

# Evidence on Energy and the Environment submitted to the North Yorkshire Rural Commission

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## Introduction

This submission aims to address the full 30-year time frame up to 2050 under consideration by the North Yorkshire Rural Commission. Accordingly, it is natural to pay close attention to the needs of the lower, relatively poorly served portion of today's demographic range, the age-range up to 40, many of whom will be at the peak of their careers or retired from formal work by 2050. In addition, it is of great importance to support and engage with people in the numerically dominant upper (older) portion of the demographic, who are essential for consent and support of future policy, and are often closely involved in local decision making.

In this period North Yorkshire will be impacted by major changes resulting from climate change and society's response in mitigating and adapting to its effects. North Yorkshire has already seen early impacts from climate-driven extreme weather, such as failing crop yields and major flooding, and it cannot be over-emphasised that future impacts will be greater and have potential to severely damage our rural economy and social fabric. This is also true in areas of the county which, although not fully rural, are already subject to economic and social difficulties, such as Selby.

Nevertheless, the right societal response to this challenge can unlock major new economic and social opportunities for North Yorkshire. This is of course especially important in view of our low average population density, relatively low funding from central government for education and training, relatively low income for younger working people, and a rural demographic weighted towards older age groups [1].

Thus, the national requirement to achieve a fully sustainable economic model by 2050 must surely be a central focus for the North Yorkshire Rural Commission, as it informs the main thread of actions needed during the 2020s, 30s and 40s. With the right guidance from the Commission at this key moment, North Yorkshire in cooperation with central government and the private sector can open up of major opportunities for local education, training and employment in industry, agriculture and tourism that will sustain a healthier demographic and more thriving communities into the future.

## Climate change, energy transition, and the role of the Rural Commission

It is now well established that climate change will have a dominating influence on human societies and economies over the next three decades and the century beyond, and is already having significant impacts on the UK's climate in the year 2020. During the last decade the rate of climate change has been accelerating, partly owing to changes in industrial emissions and partly to an increase in warming due to growing climate feedbacks such as Arctic sea-ice melt [2]. This has had an amplifying effect on extreme weather events, for example, in the UK, crop yields are already being affected [3], and North Yorkshire has experienced major flooding events which are likely to intensify and become more frequent during this period. At global scale, climate-induced changes that had been expected to occur many decades from now are already underway, and it is possible that the recommendation by the International Panel on Climate Change (IPCC) to keep global warming within 1.5°C, proposed only last year, may already be breached within the next ten years [4].

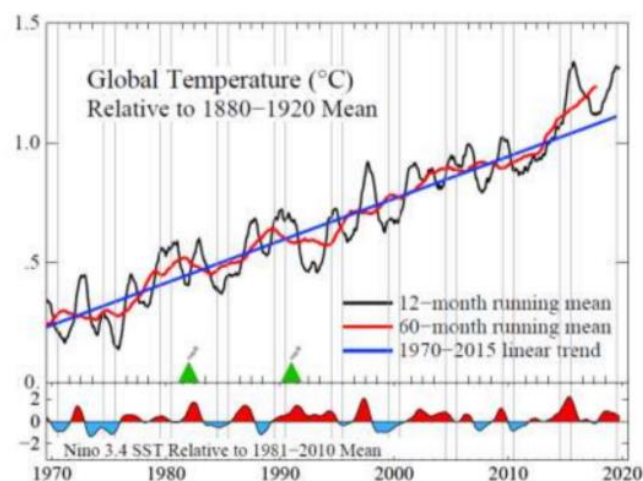


Fig. 1: Increase in global mean surface temperature since 1970 relative to temperatures around the beginning of the 20<sup>th</sup> century (GISTEMP dataset, [5]). The last five years have seen accelerated warming, with 2020 potentially the warmest year ever despite the opposing effect of a cooling La Niña event. This faster warming is likely attributable to increasing global solar irradiance as the atmosphere has progressively cleared of sulphur pollutant haze over the last decade [6]. This atmospheric 'clean-up' is ongoing (now especially in the field of maritime shipping [7]) and likely to cause a continued steep rise in temperatures up to 2030-40, even after CO<sub>2</sub> emissions begin to fall.

