Empowering Efficiency:
A Policy Perspective on Data Centres

Brendan Reidenbach, Digital Demand Driven Electricity Networks (3DEN), Tracking Clean Energy Progress, Office of Energy Efficiency and Inclusive Transitions

15 February, International Energy Agency

International Energy Agency

Empowering Efficiency:
A Policy Perspective on Data Centres

Brendan Reidenbach, Digital Demand Driven Electricity Networks (3DEN), Tracking Clean Energy Progress, Office of Energy Efficiency and Inclusive Transitions

15 February, International Energy Agency

Historic agreement at COP28

Triple up and double down

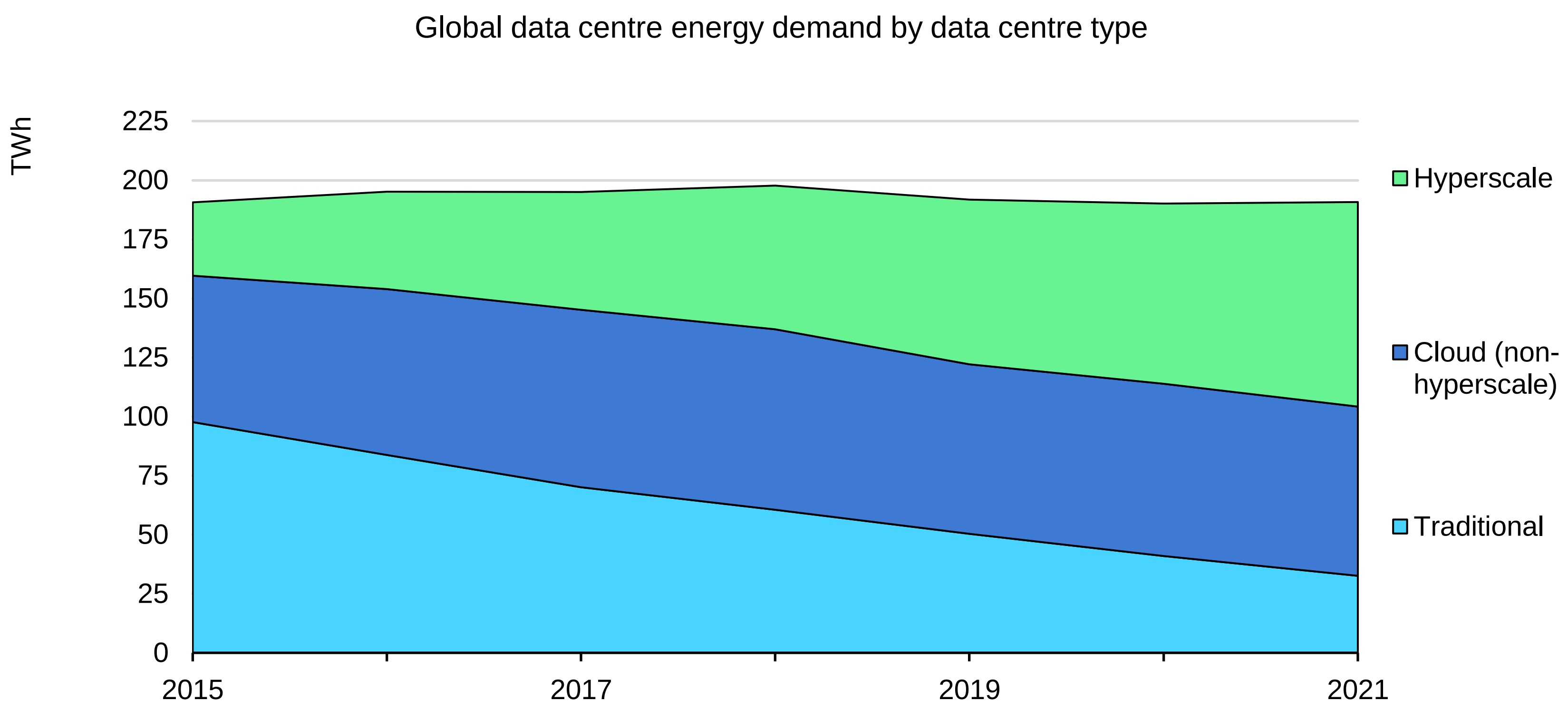
Noting that the International Energy Agency and the International Renewable Energy Agency forecast that, to limit warming to 1.5°C, the world requires three times more renewable energy capacity by 2030, or at least 11,000 GW, and must double the global average annual rate of energy efficiency improvements from around 2% to over 4% every year until 2030.

