

Traction Electrification

PWI Cheshire & North Wales Section: 25 February 2021

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What am I aiming to explain?

- A brief guide to the history of development and deployment of electrification in the UK
- The place of Traction Electrification in the context of the 21st century and transport provision as the climate crisis is addressed
- The challenges that must be faced

I hope I can do that without preaching (too much) and keeping your interest

Why do we need Electrification?

Electric trains are:

- Cheaper
- Quieter
- Cleaner
- Carbon free at the train
- Lighter, less damaging to the rails ballast and sleepers
- More powerful
- Operationally more flexible

Climate change (the point on carbon)

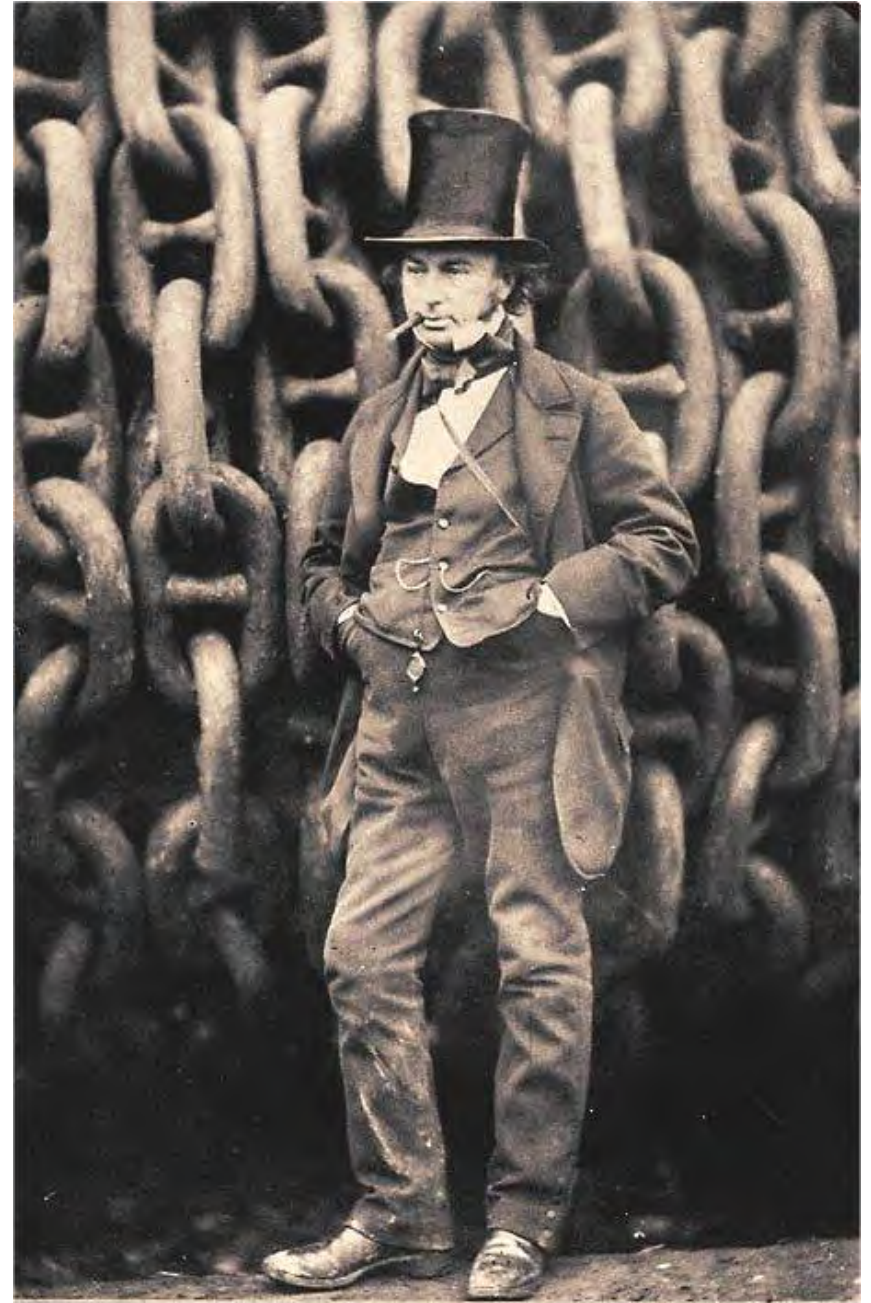
- All studies agree on one thing, we must eliminate dependence on fossil fuel
- Hydrogen **might** have a marginal role, never for main line heavy haul
- Batteries **might** have a role, but battery technology is heavy and relies on rare earth metals (the clue is in the name). Maximum range around 50 miles.
- Only full electrification works for main routes.
- If all that is true, why are all railways not already electric?

