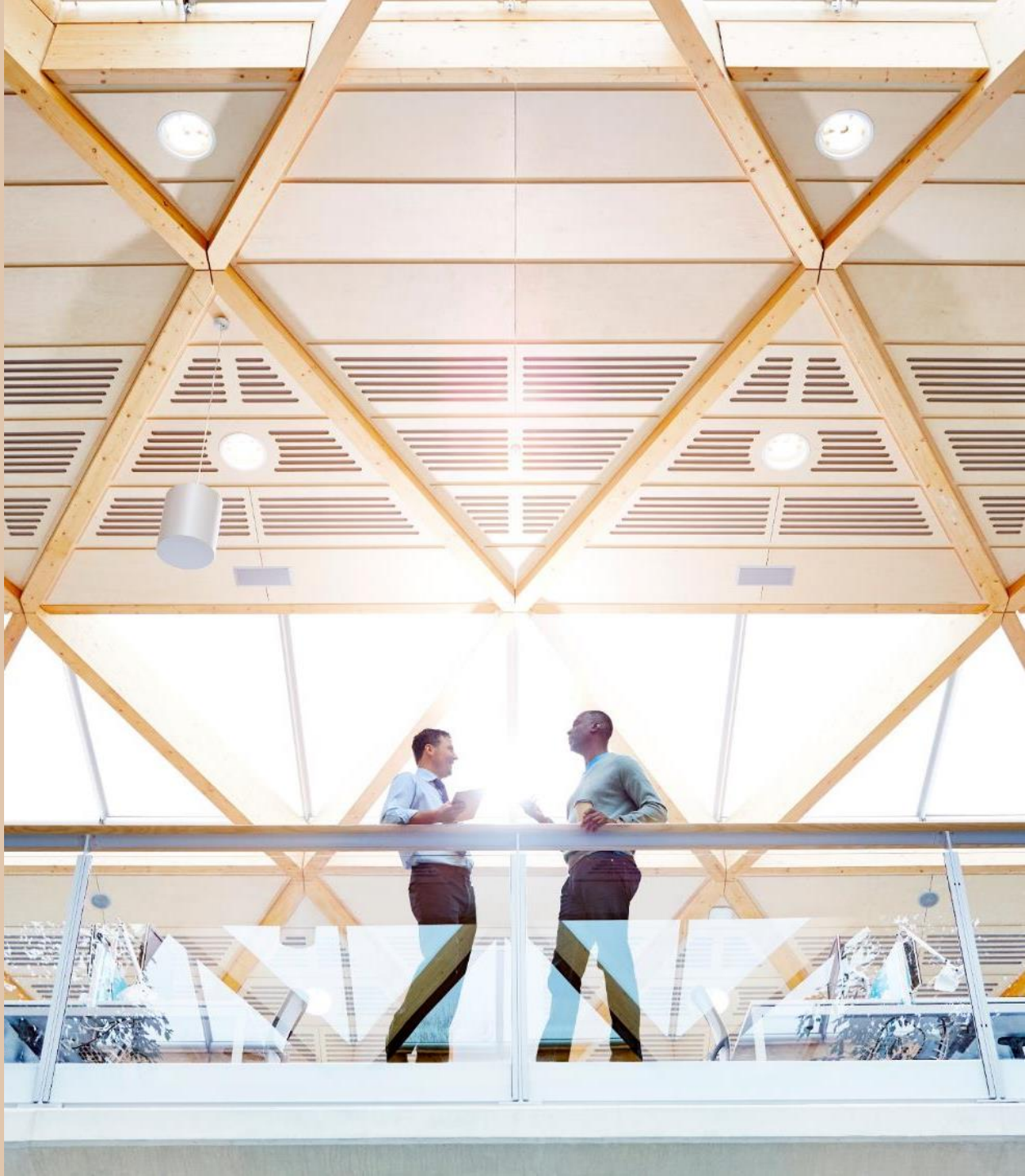
Data Centres

A Knowledge Share

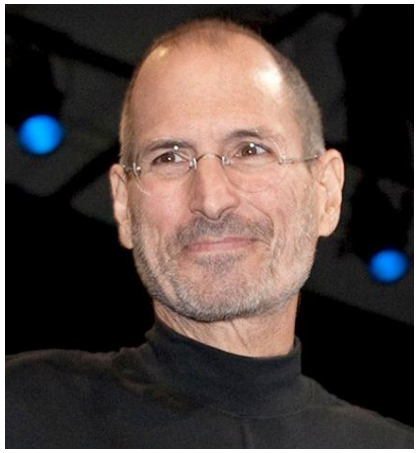
James Rix ASA
Head of Data Centres & Industrial (Malaysia & Indonesia)
Nomad Futurist Ambassador

JLL SEE A BRIGHTER WAY



Who’s the most important?

1



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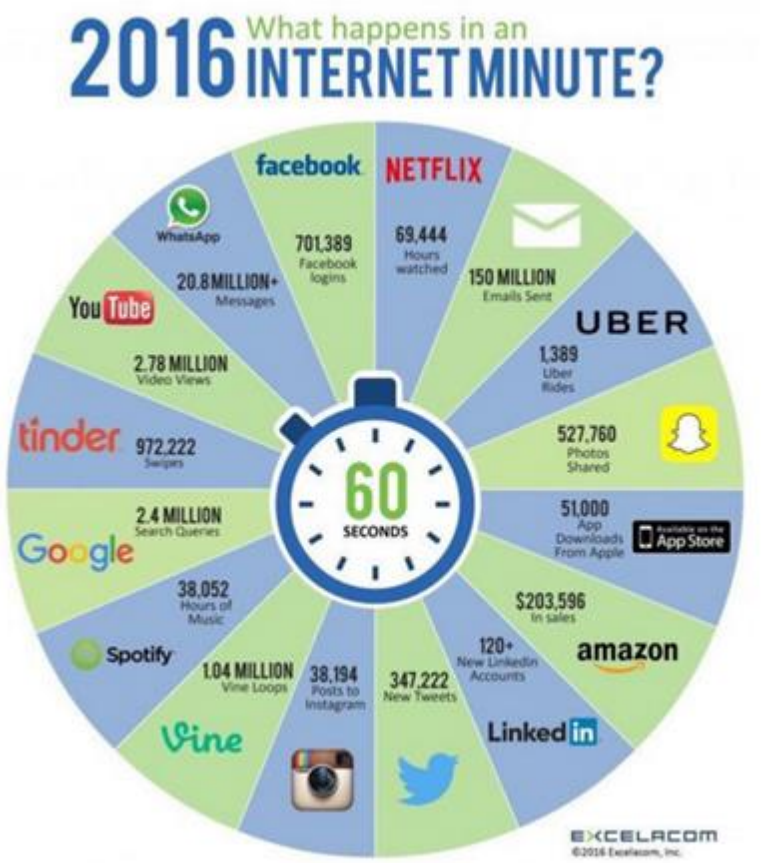
JLL

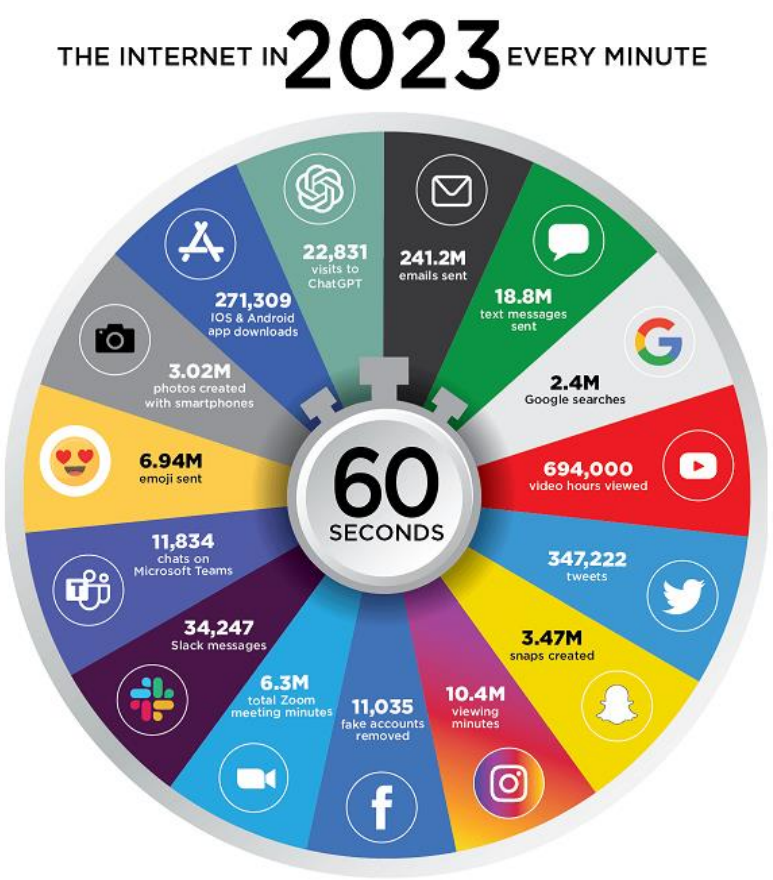
What is ‘The Cloud’

Anatomy of ‘The Cloud’

Kettle = 1.5kw, 750 kettles = 1MW, 60MW = 45,000 kettles, this site equals 135,000 kettles just for IT!

