with vulnerable parts of the community - will be shaped in turn by technologies and infrastructures.

6.1 Local factors affecting technology adoption

Local net zero pathways can be expected to vary from regional pathways (such as those set out in Figure 1) as a result of local variations in geographical, infrastructural, socioeconomic and sociocultural contexts affecting decarbonisation and societal change. These factors affect opportunities and challenges for shifts in some key low carbon energy technologies as well as the willingness and ability of the local population to adopt shifts in behaviours. Table 3 summarises a range of factors of relevance to decarbonisation and compares metrics for these factors for Wadebridge and Padstow to Cornwall as a whole.

Table 3. Factors shaping local net zero trajectories

Dimension	Factor (metric)	Wadebridge and Padstow area	Cornwall (excl. Isles of Scilly)
Infrastructure	Properties (number)	9286 ¹	272229
	EPC E and below (%)	18	18.6
	Non-gas properties (%)	44	51
Socio-economic	Fuel poverty (% of homes)	12.26	11.47
	Tenure (owned/non-owned)	2.18	2.28
	Tenure (% social housing)	9.7	10.2

¹ Note that WP4 is modelling a subset of 5267 homes in the network area for which EPC data exists

	Affluence (Total annual income, £)	36,933	37,333
	Deprivation (IMD19)	19.57	23.15

Source: Data on properties, non-gas properties, EPCs, fuel poverty and tenure from BEIS, Census 2011 and NOMIS

Aside from the factors outlined in Table 3, a large number of other factors may also shape net zero trajectories, including average building size, transport connectivity, economic structure, grid constraints, demographics, the number of temporary occupied (holiday homes and rental properties) buildings, local fuel costs, and support for low carbon technologies.

6.2 Incorporating vulnerabilities

Reaching net zero will rely on a suite of technologies, some of which could be achieved by way of system-level shifts, and some of which will require societal change. Table 4 sets out how the technologies proposed in WP2 interact with different vulnerability dimensions within the local community.

Table 4. NZCom interventions and levels of engagement, and impacts upon vulnerabilities

Intervention and level of engagement	Technological components	Factors affecting vulnerability impacts [home ownership status]	Factors affecting nature of societal engagement	Examples from literature
Pseudo Microgrid (PMG) & flexible tariffs	Switches and hardware		Behind the scenes technical intervention	
	Tariffs / algorithms	Design of tariffs/algorithms to address needs of vulnerable residents?		- Design of tariffs for fuel poverty (10) - Tariffs which provided financial return on investment using an aggregated community approach (11)
	Data analytics		- Data privacy/ sharing concerns for Smart meters - Trust in ESCO for using household data	- Need awareness and sensitivity to residents' concerns about data privacy (12)
	Smart meter installation	Digital and tech readiness <ul style="list-style-type: none"> - Houses with no IT or internet connection? - Home broadband speed - Energy literacy: understanding energy system - IT literacy: smartphone or tablet owner/ user 	<i>Pre-installation:</i> Explanation of requirement for smart meters and real time data <i>Installation:</i> Advice and explanation of how meters work and usage, EST app? ² <i>Ongoing:</i> Training / understanding about time of use and using equipment How do smart meters interact with existing appliances?	<ul style="list-style-type: none"> - Trusted intermediaries are important for providing in-person support, explaining new technology and providing support over time (9,13,14) - Resident's perception of and confidence with new/smart technologies (15)
	Tariffs	<ul style="list-style-type: none"> - Range of tariffs and fair distribution - tariff for vulnerable residents? - How do tariffs impact those who cannot participate? - Interaction between tariffs and those on prepayment meters 	What assumptions about flexibility are being made? How to get most out of flexible tariff (e.g. need for smart appliances?)	<ul style="list-style-type: none"> - Importance of exploring what control means for vulnerable citizens (15) - How do vulnerable residents manage their energy usage, and how can benefits can be realised? (15) - Patterns of household occupation influence flexibility of demand (11,15)

