Copenhagen Economics CE

THE ECONOMIC VALUE OF SUBMARINE CABLES IN THE ARCTIC

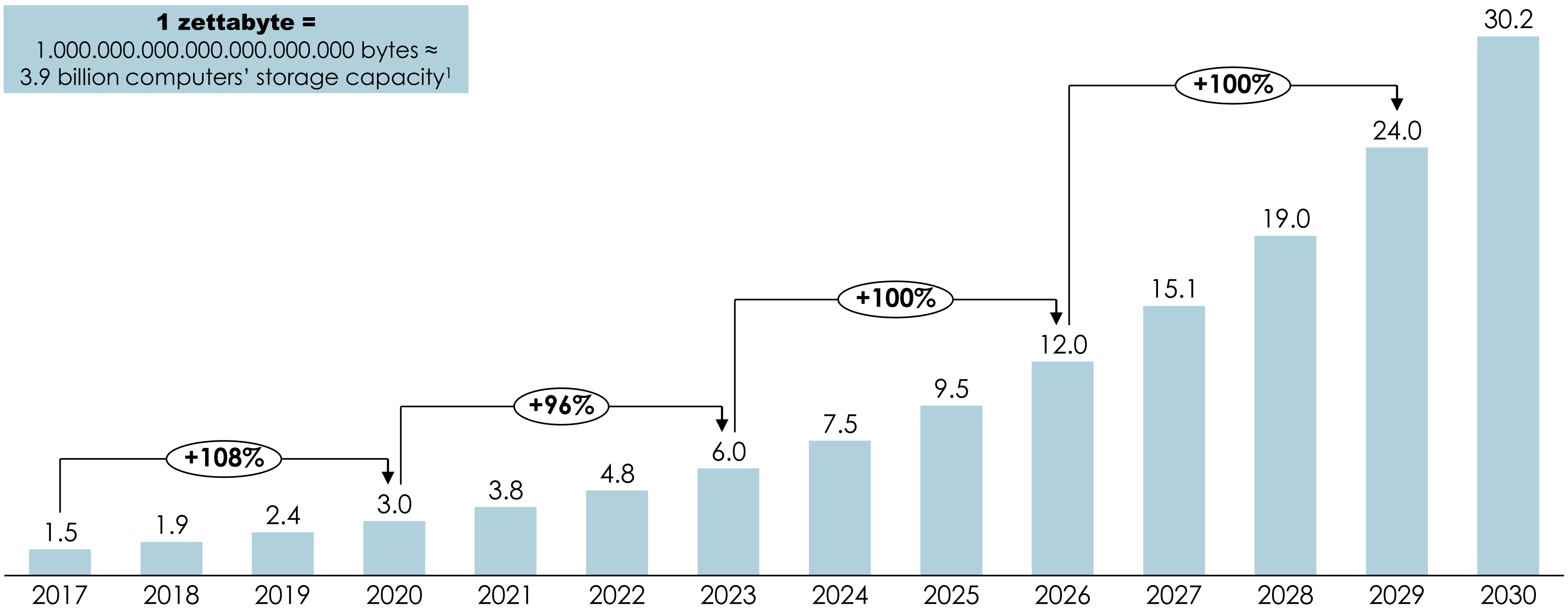
Copenhagen Economics for
NORDUnet

Presentation in Brussels 5th May 2023 – Polar Connect seminar

Global demand for internet data traffic is doubling every three years

Global internet data traffic demand 2017-2030
Zettabytes

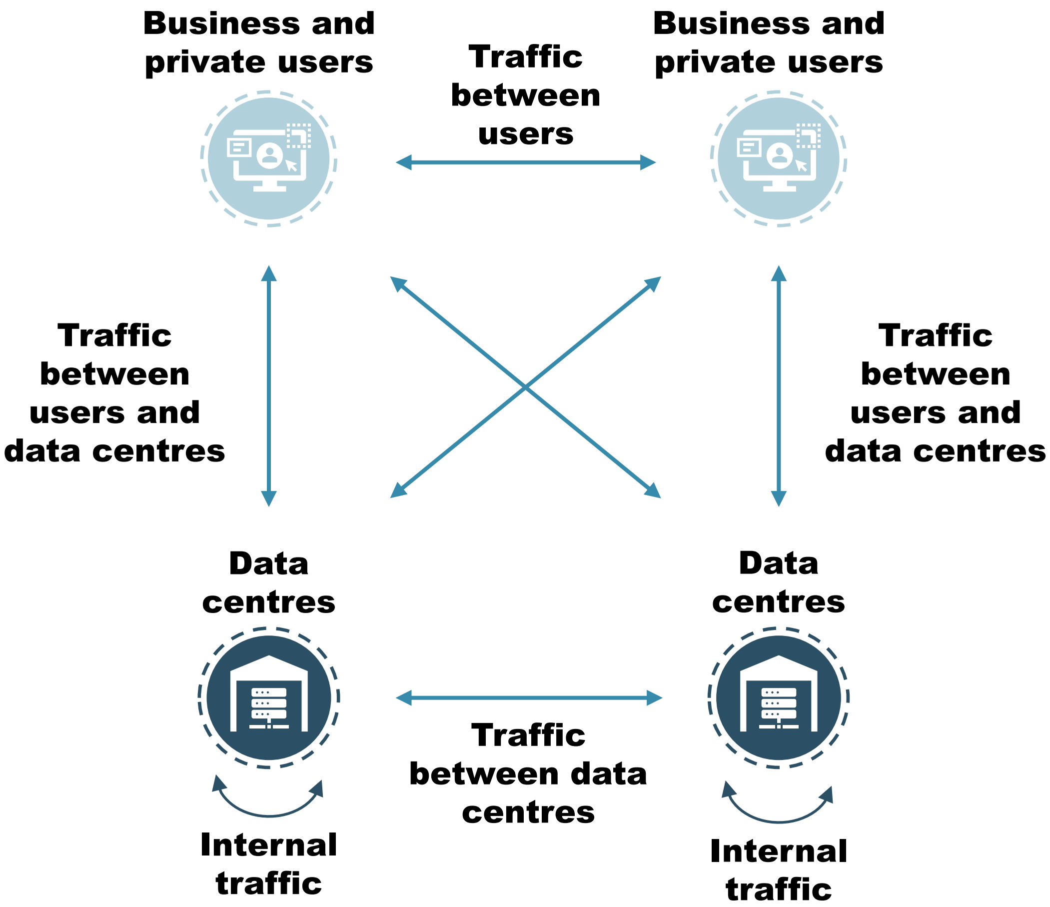
1 zettabyte =
1.000.000.000.000.000.000.000 bytes ≈