With this rather threatening global outlook in mind, government is working hard to grasp the necessary actions needed. The Committee on Climate Change (CCC) set up to guide government following the passage of the Climate Change Act into law is now strongly holding government to account over the sequence of actions needed to achieve transition from our current fossil-fuel run economy to a high level of electrification and net zero emissions by 2050. Current UK initiatives like the Renewable Heat Incentive and the Green Homes Grant scheme are an early manifestation of government's response to this, but will

inevitably have to be dramatically ramped up, on a permanent basis, in order to reach the government's legally binding emissions targets (in effect, deadlines) stepping down towards net zero, currently targeted for 2050.

In addition to the above, scientific evidence for a steepening rate of climate change, expected to be summarised along with policy recommendations in the next major global climate report, IPCC-AR6 [8], will likely cause the CCC to reconsider, and potentially bring forward, the legally binding target dates it has set for UK decarbonisation. In short, the UK's curve of action on energy and the environment is inevitably going to steepen, and quite possibly steepen very sharply.

It is therefore vitally important that the Commission

- (a) Build into its assumptions that central government will actively support and fund major changes to our energy system and major improvements in the sustainability of our environment over each of the next three decades. Perhaps uniquely, this will almost certainly happen regardless of the political persuasion of any particular government during this period.
- (b) Recommend the necessary steps that North Yorkshire should take to respond to, and preferably lead, these changes. These will include in-depth planning, lobbying for funding and partnering with government and private enterprise, especially in education, training and re-training for better paid local jobs in design, construction and engineering for new and retrofitted buildings, energy generation, smart grids, etc. This should include partnership with the private sector in rolling out a comprehensive network of electric vehicle charging facilities across the county over the next 5-10 years, undertake steps to encourage alternative transport modes such as cycling, including a high-coverage network of off-road (e-)cycle routes, support home working, and increase pedestrian and cycle use of town-centre streets.
- (c) Link its considerations to initiatives such as Local Enterprise Partnerships [9] Green Homes Grant skills training and potential successor schemes, etc.
- (d) Emphasise the need to develop continuing education in the community (whether funded or voluntary) so that the public, and particularly older residents, understand their own role in the energy transition and the reasons for this in terms of climate change and their children's future. This will, for example, be a key adjunct to future, more extensive government funding of home energy retrofitting measures, which will likely continue to require a fraction of the cost to be contributed by the homeowner. It is also needed in order to gain increased support for well sited solar energy generation projects and enable increased uptake of smart energy tariffs, both of which will enable a larger fraction of cheap, clean renewable electricity on the grid in the next few years. At present, facilities for continuing education in most parts of the county are extremely limited; a bottleneck which will need to be overcome so that the people of North Yorkshire can properly benefit from the new sustainable economy of the next decade and beyond.

## Renewable energy generation, energy storage, and transport

### *Solar energy*

Owing to its relatively low number of cloudy days, North Yorkshire has a solar irradiation profile similar to that in parts of the South of England, making the county well suited in principle for solar energy generation. Rooftop solar gained in popularity in recent years owing to the availability of government subsidy via the ‘feed-in tariff’ (FIT). After the current hiatus caused by the ending of the FIT, rooftop solar will again have scope for strong growth as prices for home energy storage systems (electric and heat batteries) fall within reach of consumers’ pockets, and prices of solar energy installations continue to fall, making it affordable for homes (heating included) to be supplied partly or wholly by home-generated electricity. Moreover, with the rapid growth in electric car sales, vehicle-to-home charging/discharging will enable car batteries to be used, in effect, as home electricity storage for those who are home working, retired, or have more than one car.

Owing to the low population density of rural North Yorkshire, there is also scope for significant electricity generation from solar farms in locations where the quality of landscape, capacity for appropriate visual screening, and availability of nearby high-power electricity grid permits. The build-out and maintenance of solar farms could lead to significant new employment in areas such as the A1(M) corridor between Boroughbridge and Scotch Corner, areas around Selby, Cleveland, and possibly central Ryedale where Third Energy currently has a high-power line from the nearly defunct gas turbine at Knapton Generating Station. It is worth noting that when set out at a density and panel tilt appropriate to this relatively northern latitude, fields used for solar energy generation can have a dual use, e.g. sheep grazing alongside solar panels, making solar farms somewhat easier to fit into the existing rural economy.

Image taken from Ref. 10,  
acknowledgements to  
BRE National Solar Centre



### ***Wind energy***

At present, onshore wind is relatively unpopular owing to its visual impact, and it is unlikely ever to be rolled out widely across scenic North Yorkshire, though combined wind and solar farms would merit consideration in plans to regenerate former industrial areas of Cleveland. More significantly, coastal connection hubs to rapidly growing offshore wind generation in the North Sea, together with construction of associated onshore power lines, could be of significant economic importance.