We need to look at what history can teach us

In The Beginning

Railways Revolutionise the world 1840s

- GW and railways more generally owe much to Isambard Kingdom Brunel
- Brunel knew that energy efficiency and cleaner operation could be achieved if the engine was part of the infrastructure
- His answer was atmospheric propulsion
- That failed not least because it leaked



Too late for Brunel

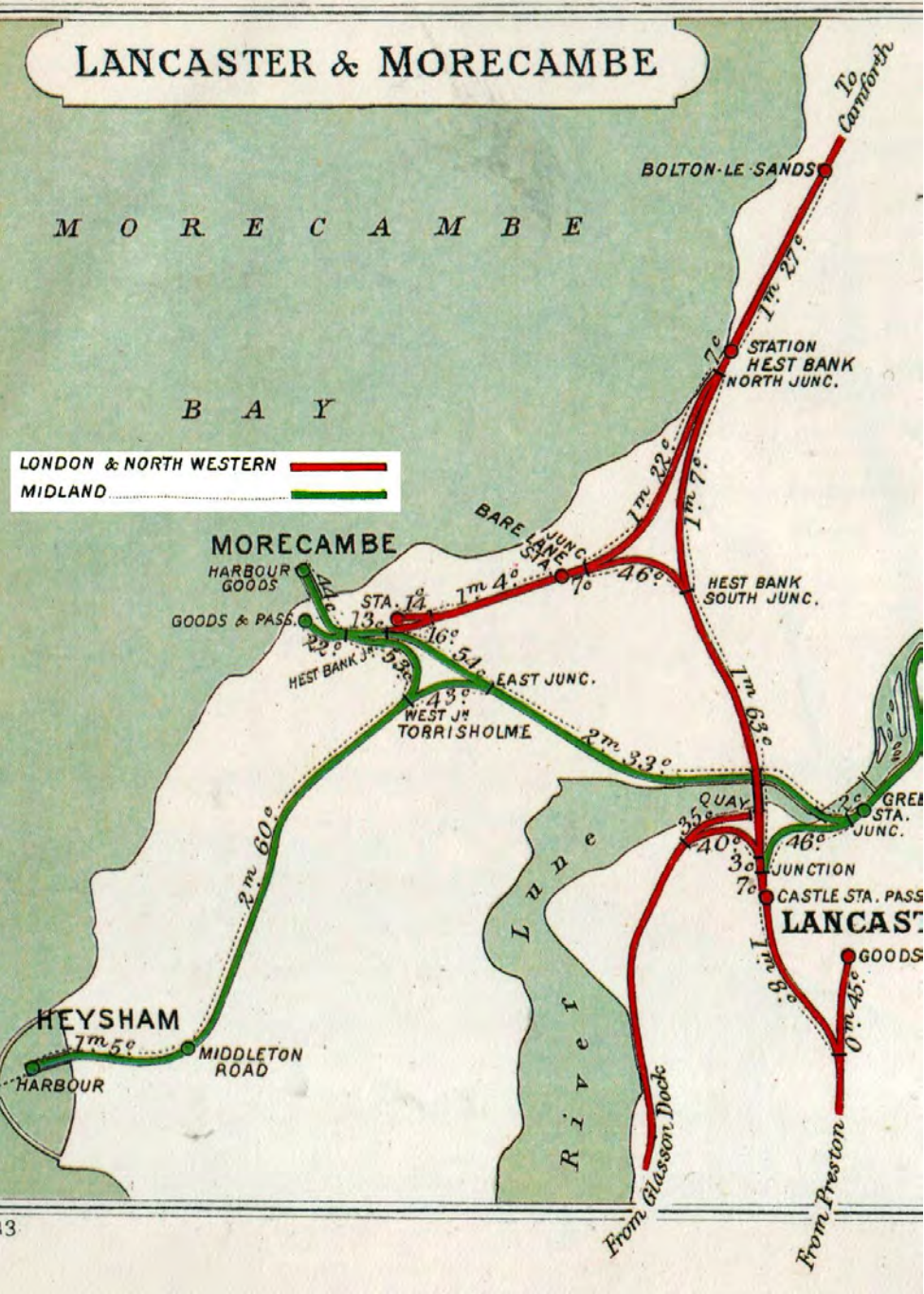
The birth of electric traction

- 1879
- Siemens demonstrates the first practical electric locomotive
- Picked up later and further developed by Westinghouse in America



In the North West

- R M Deeley was Chief Electrical Engineer of the Midland Railway
- In 1906 MR announced that Morecambe-Heysham and Lancaster was to be electrified.
- 1908 work completed
- Electric services ceased in 1951, and the line became diesel only
- Through the 1950s the line was an experimental test bed for the BR 25kV system in preparation for Euston-Manchester and Liverpool electrification.



The Midland Lines

- Railway Clearing House junction map
- Green lines are the Midland



Heysham Generating Station

- In the era pre national grid, industrial use of electricity made it necessary for users to build their own generating capacity
- Already in service for dockside cranes the Midland Railway had a Power-House at Heysham
- Expanded to supply Traction Power this is I believe an image of the MR Generating Station
- It generated 6,600v ac, state of the art in 1908



The rolling stock

- Two power cars from Westinghouse (upper image)
- One power car from Siemens (lower image)



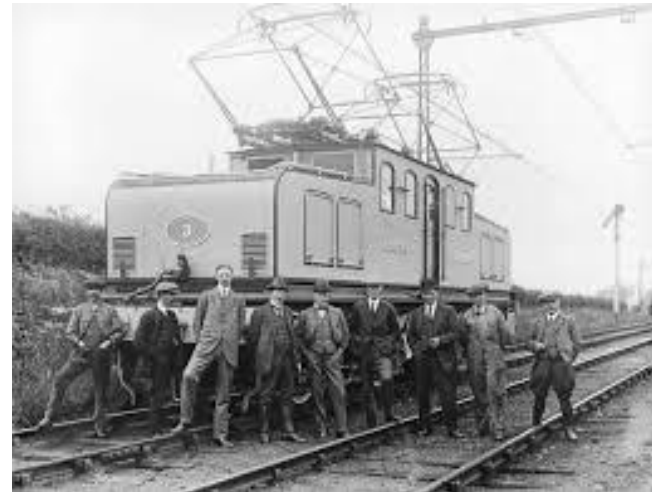


Morecambe Station 1933

- The railways were bigger then!
- Note the multi track portals