3.9 billion computers' storage capacity[1]



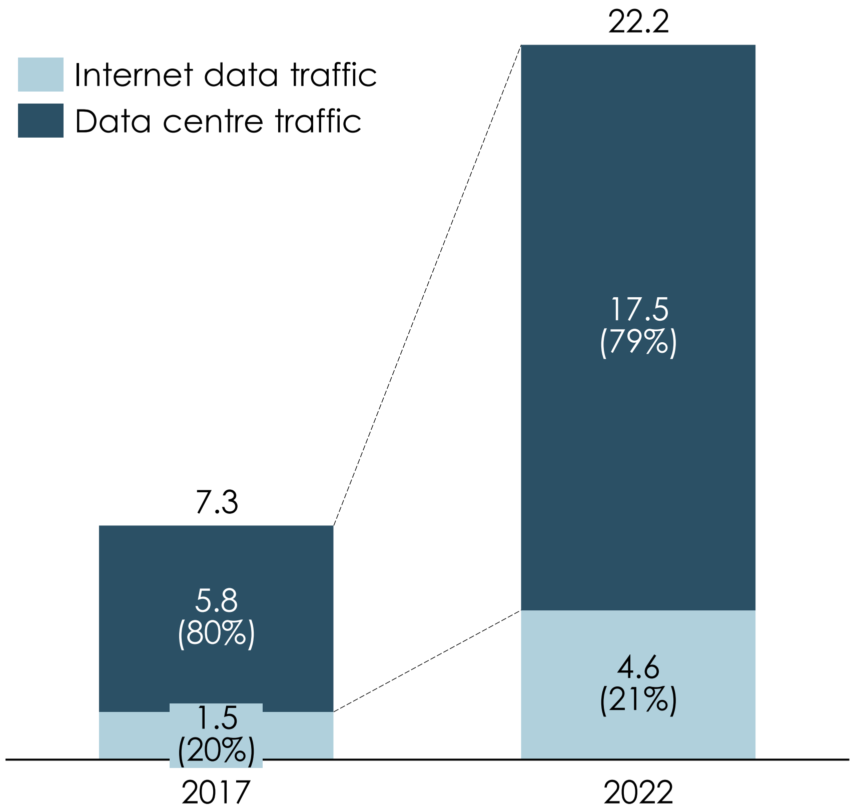
1) Calculated based on a computer with 256 gigabytes storage.
Note: These numbers show consumer and business IP traffic and hence exclude internal data centre IP traffic as well as IP traffic between data centres. 2023-2030 own calculations based on fixed CAGR of 26% for the years 2017-2022 as reported by Cisco.
Source: Cisco Visual Networking Index: Forecast and Trends, 2017–2022