What happens in the cloud in one minute?





Created by: eDiscovery Today & LTMG

Our Digitized World:
Data Centers are the Backbone

Camera

Portable Gaming Device

Calculator

Alarm Clock

TV & Movies

Ordering food

Flashlight

Books

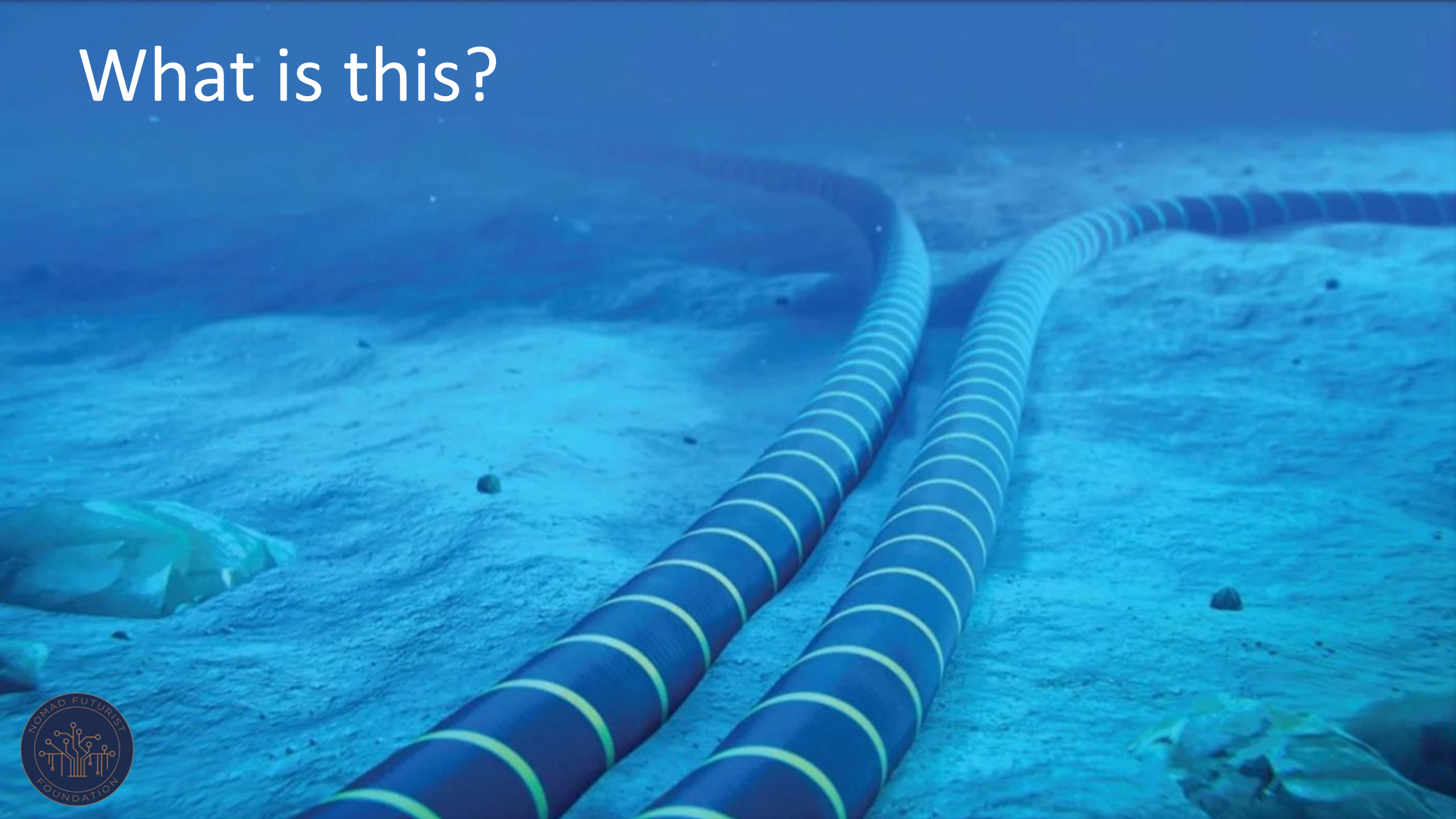
Notepad

Calendar

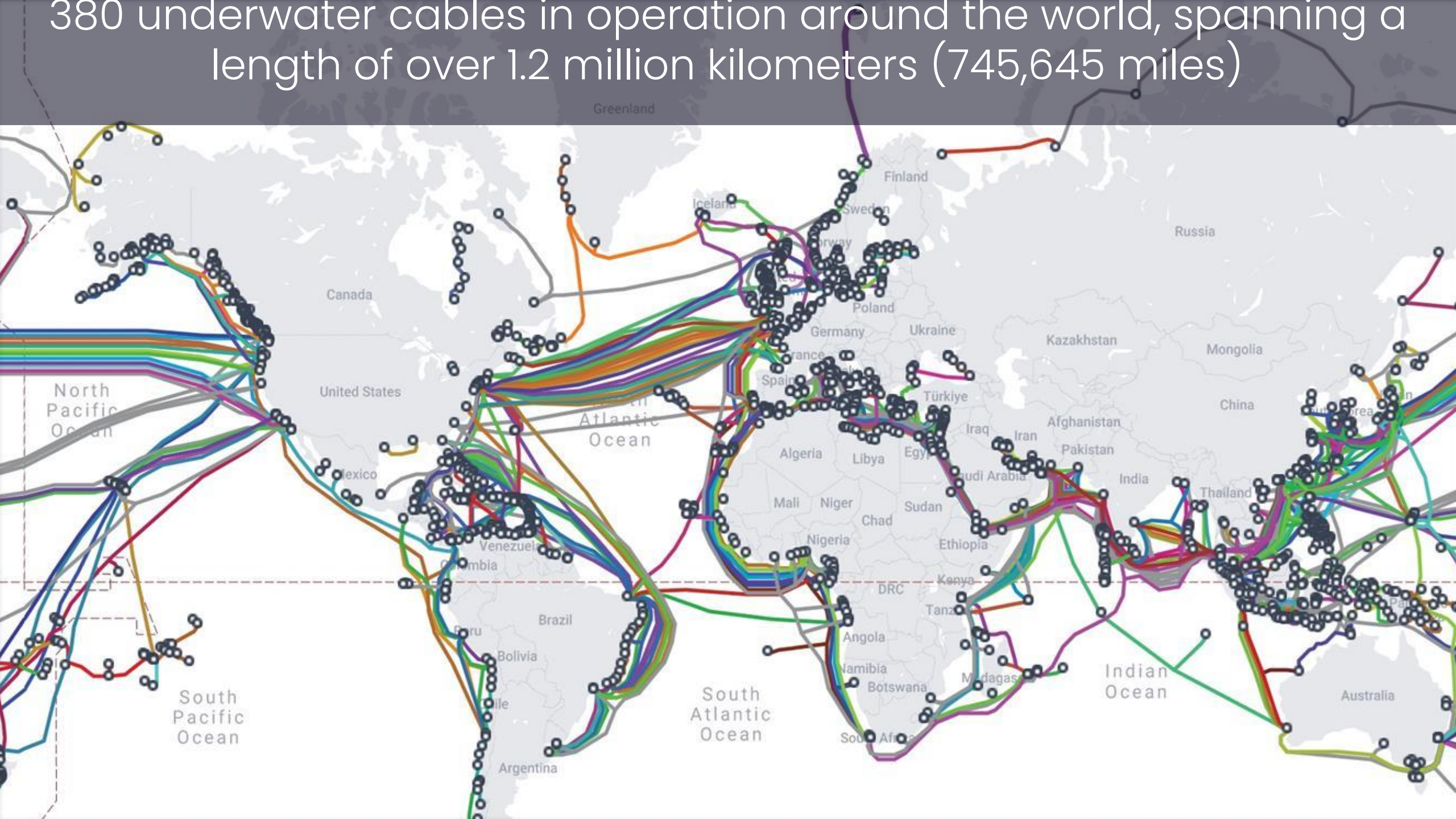
Credit Cards

GPS

What is this?