IEA leading the way to raise global ambition on efficiency first policies

Energy efficiency continues to take centre stage

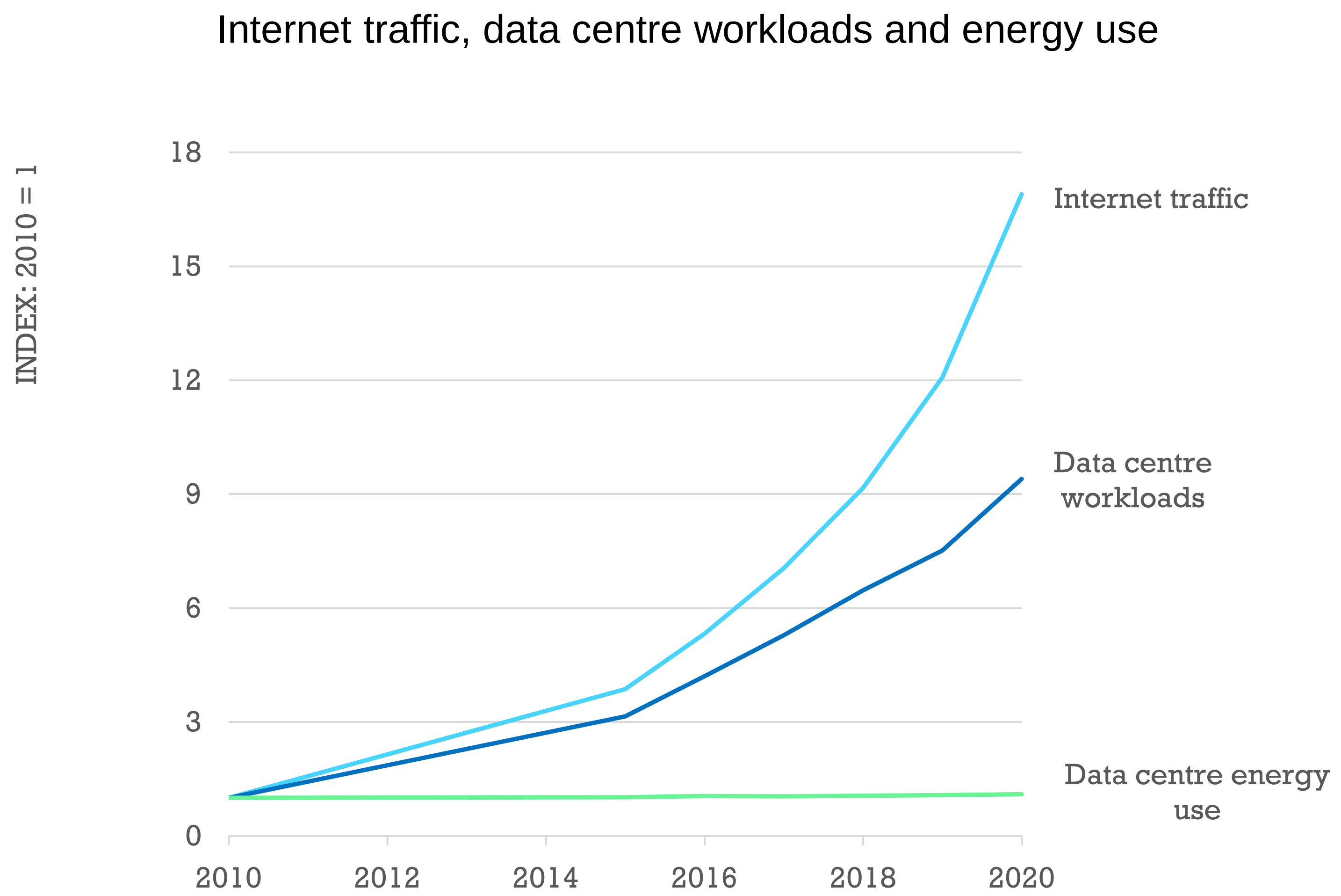
"**We support stronger policies and actions** towards the goal of putting the world on track to achieving a doubling of the global average annual rate of energy efficiency improvements by 2030"