The majority of data demand comes from data centres

Illustration: Key data flow channels

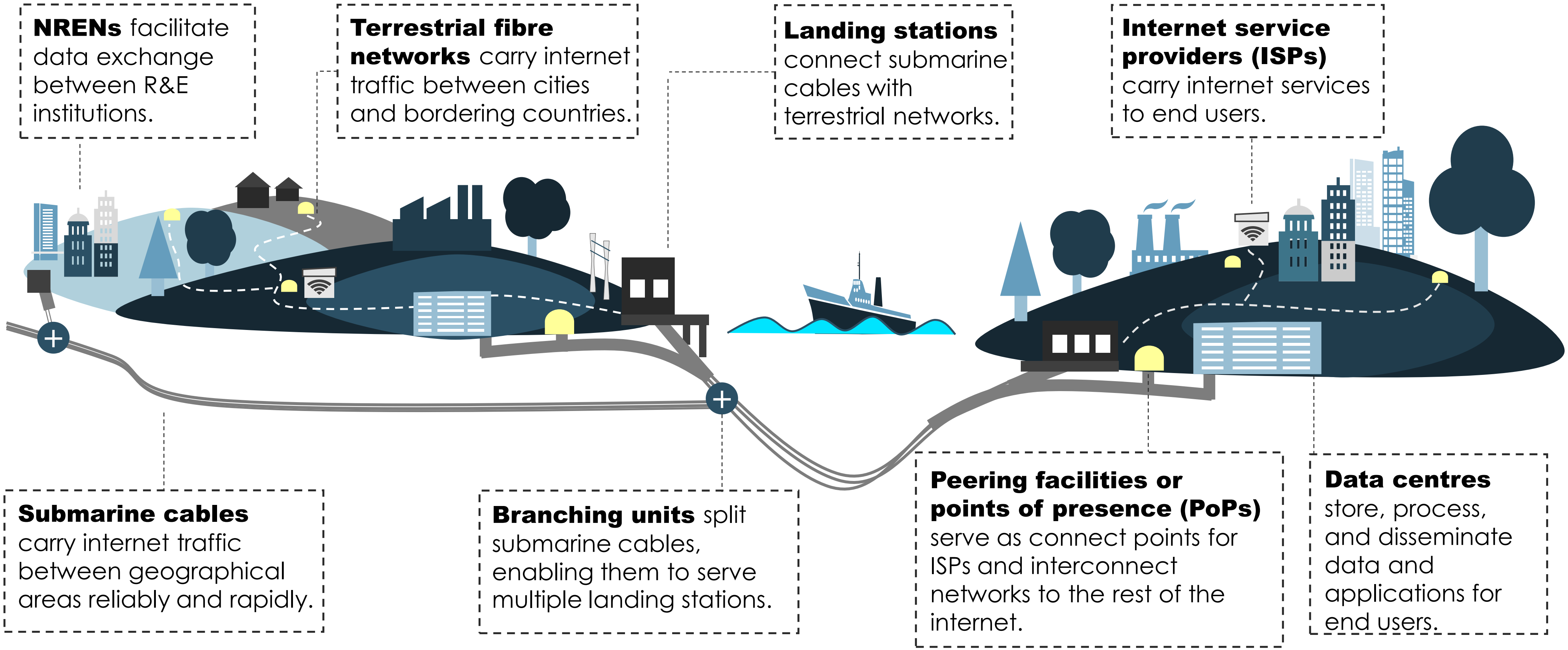


Internet and data centre traffic, 2017-2022
Zettabytes per year



Note: Internet traffic contains consumer and business internet traffic. Data centre traffic contains data traffic between data centres and internal data centre traffic. All data traffic is measured in IP traffic.
Source: Copenhagen Economics / Cisco Global Cloud Index: Forecast and Methodology, 2016–2021) / Cisco Visual Networking Index: Forecast and Trends, 2017–2022