380 underwater cables in operation around the world, spanning a length of over 1.2 million kilometers (745,645 miles)



It’s all about YOU?

A **Google Search** will use as much energy as it takes to light a low energy light bulb for 17 seconds. 1 question to ChatGPT take 50-100 times as much energy.

Average person may make 3 or 4 searches per day that’s around 1,000 per year – 4 hours 45 seconds for a light bulb moment!

Your searches also produces 200grams of carbon – that’s the same as driving a fossil fueled car 1 mile or 1.5km

This Teams meeting could generate around 1 kg of carbon and use 12 litres of water.

18 grams of carbon generated per email with attachments

What’s the answer?

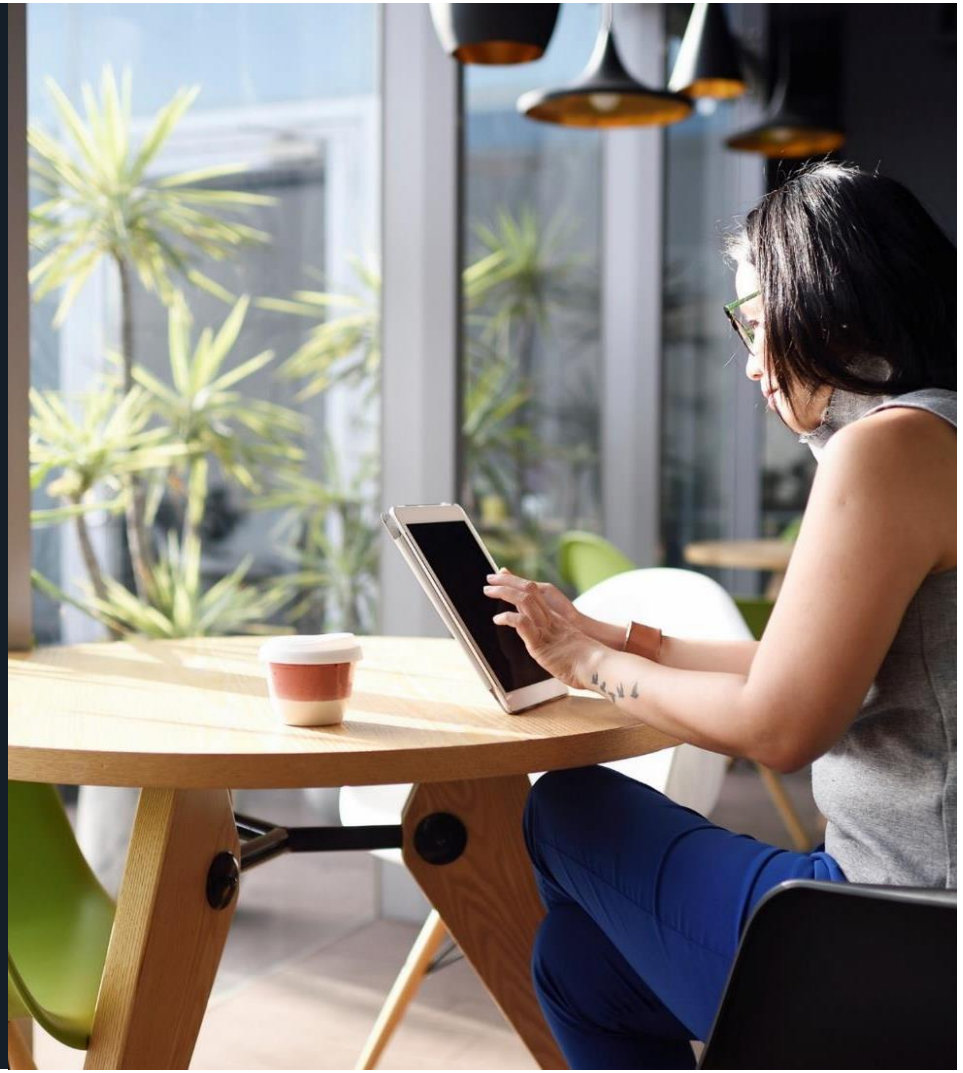
It’s a thought process – ‘think before you click’

No perceived cost as we are ‘always on’

Conversations matter – human connection

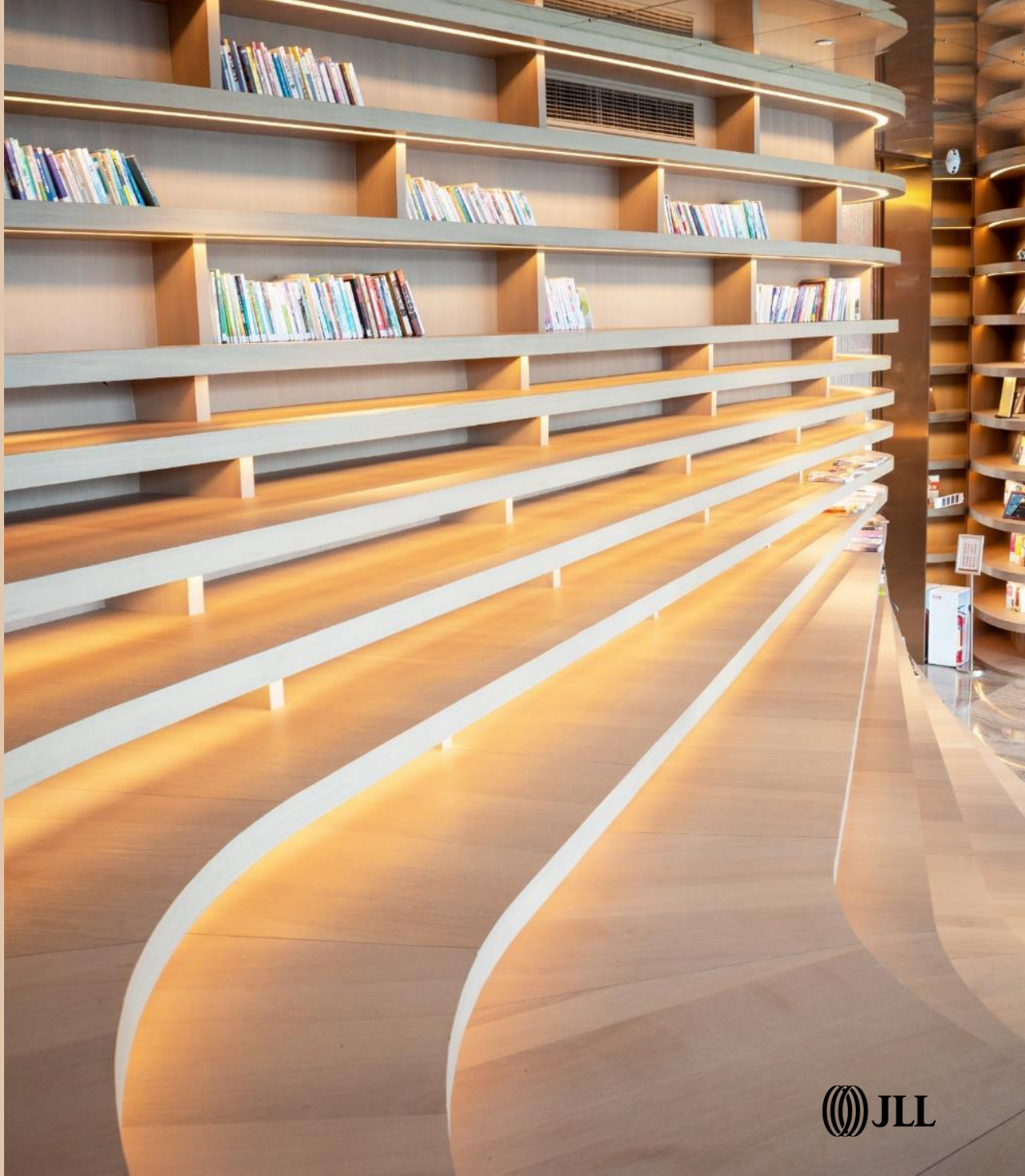
ChatGPT3 produces 3.8 tons of carbon per day

https://karmametrix.com the carbon footprint of chatgpt



https://fullfact.org/environment/google-search/

Current Issues



The Future is in the Past!