### ***Water energy***

Small-scale hydroelectric power from rivers and streams is of interest in many parts of North Yorkshire. Since this technology is well known to the Commission through Dr Trebilco's involvement we do not discuss this in detail here.

### ***Energy storage***

Storage, both of electricity and heat, comes in a variety of forms and technologies. We briefly review these and discuss their relevance to rural North Yorkshire.

1. Batteries are the future of home electricity storage, particular where electricity is generated from domestic solar panels. Their price is currently too high for widespread adoption but this will change, as prices are expected to fall rapidly over the next few years. The combination of solar with batteries will enable a strong decrease in electricity costs per kWh for homes, independent of the price of electricity drawn from or exported to the grid. Large grid-supporting batteries are increasingly important for frequency stabilisation of grid electricity, and large batteries will also be important for commercial reasons in selling renewable electricity to the grid when the wholesale electricity price is high. Battery farms have a much smaller footprint than solar farms, and with careful design can even be located in sensitive landscapes.
2. Pumped storage is a well-known technology with significant potential for growth, but is clearly limited by landscape considerations in many locations where it could potentially be used. We assume that for visual reasons this would not be a significant contribution to energy storage in North Yorkshire, despite the availability of suitable topography in some areas.
3. Cryogenic storage using liquefied air, though in its infancy, may have significant potential for energy storage in the decades ahead. It is less energy efficient than battery or pumped storage but potentially more energy efficient than the current leading contender for high-volume energy storage, which is hydrogen.
4. Hydrogen storage is based on generation of hydrogen from renewable energy via electrolysis (known as green hydrogen) and its reconversion to electricity using fuel

cells. Our view is that the ongoing rapid decrease in the cost of green-hydrogen electricity storage will make this the leading technology for long-term / high-volume electricity storage during the next few decades. However, these would be large-scale facilities compatible with industrial or former industrial areas, not sensitive rural areas.

5. Finally, heat batteries are a potentially important way to store heat produced from domestic solar panels or cheap off-peak electricity, especially if the input electricity is used to generate the heat efficiently using a heat pump. Heat pumps are discussed below, in the section on energy efficiency in buildings.

### ***Transport***

The Committee on Climate Change makes clear that electrification of transport is a key priority for the 2020s. The electrification of cars and buses will be of significant benefit to the towns and rural areas of North Yorkshire, where environment pollution (fumes and noise) significantly impacts residents' health, quality of life, and the visitor experience in busy tourist areas and near arterial roads.

The shift to electric cars is likely to happen more rapidly than most observers expect, as the car industry already recognises the approaching endpoint for petrol and diesel cars. This endpoint is likely to be sharp, as electric car prices will drop below the price of petrol cars by the middle of this decade, and the running costs of electric cars in terms of fuel, repairs and servicing are already substantially lower than those of petrol cars. It seems likely that car companies' recent objections to the announcement of a UK ban on fossil-fuelled car sales beyond 2030 – objections now lifted – were mainly motivated by concern that petrol car sales will drop even faster when the public recognises the approaching endpoint as well.

The Rural Commission therefore has a key role in advising North Yorkshire County Council on an early rapid rollout of charging facilities across the county, both for home charging in towns where homes have no access to off-street charging, and on arterial roads where there will be high demand for rapid charging facilities. This will require a well-coordinated network of activities, to be brought on stream with considerable speed, ranging from education and training for job creation through to collaboration between local authorities, private companies, and to the extent possible, with central government. This is an area where local government may wish to lead in collaboration with business.

Beyond electrification of cars and buses it is also important, both for the environment and public health, to shift the balance between car transport and other transport modes. In addition to the obvious need for an improved public transport network, we suggest that the Commission propose as a priority the phased development of a county-wide network of off-road cycle routes. Such networks are popular in countries such as the Netherlands and Germany, and to an increasing extent in Scotland, as they offer a significant boost to quality of life and a substantial boost to tourism numbers, which benefits local communities while moderating road traffic volumes, numbers of fatal accidents, and particulate pollution levels.