The changing ICT landscape



Hyperscale data centres and cloud computing dominate the field

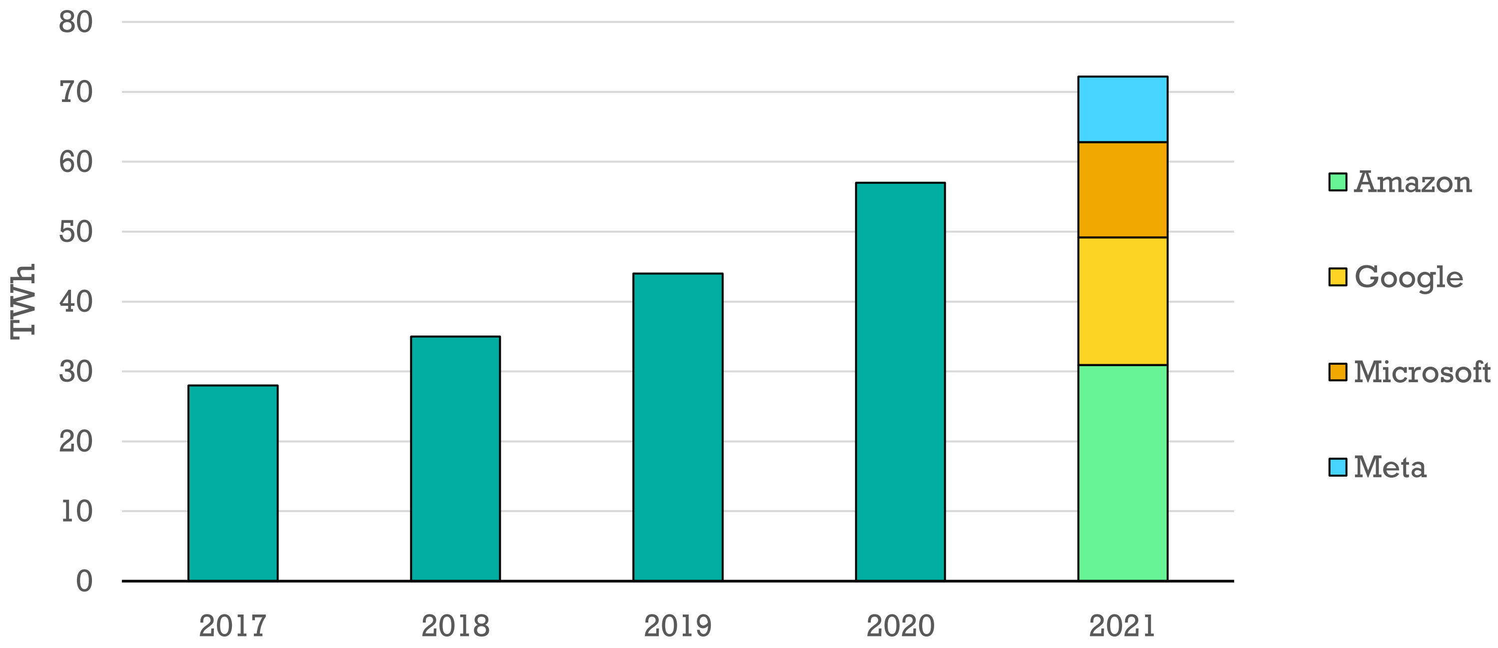
Digitalisation continues at pace



Internet traffic continues to increase skyward, data centres perform 10x more work, all while electricity demand grows at moderate pace

Total energy demand of big four ICT companies is on the rise

Total company-wide electricity use by Amazon, Google, Microsoft and Meta, 2017-2021



Electricity demand doubles as workload triples

Efficient, Demand Flexible Networked Appliances EDNA

Policy development on energy efficiency of data centres

Fiona Brocklehurst, Ballarat Consulting
Hans-Paul Siderius, Netherlands Enterprise Agency
15 February 2024