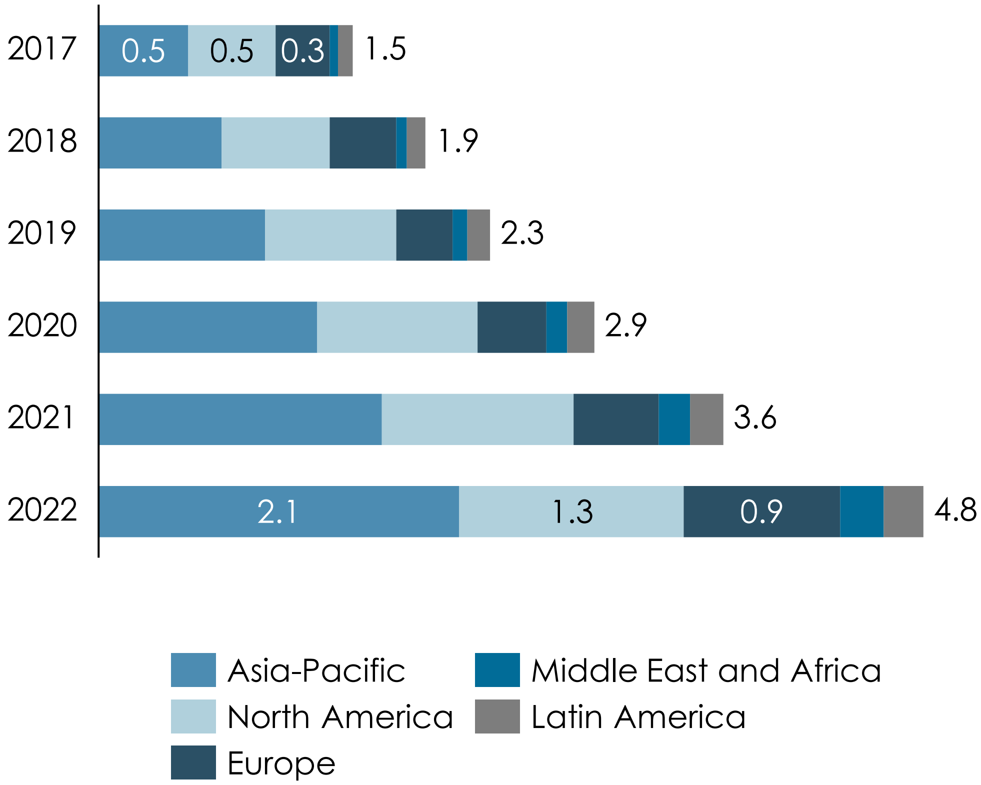
The increase in data demand requires additional investments in digital infrastructure, which consists of a complex network



Source: Copenhagen Economics based on Copenhagen Economics (2021)

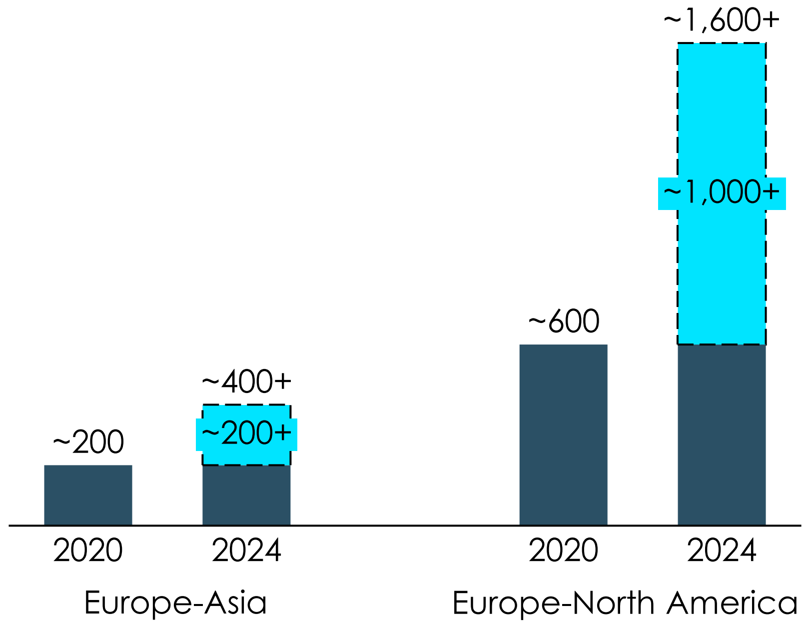
Europe needs substantial expansion of its internal capacities and intercontinental submarine cables

Global internet data traffic demand, 2017-2022
Zettabytes



Note: Data traffic defined as IP traffic. Numbers for Europe compiled from separate numbers for Western, Central and Eastern Europe.
Source: Cisco Visual Networking Index: Forecast and Trends, 2017–2022

