Recovering copper leads to potentially huge volumes of avoided emissions

November 2024

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Incumbent operators (ILECs in North America) are firming up their plans to decommission their copper networks, and we expect most operators to have fully decommissioned copper by 2035, many substantially earlier (see Analysys Mason's *Wireline decommissioning tracker*). What is less clear is how much of the copper plant has already been recovered, will be recovered, or is recoverable. The potential financial gain is real, and the potential sustainability benefits are enormous. This article focuses on the CO_2 emissions benefits of recovery of copper in networks.

Most copper remains in situ, despite a rapid decline in utilisation

The volume of copper twisted pairs (also known as telephone lines) deployed worldwide peaked at some time in the 2000s, by which time the number of active lines (used mostly for a mix of PSTN/ISDN and xDSL) had started to decline. BT indicated in 2007 that it had 121 million kilometres of twisted pairs in place. This is probably about the maximum volume it had. Given some assumptions about conductor gauges, we can calculate the approximate copper weight of those 121 million km of pairs at around 390 000 tonnes. That weight of **copper** would be worth about USD3.6 billion at current prices, although its value as scrap **cable** would be substantially less.

Anecdotal information from operators worldwide suggests that the volume of copper that has actually been recovered is a small proportion of the total that has been deployed.

- AT&T, the largest of the US ILECs, said that it had recycled 14 000 tonnes between 2021 and 2023.
- BT said in September 2024 that it had recovered 3300 tonnes of copper, although copper decommissioning in its network has barely started.
- Telefónica, which is ahead of most incumbents in copper decommissioning, said it had removed 65 000 tonnes of cabling from the approximately 1000 exchange areas it had decommissioned for copper in Spain by 2021.

In the past, regular refurbishment of copper plant allowed operators to increase the volume of copper pairs, and similarly later allowed for them to reduce the volume when demand for copper lines started to decline. However, refurbishment ceased to be a priority for operators once they had superior technologies in place. We also know that some copper was removed by some operators in exchange-to-cabinet segments of access networks when fibre-to-the-cabinet (FTTC) technology was introduced, but most operators skipped FTTC, and some that did deploy FTTC still needed these segments for voice.

A proportion of copper lines may not be economically worth recovering; cables could be buried (as opposed to being placed in ducts or on poles), and the number of pairs in distribution-side cables may be too low to make it worthwhile. BT has indicated that it aims to recover about 200 000 tonnes over the next decade.

Legacy telephone networks are not the only place where significant volumes of copper reside in telecoms infrastructure. The conductor wires in coaxial sections of hybrid fibre-coaxial (HFC) networks are made of copper, and many cable operators have started overbuilding HFC with fibre-to-the-premises (FTTP), a process that will inevitably result in the abandonment of coaxial plant. Analysys Mason's *Wireline decommissioning tracker* also covers these plans. Even mobile networks contain copper. Many mobile cell sites still have thick copper cables transmitting the unprocessed radio signal from the radio units to the baseband units on the ground. These are progressively being replaced with fibre, starting with high-traffic sites, and the process can be accelerated by a move to centralised-RAN architecture.

The carbon cost of recovered copper is significantly lower than the carbon cost of mine production from ore

The carbon cost of producing a tonne of pure copper from ore is estimated to be 4 tonnes of CO_2 equivalent (tCO_2e).[1] The total copper mine production worldwide was about 22 million tonnes in 2023, and production has steadily increased since 2010.

The carbon cost of recovery is harder to estimate. The process has two main components: the removal of cables (and possible associated remedial work such as removing poles), and the processing of cables to remove and refine the copper.

Removal will not typically occur at the same time as FTTP roll-out. Migration, even forced migration, takes time. Some operators will remove the final aerial drop as a customer courtesy when installing FTTP, but this is a trivially small proportion of total lines. Hence the (carbon) cost of removal is a separate cost.

Estimates of the carbon cost of recycling copper from removed cables vary considerably. But they all show that the carbon cost is a fraction of the carbon cost of producing copper from ore. We have seen figures between $0.62tCO_2e$ and $1.54tCO_2e$ per tonne of copper recovered. Some of that variation will be down to whether or not the carbon cost of removal is included.

An operator could sell into the market resulting in that volume of copper not needing to be produced from ore. The difference between mined copper and recycled telephone wires would be $2.46tCO_2e$ and $3.38tCO_2e$ per tonne of copper, minus whatever the removal costs turn out to be. For an operator such as BT that intends to recover 200 000 tonnes, that translates to between about 500 $000tCO_2e$ and 700 $000tCO_2e$. To put that number in context, BT Group's annual Scope 1 and 2 (location-based) emissions in 2023 stood at 686 $000tCO_2e$.

It is well-known that replacing copper/xDSL with FTTP/xPON creates massive operational energy savings, and that therefore, depending on local energy supply, it can reduce Scope 2 greenhouse gas (GHG) emissions. The extent to which an operator could count copper recovery as Scope 4 or 'avoided emissions' is complicated. Carbon avoidance is a big subject of discussion, but there is no formal GHG protocol at this point. To avoid double-counting or cherry-picking, the operator and the recycler would certainly have to come to an agreement about sharing the emissions savings. These caveats aside, copper recovery from telephone networks does look eligible for reporting as avoided carbon, and it is certainly worth operators shouting about it.

1 See for example https://www.boliden.com/products/our-products/GTM/.

Analysys Mason's *Sustainable Networks* programme helps technology companies within the networked economy to benchmark their sustainability progress against peers, understand the implications of choices relating to network technology and architecture, and implement effective strategies for enhancing the sustainability of operations, including those of suppliers and customers.