Download report:

Policy development on energy efficiency of data centres

www.iea-4e.org/edna/publications/

Efficient, Demand Flexible Networked Appliances EDNA

Policy development on energy efficiency of data centres: Introduction to EDNA's workstream

Hans-Paul Siderius, Netherlands Enterprise Agency

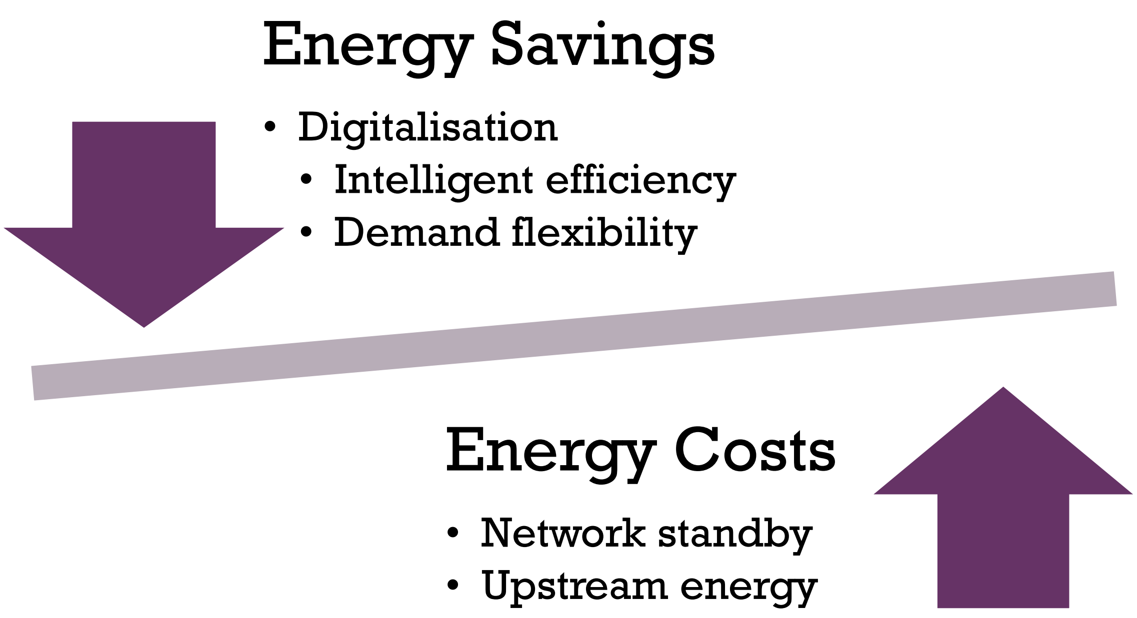
15 February 2024

Contents

- Introduction to EDNA
- Workstream on the energy efficiency of data centres
  - Previous workstream activities
  - Future workstream activities

Introduction to EDNA

- Since 2014, EDNA was the *Electronic Devices and Networks Annex*
- Providing policy guidance on energy implications of device connectivity



‘Upstream’ = data centres & networks

- Why data centres?
  - Data centres consume around 2% of the world’s electricity – 460 TWh p.a.
  - By 2026 this will grow to 620 – 1050 TWh p.a.
    - ≅ adding the entire electricity consumption of one Sweden or one Germany[1]
- To date, most policy efforts focus on:
  - Infrastructure energy (cooling, lighting) = PUE metric
  - Use of renewable energy, export of waste heat
- Policy addressing ICT energy use is more difficult
  - Lack of suitable metrics
  - Lack of data required for metrics
  - Highly dynamic environment

1. https://www.iea.org/reports/electricity-2024

Previous EDNA workstream activities

- Total energy model (TEM)
- Energy efficiency metrics for data centres
- Data centre and server ‘idle coefficients’
- Policies for DC energy efficiency: scope, trends and availability of data
- Policy brief on blockchain

Potential future workstream activities

- Update total energy model – include more (technical) characteristics
- Collecting public data
- Metrics and standardization
- Labelling and consumer information
- Engagement with industry
- Update Policy Observatory

In March 2024
EDNA will change its name

4E Efficient, Demand Flexible Networked Appliances EDNA

- Total energy model, publications, etc: www.iea-4e.org/edna/
- More info: steve@beletich.com.au