## **Energy efficiency in buildings – retrofitting and new builds**

There can be little doubt that, over the course of the next 10, 20, and 30 years, society will respond to increasingly disruptive climate impacts by holding governments' 'feet to the fire' over their response on climate mitigation and adaptation. One of the most effective methods of climate mitigation is the transition to a fully electrified economy powered by low-carbon electricity, which is now in fact already underway. Full electrification requires a several-fold expansion of electricity generation at the same time that the electricity supply is decarbonised, and this places a strong emphasis on improving the efficiency of energy use. A recent assessment by National Grid [11] shows a need for a 75% reduction in the energy consumption of an average home by 2050, of which the largest part in UK buildings is the energy used for heating. This makes energy efficiency, and in particular a combination of high-quality insulation and energy-efficient heating, a major thrust of the low-carbon transition. Because of this, central government, guided by advice from the Committee on Climate Change, will inevitably have to provide major sustained funding for energy efficiency improvement throughout the next decade and beyond.

In order to ensure widespread uptake of government funding in rural North Yorkshire the country will need to drive up public education in this sphere and support a strong (probably exponential, doubling every 2-3 years) build-up in the number and the capacity of local businesses able to install energy efficiency measures. Before discussing the topic of education and training, we first outline the energy efficiency measures that will be needed.

### ***Insulation***

Currently most existing buildings in the UK have roof or loft insulation, some form of double or secondary glazing on some or all windows, and buildings with cavity-walls typically have some level of cavity-fill insulation. This leaves most buildings with considerable thermal losses, first, because ground floors are typically not insulated, and second, because levels of insulation installed to date (typically 150 mm loft insulation and often poor, ageing, or bridged cavity-wall insulation) are inadequate. Current standards for improvement, e.g. under the Green Homes Grant scheme, envisage increasing loft insulation thickness to 300 mm (still allowing significant, though smaller, thermal losses), potentially replacing cavity-wall insulation, adding underfloor insulation, replacing any remaining single-paned windows with double or triple glazing, and draught-proofing.

However, a 75% reduction in energy use for home heating, as envisaged in long-term planning for the period the Rural Commission is considering, is a major challenge requiring a very large-scale re-vamp of the existing housing stock and very high standards (possibly Passivhaus) for new buildings built within the next few years. This is a particular challenge in North Yorkshire where a large part of the housing stock is old (pre-1930) and lacks cavity-wall construction. Nevertheless, reasonably good insulation of such buildings is possible. Where appropriate, external wall insulation can be used, and in situations where this is not feasible for aesthetic or planning reasons there are now modern internal insulation methods (sustainable insulating plaster or 10 mm roll-on insulation) that do not occupy significant

interior space and may be more affordable than previously available methods. It should be noted that very few members of the public, or even professional installers, are sufficiently aware of these methods – a further example of the need for better technical education and training. An illustration of what can be done in a typical small rural property at modest cost is given in Reference 12 below.

### ***Energy-efficient heating***

Electricity will need to become the primary mode of heating for most UK housing within the next 1 – 3 decades. Traditional resistive heating using oil-filled electric radiators or storage heaters is highly inefficient, as 1 unit of high-grade electrical energy translates to just 1 unit of low-grade heat. Efficiency can be raised by a factor of 3 – 4 by using electricity to pump ambient heat into the home, using a ground-source or air-source heat pump which may generate as many as four units of heat for every unit of electricity consumed. The heat so produced can be injected into the home via air (air conditioning) or via hot water which then circulates to existing central-heating radiators or underfloor heating, and can also be used for domestic hot-water (air-to-water heat pump or ground source heat pump). Reference 12 illustrates the case of an air-to-water heat pump installed in a small cottage in rural North Yorkshire.

There are effectively no alternative heating methods that can compete on efficiency with heat pumps. Hydrogen has been discussed as an alternative low-carbon fuel, but this is less efficient as it requires either electrolysis of water using electricity (roughly 70-80% efficient) or the breakdown of fossil methane to hydrogen and CO<sub>2</sub> which would then need to be captured and piped out to a recovery network for ultimate underground storage, as well as the hydrogen being piped or transported to the home. Moreover, if hydrogen is simply burned in a boiler, the end efficiency will be 4 – 6 times lower than for a heat pump.

It is interesting to note that in some Scandinavian countries the price of heat-pump systems is much lower, and market penetration much higher than in the UK. This is particularly the case in Finland [13,14], where heat pump systems typically cost one fifth of the current cost in the UK. These glaring differentials in price and market penetration illustrate the importance of upscaling key technologies such as heat pumps to high volumes to take proper advantage of these efficient, fundamentally cost-effective systems. While this aspect is out of the control of one county, it is again important that education and training in North Yorkshire is made available to all age groups, so that they can participate in the benefits of energy transition, in the same way that the population has benefited from access to computer skills and IT.