The North Eastern Railway

Sir Vincent Raven and Charles Mertz



Electrification schemes I have left out

- Shildon Newport
- London Brighton and South Coast
- The Underground in London, Liverpool and Glasgow
- Southern Railway (and the other dc conductor rail lines north of London, in Newcastle and Manchester)
- Altringham and South Manchester Junction
- Manchester Sheffield and Wath

The Story Up To 1939

- From the last years of the 19th century electric traction began to develop
- Conductor rail systems grew rapidly
- OLE systems both high voltage AC and DC were put into service
- By outbreak of World War Two in the UK the Wier report had set out standardisation of two alternatives, 750v conductor rail and 1500v overhead

Standardising the Main line system

- BR came into existence with the GE system as a work in progress and Manchester-Sheffield and Wath at an advanced stage
- In its early years BR progressed those schemes but recognised that a different system of electrification in Europe had emerged which seemed to have economic advantage
- Exploration of the approach by SNCF and development of a clear economic case lead many to see the advantages of 25kV overhead
- Between two UIC conferences in 1956 and 1962 the 25kV system architecture and the technology matured and was adopted by BR

So onward now to the post war period

British Transport Commission

Post War, post nationalisation optimism 1955

- British Transport Commission publish a modernisation plan
- Electrification of the network is the goal, with diesel as an interim measure
- Plan was for most lines to be converted by around 1990
- 1500 volt dc was the standard
- Austerity slowly kills the electrification plan
- Dieselisation becomes the established norm