THE

LONDON, EDINBURGH, AND DUBLIN

PHILOSOPHICAL MAGAZINE

AND

JOURNAL OF SCIENCE.

[FIFTH SERIES.]

APRIL 1896.

XXXI. *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground.* By Prof. SVANTE ARRHENIUS *.

I. *Introduction : Observations of* Langley *on Atmospherical Absorption.*

A GREAT deal has been written on the influence of the absorption of the atmosphere upon the climate. Tyndall † in particular has pointed out the enormous importance of this question. To him it was chiefly the diurnal and annual variations of the temperature that were lessened by this circumstance. Another side of the question, that has long attracted the attention of physicists, is this : Is the mean temperature of the ground in any way influenced by the presence of heat-absorbing gases in the atmosphere? Fourier‡ maintained that the atmosphere acts like the glass of a hot-house, because it lets through the light rays of the sun but retains the dark rays from the ground. This idea was elaborated by Pouillet § ; and Langley was by some of his researches led to the view, that " the temperature of the earth under direct sunshine, even though our atmosphere

Bersey electric cab, 1897, designed by Walter Bersey (General Manager of the London Electrical Cab Company).

BBC Film - Hydrogen: The Forever Fuel (1980)

"Those who cannot remember the past are condemned to repeat it."

Writer and Philosopher George Santayana

The Future is in the Past!

One of the oldest building materials man has ever used

Great clear spans up to 50m limited by logistics

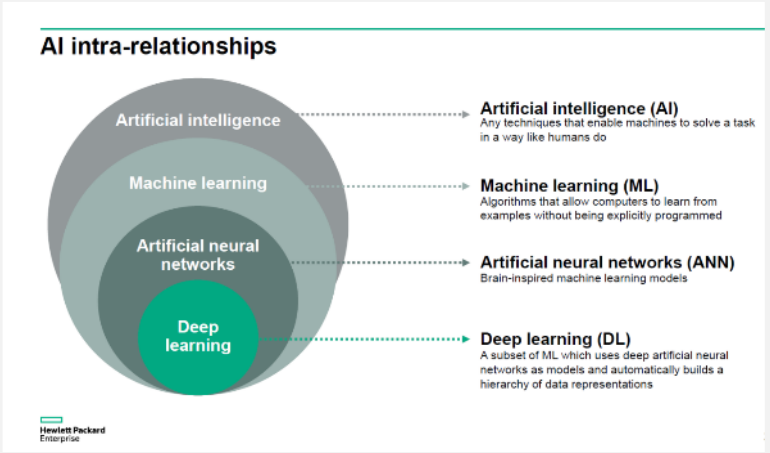
Carbon reduction of 40%

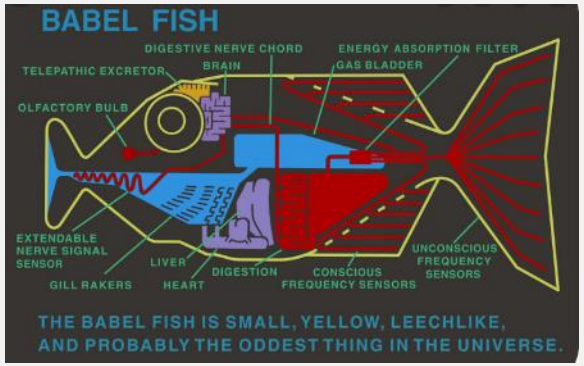
Glulam & CLT

- Timber is a great carbon sink through sequestration
- Sustainable forests (majority of Europe) mean constant re-supply
- Comparable costs to steel
- What's stopping **YOU** using it?

AI, ML, ChatGPT

Training ChatGPT4 used 1,287 MWh of power and produced 552 tons of carbon





Server Type	HPC – Standard Density	HPC – High Density	Typical Low-Power
Rack	42U	42U	42U
Server Power Draw	500 watts	1,430 watts	100 watts
Rack Power Draw	21 kW	60 kW	4.2 kW

Rack Unit or U = 44.45 mm / 1.75”

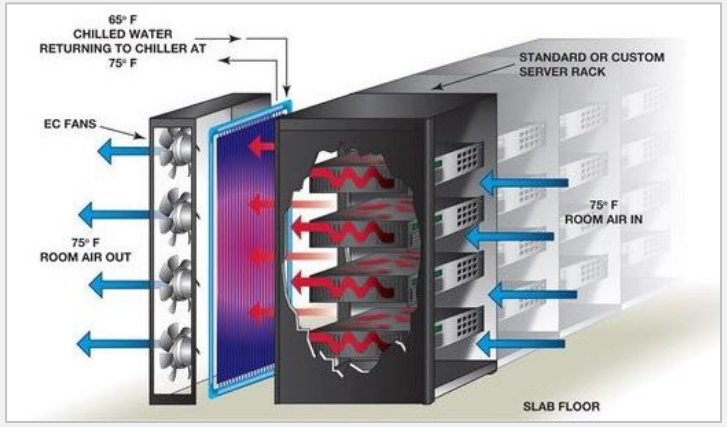
Cooling - the big ‘hot topic’

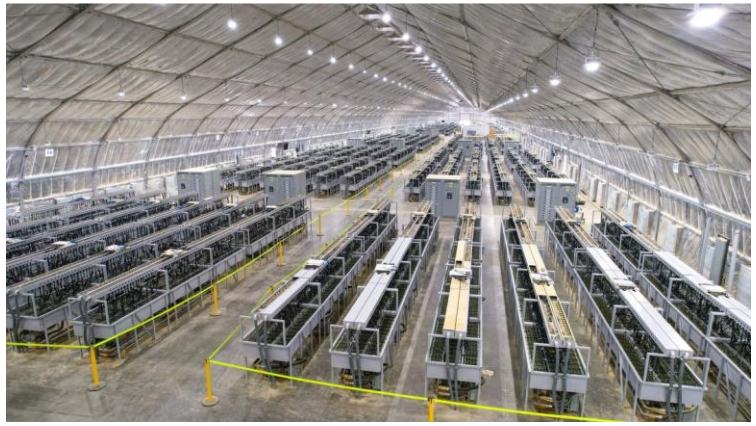
Air has been used for decades to cool facilities, but the most dangerous comment is ‘it’s the way we have always done it’ leaves many problems

Air is inefficient as a cooling medium at a IT power draw above 15kW

Single or Two-Phase Immersion Cooling

Rear Door Cooling and Cold Plate





Immersion Cooling

Servers plunged into a ‘bath’ of oil or dielectric (nonconductive) fluid

Vegetable derived oil can work (cheap)

Some two-phase dielectric fluids contain ‘forever’ chemicals (expensive)

Cold Plate

Chilled water in a closed loop is passed over the CPU

Benefits

Up to 98% of heat can be removed from the servers by this method

More heat to recycle

Moratoriums or Restrictions

The Netherlands

Ireland

Singapore

Denmark – heat reuse

Where else?

Germany
China
USA – one state

Why?