² [1] <https://energysavingtrust.org.uk/tool/energy-efficiency-advice-tool/>

Intervention and level of engagement	Technological components	Factors affecting vulnerability impacts [home ownership status]	Factors affecting nature of societal engagement	Examples from literature
New community owned wind and solar PV connected into PMG	Location of new wind and solar PV	How does the location of new wind and solar impact vulnerable residents?	Consultation on new wind and solar. Local residents, interest groups and council supportive of /not opposing new community owned wind and solar PV.	- Place attachment and new renewables
	Business model design	How are interests of vulnerable residents reflected in business model?	How does business model influence level of support for new wind and solar?	
Community heat or District Heat Networks (DHN)	Infrastructure development partnerships	How are interests of vulnerable residents reflected in design, development and location of DHN?	How are residents involved in the design, development and location of DHN?	
	Design of contracts, prices, tariffs	How are interests of vulnerable residents reflected in business model?	Community engagement for infrastructure changes	
	Connection to DHN	<ul style="list-style-type: none"> - Energy and IT literacy - Connection, ongoing training and support required to understand and make best use of heating controls - Contracts, tariffs and assurances for vulnerable citizens 	<ul style="list-style-type: none"> - Understanding and implications for consumer in changing heating services - How interacts with domestic retrofit or changes time of use - Understanding of new heating controls 	<ul style="list-style-type: none"> - Importance of accessible (in person) explanations of how heating system works (9,15), and ongoing support (16) - Concerns over long term contracts for vulnerable residents (16).
Electrification of heat (heat pumps, storage heaters)	Pre-installation	<p>* Upgrade and insulation of fuel poor houses in advance of electrification of heat</p> <p>Pre-installation advice for:</p> <ul style="list-style-type: none"> - choosing technology (heat pump/ other electrical heating) - replacing boiler - upgrading radiators - interaction / sequencing with retrofits 	<ul style="list-style-type: none"> - Householder capital expenditure - Space in dwelling - Energy literacy and understanding how heat pump interacts with other components of smart home energy system 	

Intervention and level of engagement	Technological components	Factors affecting vulnerability impacts [home ownership status]	Factors affecting nature of societal engagement	Examples from literature
	<i>Installation</i>	Energy literacy: training and feedback on use to keep bills as low as possible	- Installers are important point of engagement and contact with residents	
	<i>Ongoing maintenance</i>	Understanding controls and maintenance		- Resident's understanding of heat pumps important to minimise electricity bills (17) - Need for accessible manuals and advice (15)
Upgrade of Fuel Poor Houses	<i>Pre-upgrade: Whole house advisors / home energy health check</i>	<ul style="list-style-type: none"> - Energy literacy - Available sources of funding or grants for vulnerable residents 	<ul style="list-style-type: none"> - Different advice for homeowners / landlords - Policy (and enforcement) for Landlords to prepare rental homes for a transition towards lower carbon. - Support for home owners through the development of more cost effective solutions, cost competition and up-skilled workforce - Accessible advice at upgrading opportunities (e.g. through routine repairs and maintenance) - Landlords require specific targeting to outline obligations and options 	-
	<i>During upgrade</i>	<ul style="list-style-type: none"> - Who is responsible for upgrade? - Costs of alternative living space during whole house renovation? 	<ul style="list-style-type: none"> - Street by street basis for housing types? - 	-
Zero emissions fleet (domestic)	<i>Awareness and design of pooled EVs</i>	<ul style="list-style-type: none"> - Cost of new EVs prohibitive - Pooled EVs/ car clubs – reduced hire charges for vulnerable residents? - Space for parking/charging - Accessible charging points 	<ul style="list-style-type: none"> - Education/ training for using electric vehicles - Encouragement to switch to EV / modal shift to public EV transport? 	-
	<i>Uptake of EVs</i>	- Reduction in refuelling options for those reliant on diesel/ petrol		- Vulnerable citizens who rely on diesel/ petrol may find it difficult to refuel (17)

Intervention and level of engagement	Technological components	Factors affecting vulnerability impacts [home ownership status]	Factors affecting nature of societal engagement	Examples from literature
HVO fuelling stations	Location of HVO fuel suppliers	- Increase of HVO fuelling could mitigate reduction in fossil diesel refuelling	Education and awareness of how to use and where to refuel	-
Hydrogen for transport		-	Government and/or regional support required for roll-out	-

7 Next steps

Building on the scenario framework set out here, the next steps for WP2 is to:

- Articulate NZCom's proposed interventions specifically in terms of opportunities and challenges for engagement
- Gather feedback from project partners on local factors affecting technology adoption / behaviour change
- Develop a grounded understanding of specific vulnerability dimensions which might interact with technology propositions
- Draft narrative storylines to articulate three scenarios in terms of meeting net zero whilst addressing local vulnerabilities.
- Present and validate these scenarios, assumptions and the overall approach in a participative workshop with key stakeholders with interest and influence in the local energy system, to take place in March 2022.

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