Modernisation plan delivered only in part

- The 1962 switch to 25kV tips the scales and the Main line from Euston to the North is started.... but
- Euston-Manchester and Liverpool runs late
- Overspend alienates the minister of transport and electrification is halted
(Depressingly you will hear that again in a few minutes)
- Eventually BR address the costs and WCML to Glasgow is completed



A short pause for detail in the narrative

- What BR did was nothing short of transformational
- The need for project planning was recognised, WCML was the first project anywhere outside America to adopt critical path analysis
- A strategic planning principle known as Route Rationalisation, Re-signalling then Electrification (Route Rat, Resig then Electrify) became a fixed principle and a mantra
- Every component of the electrification fixed infrastructure was re-thought, re-designed and actively integrated into a production process relentlessly reducing unit cost of every minute part of the project
- Weaver Junction to Glasgow was first to apply the new way
- Those measures brought forward the most successful and cost effective delivery ever achieved

British Rail

The Nationalised Railway is Mature 1977

- BR publishes electrification plan
- Option 5, wholesale electrification is selected
- 25kV ac is the selected system
- 11% return demonstrated, and full treasury backing secured
- May 79, election result, shelves the plan
- The HST wins out over APT



Option 5 delivered only in part



- Schemes in Anglia and Scotland completed
- ECML is BR greatest success
- But when it is completed, privatisation is in view
- Signalling then track grab the attention of Railtrack and then NR
- Electrification is off the agenda

Network Rail

Network Electrification Plan Announced 2010

- The Network Electrification Programme
- A new rolling programme to electrify the network
- Full and enthusiastic backing from DfT
- CP5 cost and programme overruns alienate the minister of transport and electrification is halted

(I warned you that was coming)



NEP delivered only in part



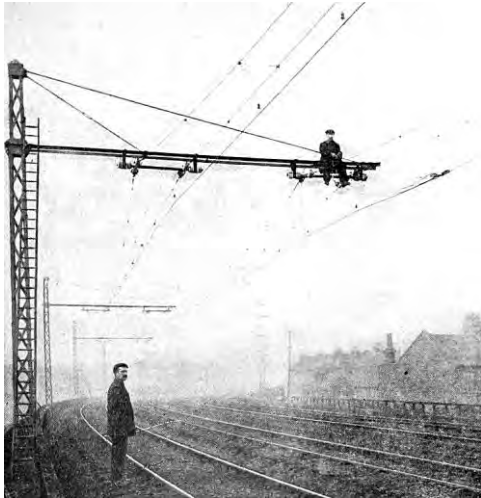
- Great Western is partially completed
- Wires go only to Cardiff and Bristol
- No wiring via Bath, no wiring to Oxford, no wiring beyond Cardiff
- Schemes in the NW and Scotland overshadowed by delay and cost escalation

What point am I trying to make?

- That history has important lessons
- Right from the start electrification has been the obvious superior solution to railway traction
- Each and every scheme ever tackled has been a transformational success once in operation
- Passengers, the railway, businesses and communities served all experience benefit, the pain of the conversion is quickly forgotten
- GW was among the more painful and was constantly news worthy for all the wrong reasons, but try offering users of trains from Bristol to London the choice to still be on HSTs

Some pictures of example

All of these electrifications were a paradigm shift improving the railway, there are literally hundreds more I could have shown.