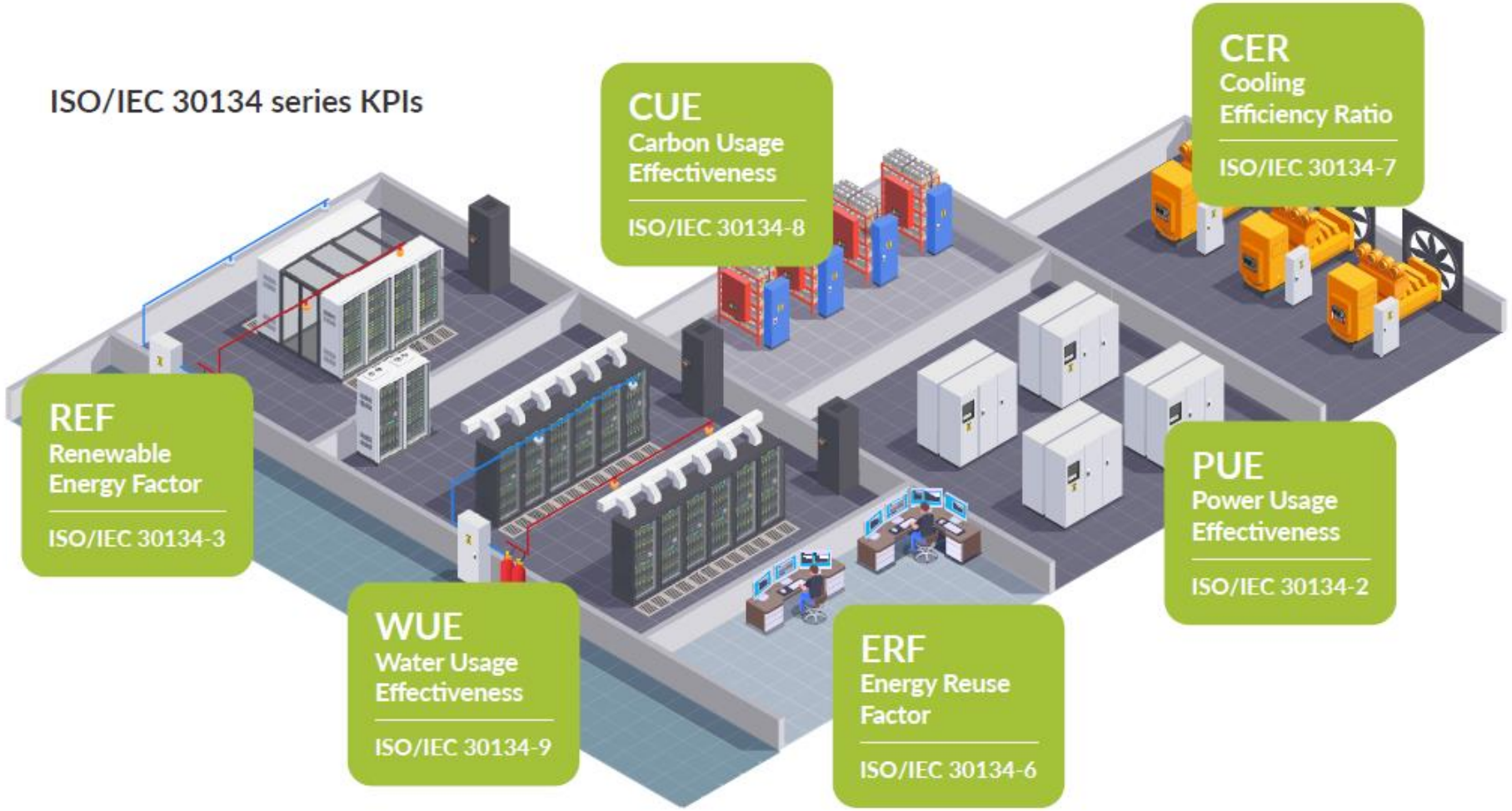
Power
Water
Space
Monetization
Societal Tensions

Where else?

Any country with tensions around power and water
Water poverty is a real issue
Regulation of the unregulated

‘Dionne Brown, 44, who lives 20 yards from the site, said: 'It used to be amazing here. That's why I moved six years ago. It was peaceful, you could hear the birds sing and it was lovely. 'The views were stunning and it was like being in the countryside. Now it's appalling. 'It makes me upset. Google can just come in and do what they want and nobody cares about us. There's no benefits to locals, other than ruining our views and noise all hours of the day.’ Ms Brown also said she believes her and her child may have fallen ill because of it. She said: 'My boy has had a really bad chesty cough for about four weeks. I am sure it has got something to do with it. 'It seems such a coincidence.’’ https://www.dailymail.co.uk/news/article

ISO Standards Overview – Standard Method of Reporting



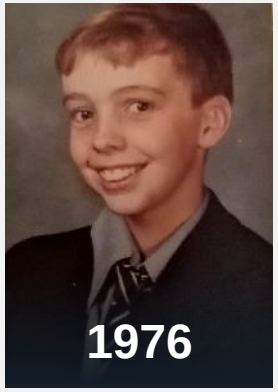
PUE Abuse

P = Power

U = Usage

E = Effectiveness **NOT** Efficiency

ISO/IEC 30134-2:2016 and European standard EN50600-4-2:2016



Measure it

Where in the Power Train is it measured?
How close to the IT?
Rack Mounted UPS?
Snapshot in time

Monitor it

12 month trailing – anything less is a ‘partial PUE’
Seasonal, Virtualization, IT efficiency

Report it

Why? Or Why Not? To Whom?
DON’T Compare

Renewables & Sustainability

Power

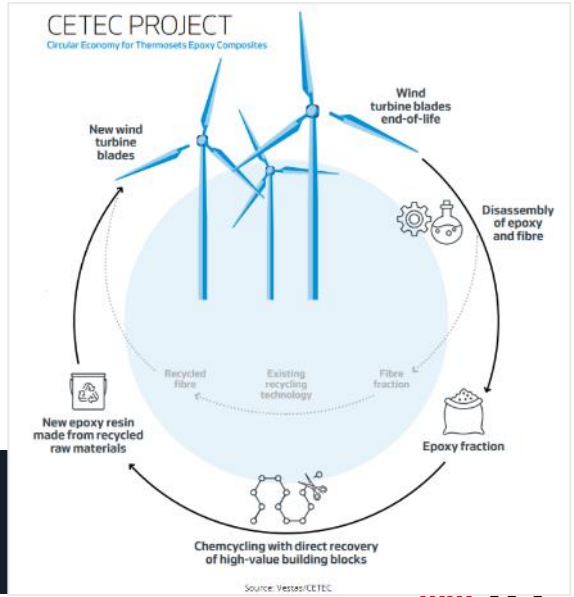
Circular Economy

Net Zero or Near Zero

Renewable Power – How Green is that?

- Vestas has discovered a new chemical process to recycle blades
- Is it available at scale? – not yet
- Will the information be open sourced?
- Are facilities available everywhere?
- How sustainable and ecologically friendly is the process?
- Science project??

https://www.offshorewind.biz/2023/02/08/newly-discovered-chemical-process-renders-all-existing-wind-turbine-blades-recyclable/



Is Nuclear or Hydrogen the answer to power problems?

- SMRs can produce between 50MW and 400MW
- Are they safe? Perception?
- Hydrogen may be the answer – what was the question?
- Infrastructure does not exist at scale to produce or deliver renewable H2 currently

60 MW x 24 hours = 100,000 kg Hydrogen

SMRs

SMR's have been around for a long time – submarines, aircraft carriers (SMR = small modular reactors)
Do you want a nuclear reactor next to you?
As yet, not available at scale
Still a long approval process

Colours of Hydrogen

Brown H2 – Fossil Fuel without Carbon Capture
Green H2 – Renewable Energy
Pink H2 – Nuclear Power
Blue H2 – Natural Gas with Carbon Capture
Gold H2 - Bio-Gas with Carbon Capture