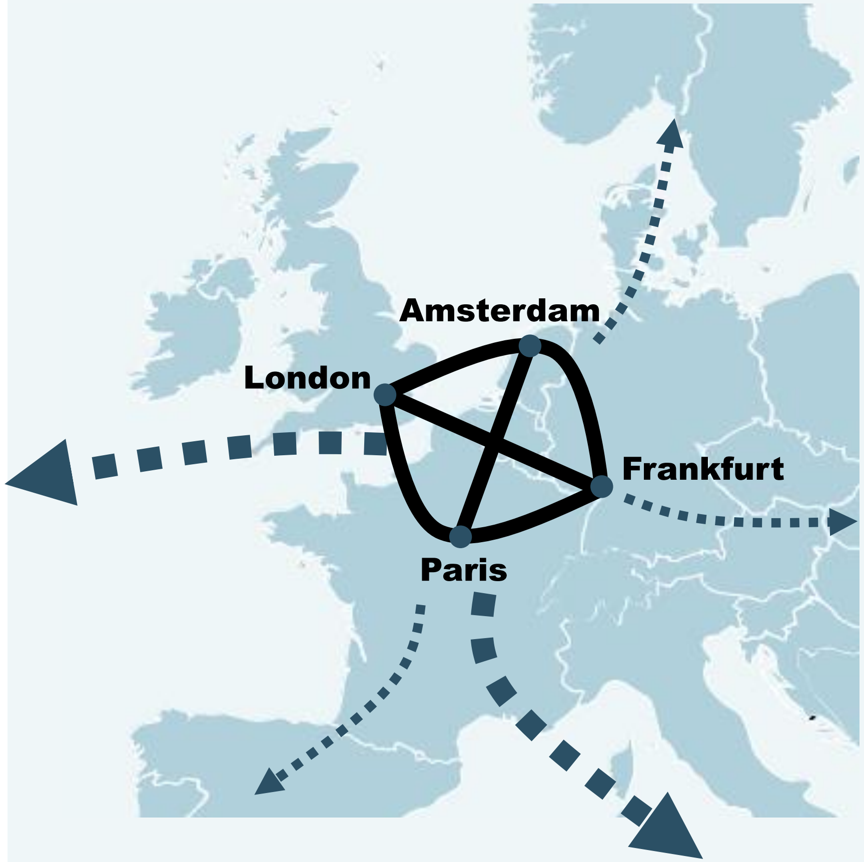
Bandwidth capacity Europe-Asia and Europe-North America, 2020 and expected in 2024
Terabits per second



Source: UNCTAD (2021), based on TeleGeography.

Today, the European landscape for digital connectivity is centred around an axis between London, Amsterdam, Frankfurt, and Paris

Illustrative map of the main digital hub in Europe



Fast fibre connections

- Fast terrestrial and submarine fibre cable connections established between major central European cities: Frankfurt, London, Amsterdam, and Paris (FLAP).
- Businesses and people in vicinity FLAP hub benefit from low-priced high bandwidth capacity/ low latency.
- Yet, the Central European region is congested.[1]

The hub is connected to other continents

FLAT hub connected to the rest of Europe and the world, primarily through terrestrial cables:

- through Russia
- submarine cables via Suez Canal (Middle East and Asia).

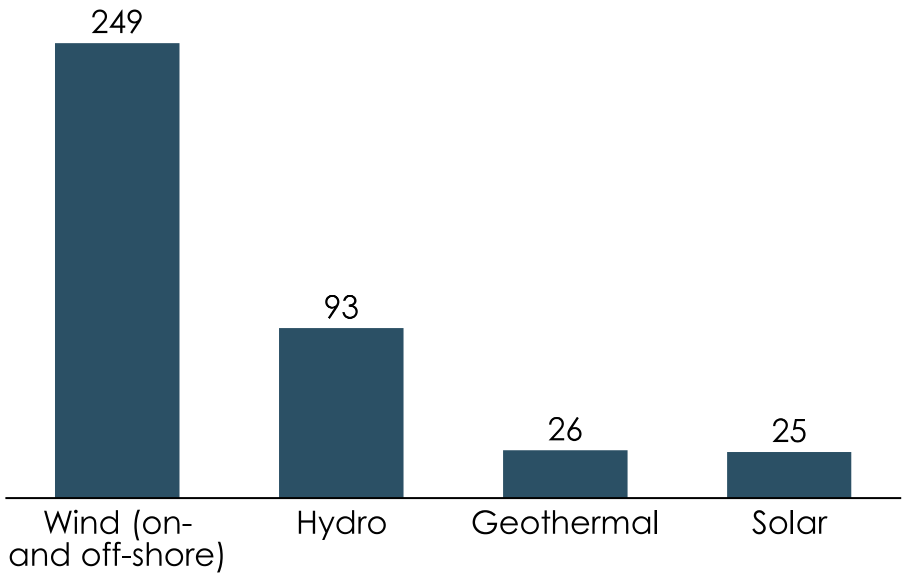
- submarine cables in the Atlantic Ocean (North America) Mediterranean Sea

Stability?
Expense?
Reliability?

