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Data Centres in 2030: Comparative Case Studies that Illustrate the Potential of Design for the Circular Economy as an Enabler of Sustainability.

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Data centres are facilities that house digital data processing (IT) equipment that enables networked communication activity. Since the launch of the world wide web in 1989 the number of DCs around the world has grown to 8.6 million; they cover 180m m^2 floor space, 6% (10m m^2) of which is located in Europe and 70% being concentrated in the NW Europe. European and global economies are dependent on data processing and storage and consequently the DC industry's priority is 100% uninterrupted operation. Reliance on and demand for data centres will increase significantly as more smart products and services are connected via the Internet of Things (IoT) and in NWE capacity will increase 15%+ per year (300%) by 2025 while a global increase of 500% is predicted by 2030.

At present the largest environmental impact from DCs derives from operational energy; this is being addressed by improved operational efficiency and use of renewable electricity generation technologies. However, in view of the above growth the embodied impact of DCs must be not ignored. During DC life (60 years) 15% of embodied environmental impact derives from the building and facilities while 85% derives from IT equipment. Impact is high because equipment is typically refreshed every 1–5 years, and although accurate data has not been published DCI is a significant contributor to the global total of 11.8 Mt/year of Waste Electrical & Electronic Equipment (WEEE). WEE is one of the fastest growing waste streams in the EU; it contains CRM that are of high economic importance and vulnerable to supply disruption. In addition to this, manufacture is energy intensive and therefore contributes to the environmental impact of the sector.

Both the speed and volume of growth of waste associated to digital technologies is unprecedented but this has not been matched by the development of supporting recycling infrastructure and reuse, recycling and materials rates are low. At present WEEE recycling in NWE is limited to 32% and much of the rest is exported and reprocessed overseas and/or sent to landfill and consequently, millions of tonnes of valuable resources are wasted and/or made inaccessible by export every year from this sector. While some 'waste' materials are hazardous and have detrimental environmental and social impacts, many others are regarded as Critical Raw Materials because reliable and unhindered access to them is threatened and substitution with other materials is currently unfeasible.

This paper considers and compares two future case studies for what has become essential industry in 2030 and beyond: the first is based on current practice while the second includes a sector-specific circular economy. Both scenarios are feasible and while the first explores the wide-ranging economic, social and environmental impacts that will derive from restricted growth in DC capability, the second explores the immediate and long-term positive impacts associated with the development of a circular economy for the sector. It also discusses the various design, manufacturing and behavioural challenges to CE development. The case studies also illustrate the potential of CE as an enabler of sustainability.