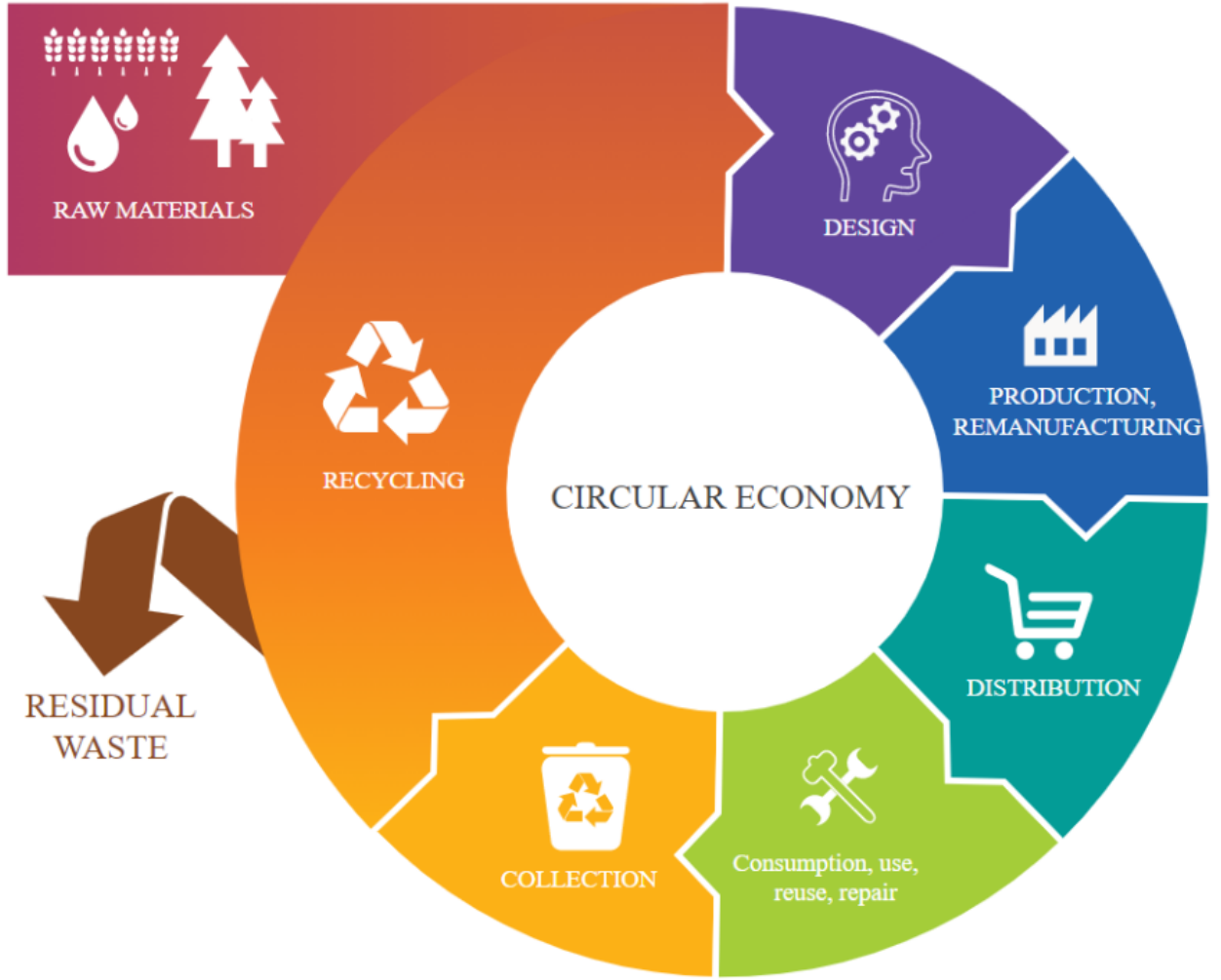
Most hydrogen is created by burning gas not from renewable sources

Not available at scale – storage is a BIG problem

60MW x 24 hours = 100,000kg Hydrogen

A Circular Economy

- Why demonstrate to be circular?
- Circularity starts with material choice and design
- Scope 3
- E-Waste
- EOL Products
- Refurb, reuse

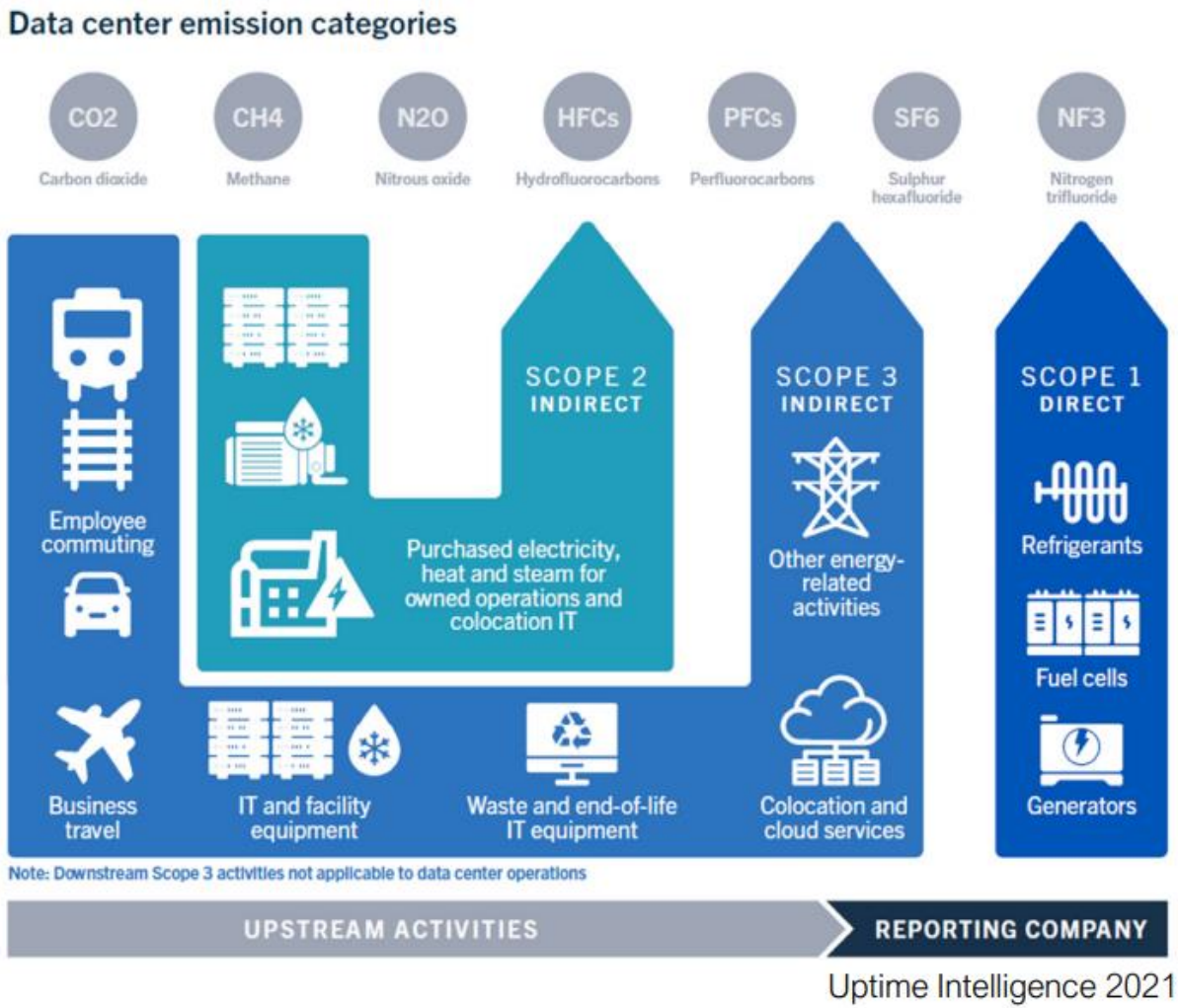


The circular economy could unlock $4.5 trillion of value by 2030. Image: European Parliament

Sustainable DC’s

It is not a choice!

- EU Taxonomy
- EU Code of Conduct
- CSRD
- EED
- TCFD – Task Force n Climate-related Financial Disclosures (https://fsb-tcfd.org)



A Circular Economy

- Report what is being recycled
- Reuse & recycle EOL products & components
- Audit & verify final disposal of EOL kit

Morgan Stanley fined $60m & $35m – disposal through an internet auction site & without removing customer data using an IT Asset Disposal Vendors

Net Zero is NOT Zero!

Net Zero or Near Zero is NOT Zero

Net Zero is removing as much as you create

It does not produce a reduction in Carbon!

Sequester, sink and reduce more carbon than you create

Whole Life

Wholistically – Circularity

What are you creating?

How will it be used?

What happens when you have finished with it?

Greenwashing

- Carbon Credits
- Carbon Offsetting
- ‘End of Pipe’ Solution
- RSG – ‘Responsibly Sourced Gas’? It’s still gas!
- A Necessary Evil or a Steppingstone?

‘See it… Say it… Sorted’

Someone else will pick it up

It’s the thought that counts

Build taller chimneys

OR

Walk the talk

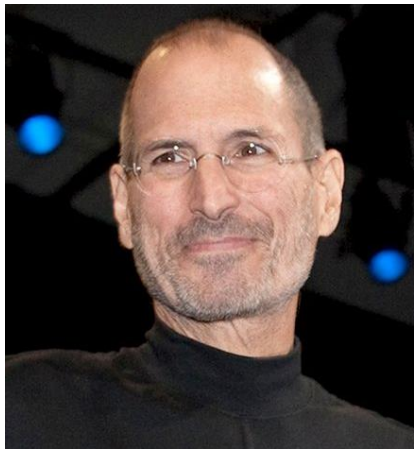
Call out the abuse

Tackle the problem at source

If it is to be it is up to me!