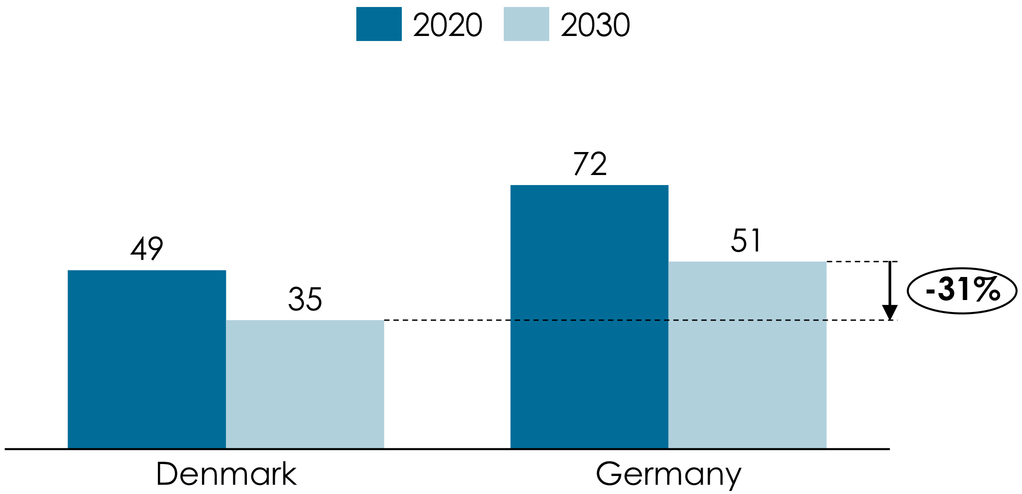
Source: Interviews with various stakeholders and 1) Data Center Knowledge (2017).

Better power to data centers: Nordic region has capacity to expand wind power at a large scale and lower costs

Renewable energy potentials in the Nordic region
Terawatt hours (annual)



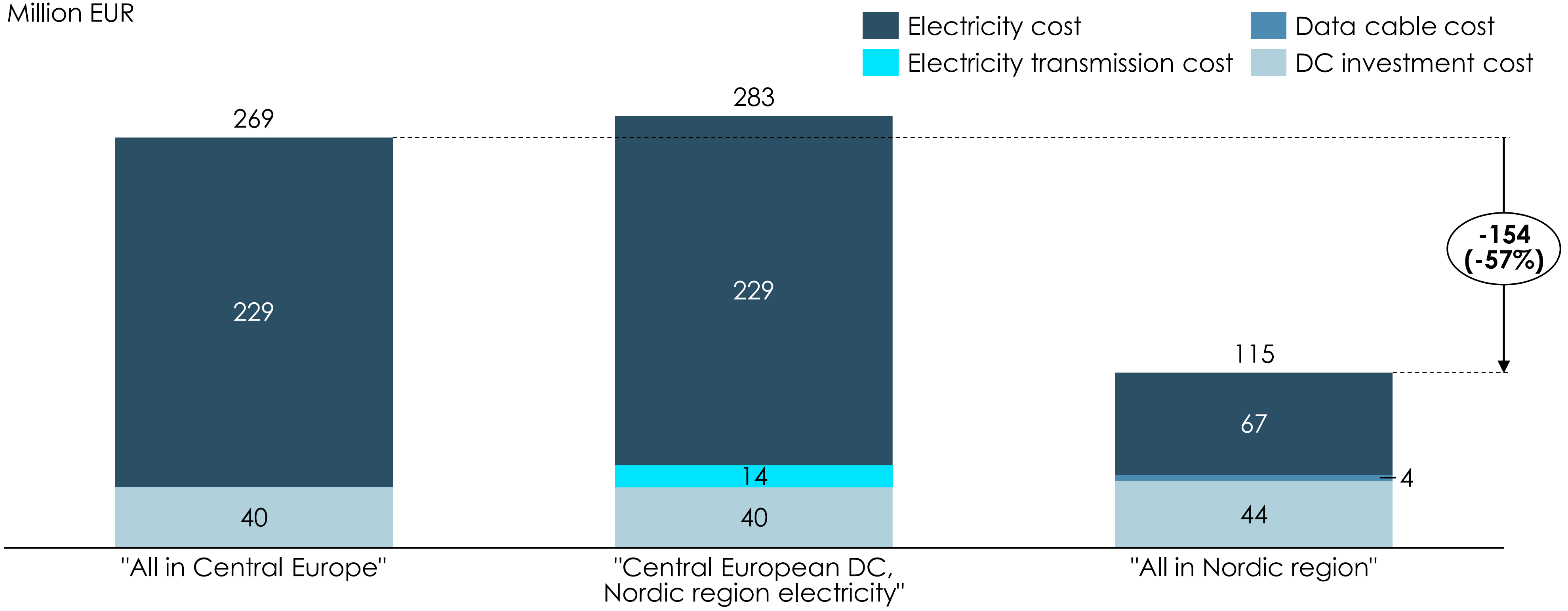
Levelized cost of energy for additional off-shore wind in Denmark and Germany, 2020 and 2030
EUR per megawatt hour