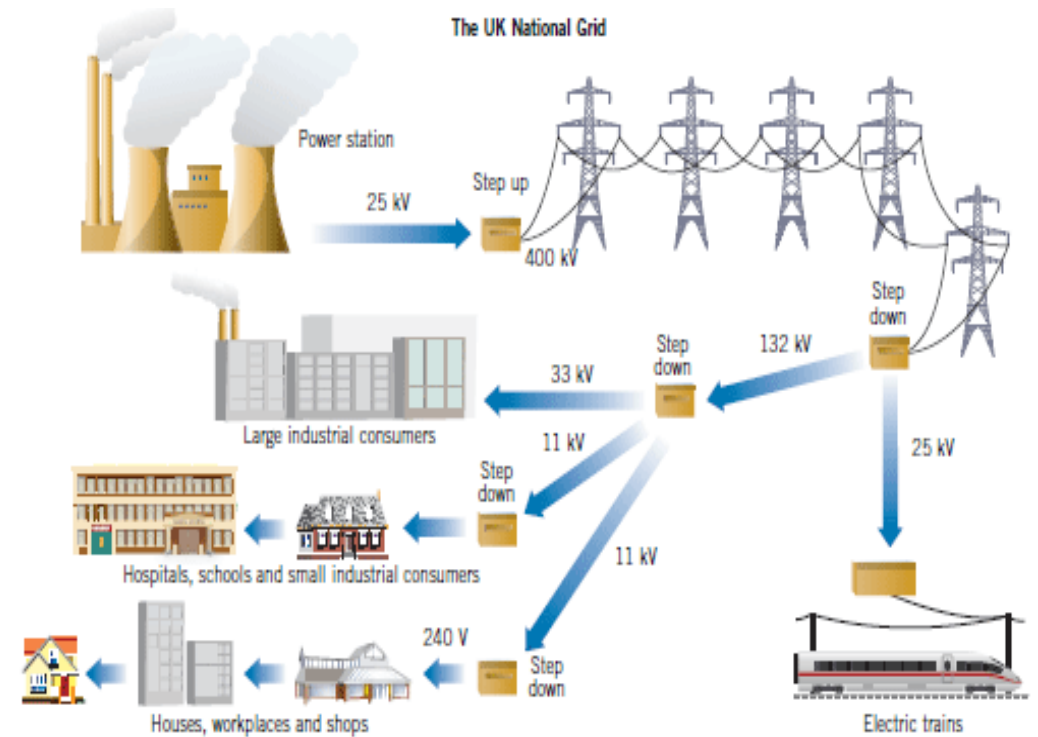


Climate Crisis: The Here and Now

- The world is beginning to respond to the threat brought by climate change
- National governments including the UK have committed to net zero carbon by 2050, that is a legal commitment
- Transport decarbonisation is a big part of the UK plan
- NR has published the Traction Decarbonisation Network Strategy
- That proposes nearly doubling the route mileage of electrified lines
- This sets the future course.....BUT

Where will all the electricity come from?

- Grid and Distribution networks are changing
- This picture will look different in 2050, most if not all big power stations will be gone, replaced by solar, wind and other renewables
- Traction demand will more than double
- Road vehicle charging point and domestic heating will challenge the national generating capacity
- A priority is to inform the generators where we will need supplies and how big those supplies need to be



What do we need to do

- First and foremost we must re-discover the energy and sense of purpose that BR showed and which culminated in Don Heath, the Project Director for ECML headlining his completion report

“One Year Early and Under Budget”

- Most importantly senior levels of the industry must have the humility to admit that the mega project bureaucracy of the post privatised railway is not fit for purpose and they must change organisation and culture radically
- We need a culture which adopts a single minded attitude which is laser focussed on cost and value for money

The Future Challenges

- The National economy must move to net zero carbon by 2050
- Transport is a major contributor to the national carbon footprint so transport must change
- Private cars will probably reduce in number but all that remain will be battery or perhaps hydrogen powered
- Diesel lorries cannot make that transition, other means of freight movement are needed
- By 2050 the whole railway must be carbon neutral
- To be a credible and relevant part of a post carbon national economy, railways must carry greatly increased volumes of freight, all electrically hauled, a so called modal shift (a cultural shift for a railway that largely fits freight only at the margin)
- The Traction Decarbonisation National Strategy has identified the imperative for a very large increase in the mileage of electrified lines, the cost of that transition must be affordable
- Unless these challenges are addressed many of our railways will become a part of history, irrelevant to future generations along with the combustion engine, and fossil fuels

My message is this

- The railway has now a chance to move to widescale electrification
- If the railway grasps that chance enthusiastically it will secure its future place in transport for this and future centuries
- Repeat of those failures seen in history will have extreme consequences
- Lines not within the net zero envelope will have no traction, therefore no trains, routes will close
- Like all aspects of climate change, the challenge for the railway is existential