Who’s the most important?

1



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Data Centre Market

Data Center market in APAC

JLL

Strong growth potential in APAC, particularly in underserved and large domestic markets

Mature Markets

- Established Data Center markets with many domestic and international operators.
- Ability to serve emerging markets.
- Market is highly competitive.
- Need to upgrade and renew existing facilities that are dated.

Developing Markets

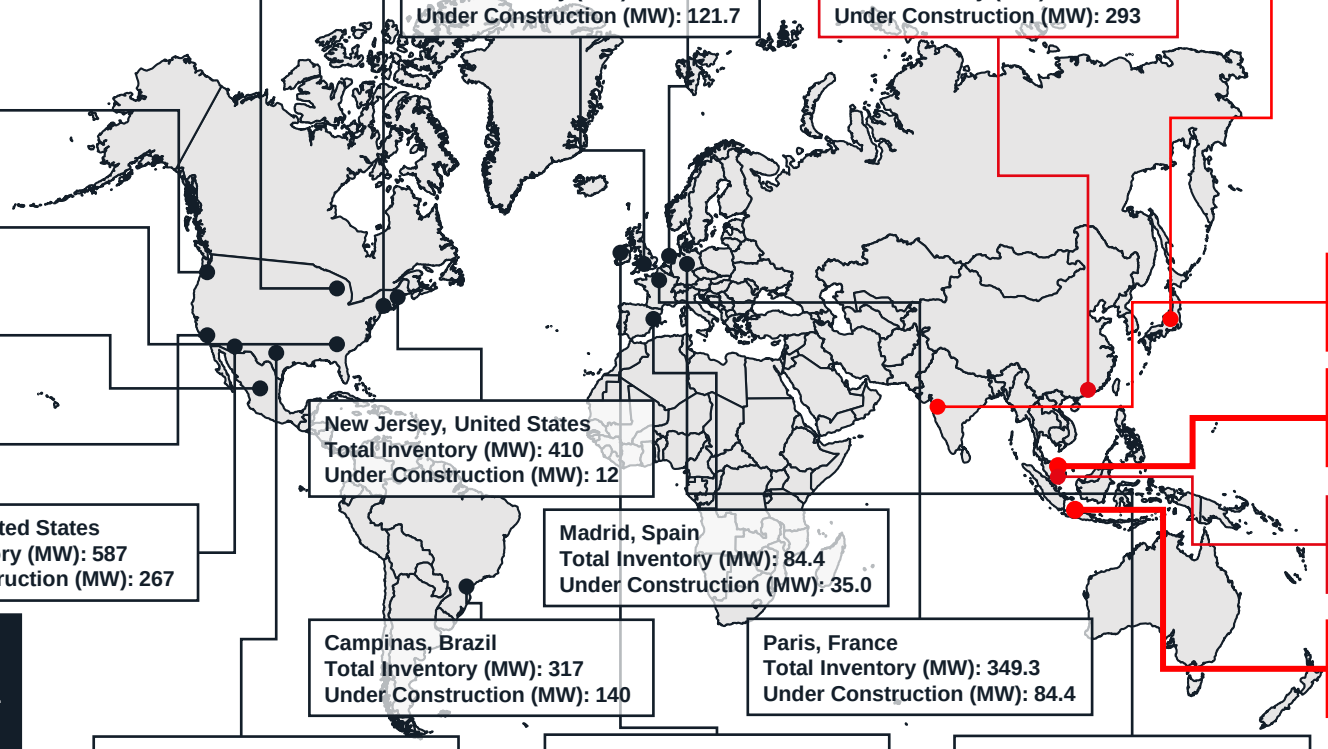
- Large domestic population with high digital usage. Demand / supply imbalance.
- Foreign operators recognize the need for local partners to secure land and develop.
- Hyperscale and potentially Edge data center markets.
- Higher margins for newer builds at international standards.

Key Markets	China	Japan	Australia	Hong Kong	India	Singapore	South Korea	Malaysia	Indonesia	Philippines	Vietnam
Capacity* (MW), Live	1500+	1000+	800+	800+	1000+	800+	500+	200+	250+	100+	120+
Key Drivers	• High growth market • Hyperscale demand	• Large domestic demand	• Political stability • Power availability	• Robust connectivity • International demand	• High growth market • Large domestic demand • Underserved	• Robust connectivity • International demand • Geo-political stability	• Domestic & international demand • Political stability • Robust infra-structure	• High growth market • Robust infrastructure • Cost competitive	• High growth market • Large domestic demand • Underserved	• High growth market • Large domestic demand • Underserved	• High growth market • Large domestic demand • Underserved
Key Challenges	• Operating licenses • Availability of power • JV partners	• Seismic risk • Availability of power in Tokyo	• Short term supply overhang • Availability of suitable land plots	• Availability and cost of real estate • Geo-political concerns	• Project execution risk • Clear land title • JV partners	• Authority approvals • Access to renewable power	• Regulatory compliance • Operating cost	• Nascency of large-scale renewable energy generation	• Permitting and construction delivery • Flood risks • JV partners	• Volcano, seismic, & typhoon risks • Project execution risk	• Operating licenses • Availability of power • JV partners

* Based on certain criteria set within the data center industry

Data Centre Market - Global

Market Overview
Primary and select growing secondary markets



Northern Virginia, United States
Total Inventory (MW): 3442
Under Construction (MW): 651

Amsterdam, The Netherlands
Total Inventory (MW): 447.6
Under Construction (MW): 59.2

Tokyo, Japan
Total Inventory (MW): 908
Under Construction (MW): 228

Chicago, United States
Total Inventory (MW): 836.2
Under Construction (MW): 310.1

London, United Kingdom
Total Inventory (MW): 905.7
Under Construction (MW): 121.7

Hong Kong, China
Total Inventory (MW): 577
Under Construction (MW): 293

Northwest, United States
Total Inventory (MW): 587.8
Under Construction (MW): 200.6

Atlanta, United States
Total Inventory (MW): 350
Under Construction (MW): 172

Querétaro, Mexico
Total Inventory (MW): 70

Northern California, United States
Total Inventory (MW): 647
Under Construction (MW): 517

New Jersey, United States
Total Inventory (MW): 410
Under Construction (MW): 12

Phoenix, United States
Total Inventory (MW): 587
Under Construction (MW): 267

Madrid, Spain
Total Inventory (MW): 84.4
Under Construction (MW): 35.0

Campinas, Brazil
Total Inventory (MW): 317
Under Construction (MW): 140

Paris, France
Total Inventory (MW): 349.3
Under Construction (MW): 84.4

Dallas-Fort Worth, United States
Total Inventory (MW): 734.4
Under Construction (MW): 182.1

Dublin, Ireland
Total Inventory (MW): 186.8
Under Construction (MW): 79.1

Frankfurt, Germany
Total Inventory (MW): 587.8
Under Construction (MW): 148.2

Mumbai, India
Total Inventory (MW): 348
Under Construction (MW): 118

Malaysia
Total Inventory (MW): 186+
Under Construction (MW): 210

Singapore
Total Inventory (MW): 1000
Under Construction (MW): 60

Indonesia
Total Inventory (MW): 100+
Under Construction (MW): 150

Primary markets have at least 600MW of supply and many of these markets are now pushing beyond the 1,000MW mark. They will continue to see strong growth as colocation and hyperscalers consolidate their position in safe metros that have become sub-regional hubs.

Secondary markets typically have 100-600MW of supply and have recently become the focus of attention as investors, lenders and developers seek new opportunities in less crowded markets.

Emerging markets will continue to grow as Edge deployments bring data centers closer to the user and national data sovereignty laws mandate in-country storage.