Comparing three models for locating data center value chain Nordic area is attractive all inclusive option

***Annualised* costs for a 150 MW data centre serving demand in Central Europe in three setups**

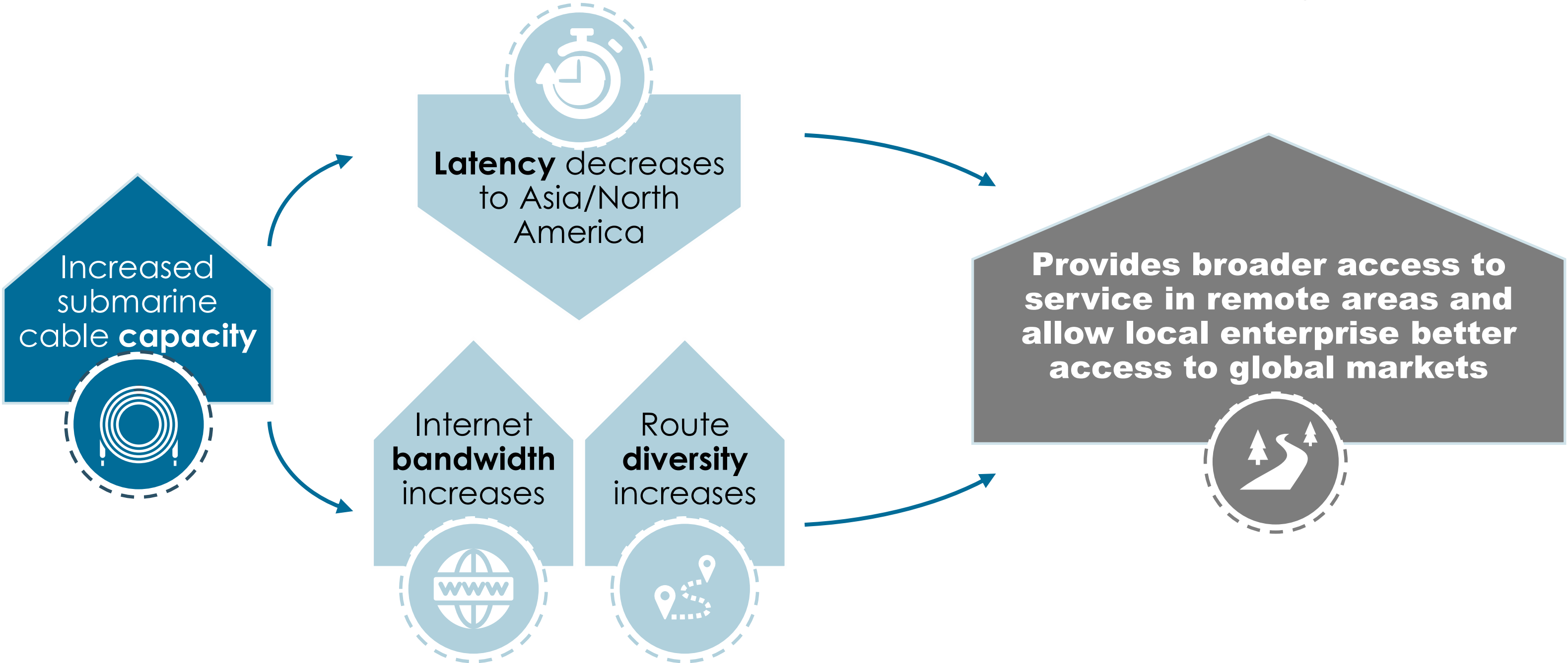
Million EUR



Assumptions: See Appendix A. Other operation- and investment costs (for example connection to local grid) are not included, and these are assumed to be the same.
Note: 1) Umwelt Bundesamt (2021) / 2) Electricity consumption from DC is to over 95% exempted from energy taxes in Norway and Sweden. We have not included this tax reduction, but it might add to the here depicted savings. / 3) Based on interviews,
Data sources: Datacenterdynamics (2020a), Green Mountain, IEA, Submarine Cable Networks, Norwegian government, Interview with Bulk Infrastructure,

Increased submarine connectivity enhances remotely located populations' possibilities to participate in the digital economy

Illustration of benefits to remote Nordic areas from increased submarine cable capacity in the Nordic region



Consumer welfare increase

- Nordic rural areas, particular in Norway and Finland, do not have access to fast broadband.[1]
- Consumers in remote areas gain access to a broader variety of online goods and services, increasing consumer welfare and quality of life.

Boost local enterprises' access to the global economy

- Faster broadband enable remotely located people and businesses to participate in the global economy.
- Online tools can help remotely located people to be socially included with family, friends, and gain easier access to public institutions.