### ***New buildings and local authority planning conditions***

It is well known that the cost of retrofitting an existing home can be up to five times the cost of putting appropriate energy efficiency measures into a new build construction. Consequently, North Yorkshire has a key role to play by applying stringent planning conditions for energy efficiency and electrification in new buildings. We respectfully suggest



that the North Yorkshire Rural Commission should strongly emphasise this point as part of its recommendations. In addition to energy efficiency measures it clearly makes sense to include appropriate rooftop solar and EV charging outlets as part of these planning conditions.

## **Education, training and employment**

This item comes last in our submission to the North Yorkshire Rural Commission but it is in many ways the most important advisory issue that the Commission has to tackle. Currently North Yorkshire is relatively poorly served with education at sixth form level, and with further education, adult education, and training. For example, in Ryedale there is no further education college [1]. This is a serious disadvantage for a county faced with major impending changes caused by the renewable energy transition, particularly changes in the employment market and public engagement / acceptance. A large proportion of the population of rural North Yorkshire, including those of school age, are relatively poorly informed of the changes that are afoot, and therefore understandably fearful of change. Although one might argue that the county has let down its own population in this respect, it is a genuinely enormous and all-encompassing task to address these issues at this time. We think that the county should, as a minimum, lobby government and major businesses alike for funding for a significant expansion of technical and engineering education at a non-academic level, in order to train the workforce needed to carry out the work described above. We hope that the Rural Commission will give close consideration to these issues and thank its members for their kind attention.

## **References**

- [1] North Yorkshire County Council, Locality Profiles, URL: <https://hub.datanorthyorkshire.org/dataset/locality-profiles>
- [2] Farmers Weekly, Natalie Noble. Harvest 2020: yields are down for barley, OSR and wheat, URL: <https://www.fwi.co.uk/arable/harvest/harvest-2020-yields-are-down-for-barley-osr-and-wheat>, accessed 17/11/2020
- [3] T.M. Lenton et al. Climate tipping points – too risky to bet against, *Nature* **575**, 592 (2019)
- [4] Y. Xu et al. Global warming will happen faster than we think, *Nature* **564**, 20 (2018)
- [5] J.E. Hansen and M. Sato. Accelerated global warming (personal communication, 14 Oct 2020)
- [6] V.E. Fioletov et al. A global catalogue of large SO<sub>2</sub> sources and emissions derived from the Ozone Monitoring Instrument, *Atmos. Chem. Phys.* **16**, 11497 (2016)
- [7] IMO website, URL: [www.imo.org/en/MediaCentre/HotTopics/Pages/Sulphur-2020.aspx](http://www.imo.org/en/MediaCentre/HotTopics/Pages/Sulphur-2020.aspx), accessed 17/11/2020

- [8] IPCC Sixth Assessment Report (2021-22), URL: [www.ipcc.ch/assessment-report/ar6/](http://www.ipcc.ch/assessment-report/ar6/)
- [9] York and North Yorkshire Local Enterprise Partnership draft report. A local industrial strategy for York and North Yorkshire, URL: [www.businessinspiredgrowth.com/wp-content/uploads/2020/06/LIS-YN-Y-BOARD-SIGN-OFF-13032020.pdf](http://www.businessinspiredgrowth.com/wp-content/uploads/2020/06/LIS-YN-Y-BOARD-SIGN-OFF-13032020.pdf), accessed 17/11/2020
- [10] J. Scurlock. Agricultural good practice guidance for solar farms, BRE report (2014)
- [11] National Grid ESO report 'Future Energy Scenarios'. Summary document "FES in 5", URL: <https://www.nationalgrideso.com/document/174016/download>, accessed 17/11/2020
- [12] N. Cowern. Greening energy use in a 1922 rural cottage in Yorkshire, Medium, 8 Oct 2020, URL: [link.medium.com/ELXSQrN1vbb](https://link.medium.com/ELXSQrN1vbb)
- [13] M.J. Hannon. Raising the temperature of the UK heat pump market: learning lessons from Finland. *Energy Policy* **85**, 369 (2015), [doi.org/10.1016/j.enpol.2015.06.016](https://doi.org/10.1016/j.enpol.2015.06.016)
- [14] Finnish Heat Pump Association, Heat pump sales in Finland continue at a good pace, URL: [heatpumpingtechnologies.org/news/1/55186](http://heatpumpingtechnologies.org/news/1/55186), accessed 18/11/2020