Talent in our Data Centre Industry

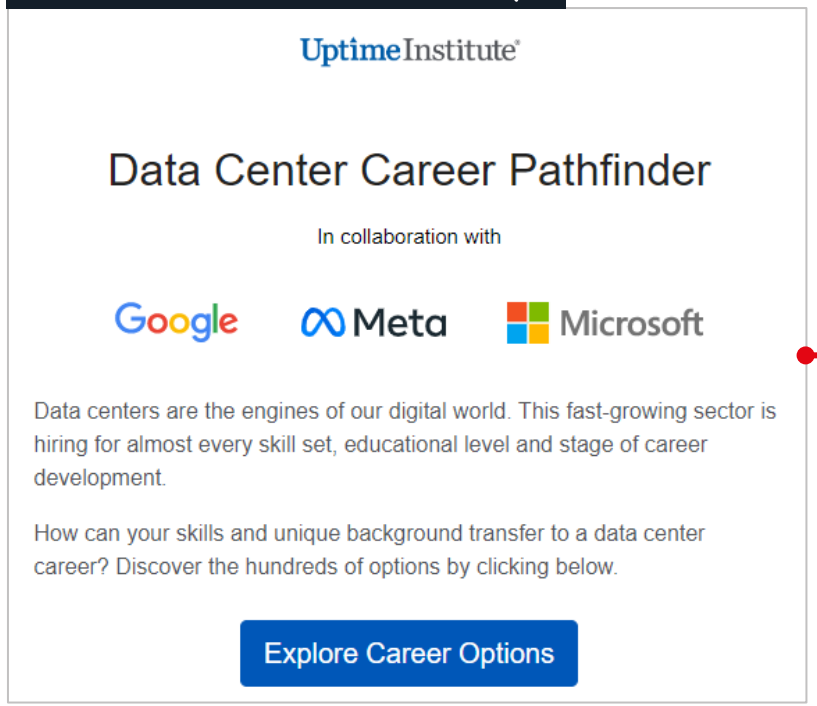
Is this for you

- Hands-on
- 24/7 industry
- A global industry
- Willing to learn attitude
- Working with diverse group of people

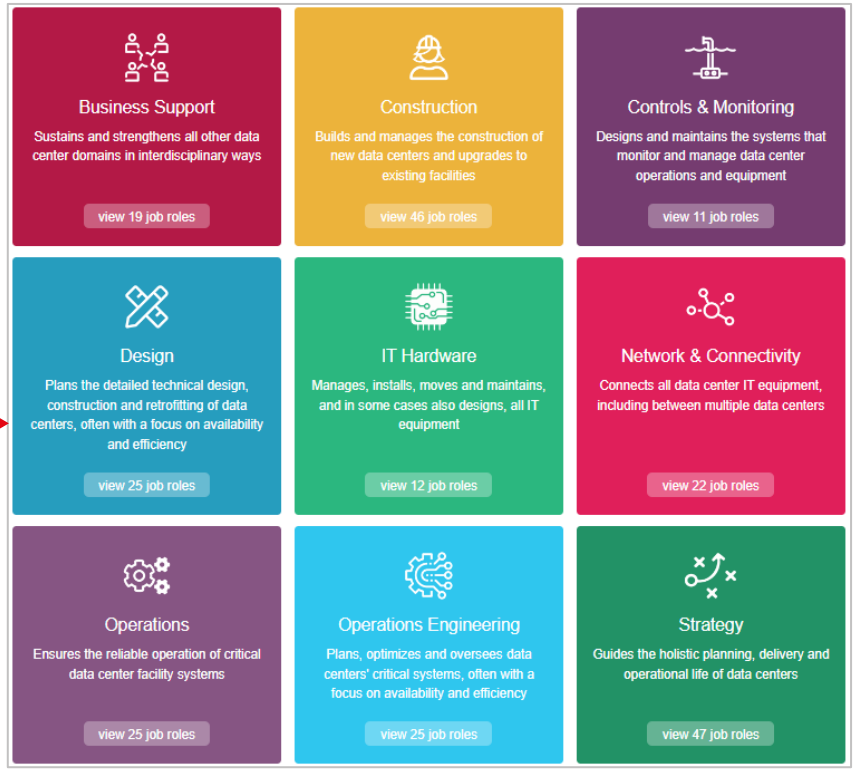
- Great entry level pay
- Growth opportunities
- Hard work is rewarded
- Transferable skills
- Job security

What Opportunity is There?

https://datacenterpathfinder.com/



Can YOU be here?



Where do you want to work?

Do you have transferable skills?

The data center industry needs **YOU!**

NOMAD FUTURIST FOUNDATION & JLL

Technical Development Programme

JLL

Project and Development Services

Our key products

Project & Construction Management

Focused on the efficient delivery of a single project on behalf of a client with defined objectives and outcomes within a defined time period.

- Planning & procurement
- Design, budgeting & scheduling
- Construction & handover

Portfolio & Interior Design

Your APAC design partner to look after your portfolio design requirements with dedicated, high calibre teams.

- Design Account Management
- Core design package
- Peer review, test-fits & visualizations

Program Management

Focused on business strategy and enhanced requirements for governance, using a standardized methodology and process that ensure visibility through reporting, embedded project and program governance, and the management of risk, cost, quality and change.

- Strategy & Scope Definition
- Increased Project / Risk Control & Governance
- Improved Communication & Stakeholder Management

Technical Advisory

- Technical due diligence
- Development advisory
- Asset enhancement

Design & Build

We bring to life the strategies discussed at the portfolio analysis level and materializes your facility, delivering work environments adapted to the needs of people and organizations in a post-pandemic world.

- End to end turnkey solution
- Design, procure & build
- Permits, approvals, & site ownership

Capital Planning

Levers in place to save time, money and resources by effectively plan, approve and motoring your financial spending.

- Focused on managing the planning process, data and advisory to achieve stated outcomes.
- Process and governance structure that integrates IFM, IPS, PDS and business requirements into one cohesive evergreen planning cycle
- Powered by Clarizen to facilitates nimble decision making and real time analytics.

What makes us unique?

We deliver more than just a project. Adopting an integrated people, process and technology approach, our team of experienced professionals seamlessly navigate local requirements whilst maximizing the information, resources, tools and technology to best meet our clients' requirements.

JLL manages the design and construction of real estate & critical projects from beginning to end – handing every detail on your behalf to maximize the returns on your investment.

JLL

About JLL PDS

JLL Project and Development Services in Asia Pacific is a leader in the development, design, construction and branding of commercial real estate & critical environment projects for the world's most prominent corporations, government bodies, healthcare organisations, industrial & tech facilities and data centre operators.

From consulting and capital planning to design and construction, we bring a lifecycle perspective to every project. We transform the places where people live, work and play to ensure that our clients realize their broader ambitions and business goals.

By leveraging our global platform, we'll help you improve your speed to market, effectively manage costs and protect your reputation.

Our APAC Data Centre capability

JLL

Regional alignment, local delivery

84+ / 600MW+
Data Centre Projects


450,000 kettles

250+
Primary Data Centres under management

465,000 sqm
DC White Space under management

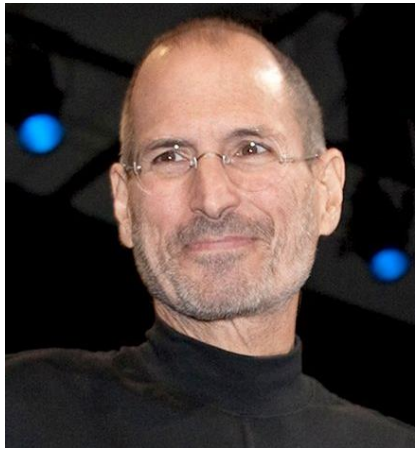
7896MVA
Mission Critical Environment Support

170 Researchers	**1,000+** Brokers
680 Capital Markets professionals	**2,200+** Project Management Professionals
730 Valuation advisory professionals	**32,000+** Property and facility managers

axiata · IBM · STTelemedia Global Data Centres · netmagic An NTT Communications Company · Microsoft · TATA COMMUNICATIONS · UOB · intel · GLOBAL SWITCH · Princeton DG · SoftBank · PCCW · airtel · DIGITAL REALTY · HSBC · 中国移动 China Mobile · NTT · nxtradata · HUAWEI · EQUINIX · citi · Google

Who's the most important?

Sundar Pichai - Google



Steve Jobs - Apple

Bill Gates - Microsoft

Sir Tim Berners-Lee – Inventor of the World Wide Web

Addison Rae – Tik Tok

Mr Beast (Jimmy Donaldson) YouTube

Khaby Lame – Tik Tok

Everyone here could not function without Sir Tim Berners-Lee' invention!

https://www.youtube.com/watch?v=iDbyYGrswtg

Thank you

www.linkedin.com/in/jamesrix

Bytes, Watts & Carbon Newsletter
https://www.linkedin.com/newsletters/bytes-watts-and-carbon-7092449906732187648/

JLL SEE A BRIGHTER WAY