1) Nordregio (2020).
Sources: Interviews with Nordic NRENs, Vodafone (2021), Desira (2020), Rumra & Smart Villages.

In total, an Arctic submarine cable from the Nordic region to Japan can contribute EUR 1.4 billion annually to Nordic GDP from 2024

Two scenarios for an annual GDP impact in the Nordic region from additional Arctic submarine cables in 2024
EUR billion, 2020-prices

Scenario A:

1. An Arctic submarine cable from the Nordic region over the North Pole or through the Northwest Passage
2. An additional connection from the Nordic region to Central Europe

Scenario B:

1. Two Arctic submarine cables from the Nordic region one over the North Pole, and the other through the Northwest Passage
2. A Nordic connection to Ireland
3. An additional connection to Central Europe

Note: See Appendix A for a description of the methodology. The impact is summarised as a GDP effect which is the potential impact per year associated with improved digital infrastructure from the submarine cables. The effect is a long-term and recurrent annual impact, sustained as long as the infrastructure is in use.
Source: Copenhagen Economics.

While Arctic submarine cables bear large potentials, the business case for the investor may not be profitable due to key barriers and risks

Barrier/risk	Description
Costs	• **Weather and climate**: May not be feasible to deploy cable in one summer season due to physical barriers, for example if the ice becomes too thick. • **Political roadblocks:** Political interference and other regulatory hindrances (for example lack of permits, negotiations with fishermen unions, etc). • **Potential need for novel solutions:** To deploy an Arctic cable close to the North Pole, a customised cable-laying-ship may be needed to handle the Arctic environment, which adds additional costs to the project. On the other hand, the Northwest Passage can more rely on existing technologies and approaches. Cable protection solutions to protect cables from outage events add another cost factor.
Demand	• **Demand risks**: The Arctic route is unknown route with no current cables, and thus no, and demand has to come from other routes or increased demand for connectivity. • **Chicken and egg problem**: To make a viable societal business case, data centres and cable connectivity need to be combined to ensure enough demand.
Broader economic benefits	• **Narrow business case**: Commercial investors do not account for the broader societal value to Europe, see next page.

To achieve the societal benefits, governments can support NRENs’ role as anchor tenants by supplying part of the financing

Example of how NRENs can lower commercial risks in an Arctic submarine cable project

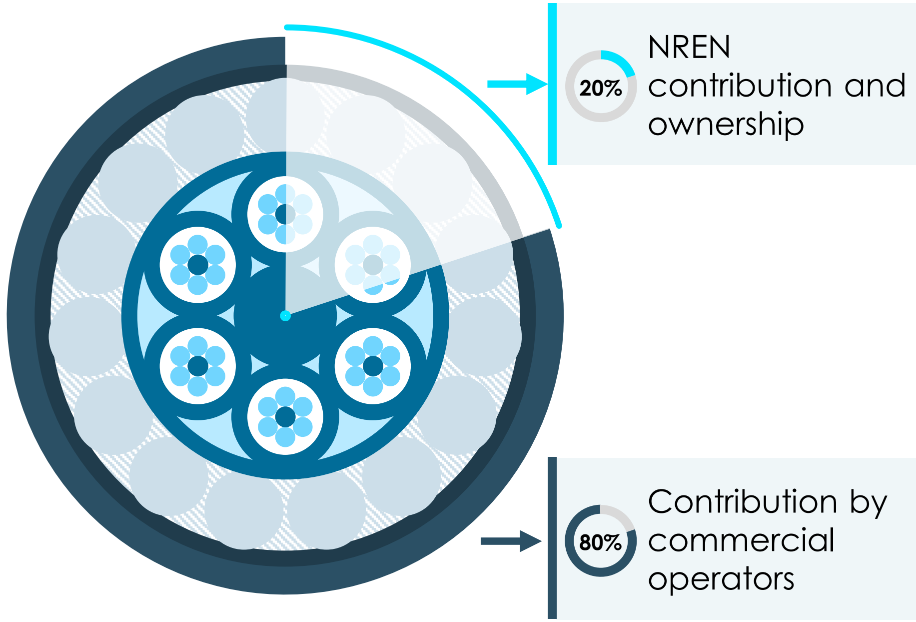
Anchor tenant role

NRENs guarantee a **certain minimum demand** in submarine cable

NRENs have ample experience with serving and guaranteeing this demand, and they support a range of research and education projects around the world that rely on low latency and secure data transfer.

A concrete version:
- an **upfront fee** which guarantees them life-long access
- Plus **a long duration servicing fee**

Leverage commercial funding and engagement by derisking demand uncertainty



Source: Copenhagen Economics based on interviews and literature review.

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