4E Efficient, Demand Flexible Networked Appliances EDNA

Policy development on energy efficiency of data centres: policies, modelling results and issues for policy makers

Fiona Brocklehurst, Ballarat Consulting
15 February 2024

Outline

- Data centre energy efficiency policies by type
- Data centre data reporting policies
- Modelling approach
- Modelling results
- Issues for policy makers

Note on Metrics

- Few currently available suitable for energy efficiency policy
- One is, PUE, Power Usage Effectiveness

$$PUE = \frac{(IT\ equipment\ energy\ use + infrastructure\ energy\ use)}{IT\ equipment\ energy\ use}$$

- Lower the better – ideal is 1
- Widely used but
- Doesn't address IT efficiency - only infrastructure
- EDNA has looked into other metrics such as server utilisation

DC energy efficiency and reporting policies

Policy search methodology

- Update policies identified in previous work
- Search in countries considered most attractive for new DC development (20 countries including in North America, Europe and Asia)
  or states, provinces, and cities with large existing DC markets
  (9 US, 2 Canada)
  Using Google and known resources

Energy efficiency policies

Policy types

1. Government permitting
2. MEPS
3. Obligations
4. Cloud first and data centre consolidation
5. Public sector procurement
6. Incentives
7. Voluntary agreements

- Labels and certificates (supporting)

1) Government permitting

Requirements to build new data centres

China: Three-Year Action Plan on New Data Centres 2021-2023
Minimum PUE and utilisation

Singapore: Pilot Data Centre Call for Applications
Announced July 2022, first awards July 2023
PUE and

BCA-IMDA GREEN MARK

and others

2) MEPS

Data centre specific

China, 2022
Combined with label (3 levels)
PUE metric

Germany, 2023
PUE metric

3) Obligations

DCs within broader policies

France, ELAN, 2019
PUE

on buildings

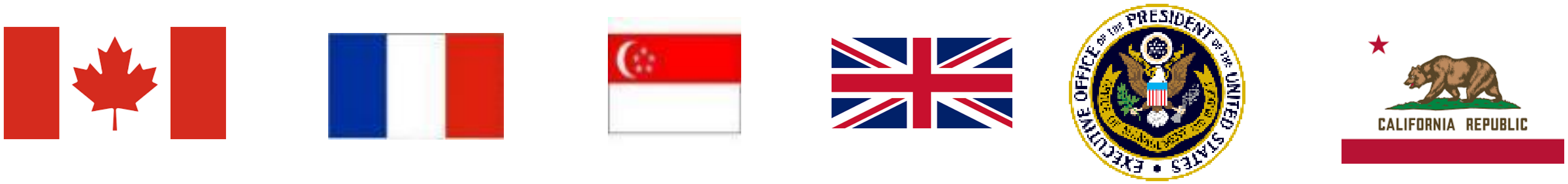
Japan, Energy Conservation Act, 2022
PUE

on organisations

Netherlands,
Energy Saving Obligation, 2019
Adopt energy saving measures

on organisations

4) Government cloud first and data centre consolidation



Canada France Singapore UK US (Federal) US (California)

Benefits of cloud vs traditional enterprise:

- Lower PUE
- Greater server efficiency
- Higher utilisation

resulting in higher energy efficiency

Plus other advantages (lower upfront investment, flexibility, greater security)

Similar benefits from data centre consolidation.

5) Public sector procurement

New South Wales (Australia) Resource Efficiency Policy 2019 — Mandatory

EU Green Public Procurement Guidelines 2020 — Voluntary

German Resource Efficiency Programme III 2020 — Voluntary

Netherlands Sustainable Public Procurement guidance for Networks, Telephone Services and Telephone Equipment — Voluntary

California Green Building Action Plan (data centers) 2014 — Mandatory

6) Incentives

EU Corporate Sustainability Reporting Directive 2023
More sustainable businesses are expected
to more attractive to investors

1. Large companies have to declare which of their businesses are sustainable
2. Using the EU taxonomy
3. Data centres meeting CoC are classified as sustainable

CODE OF CONDUCT
DATA CENTRES

French finance law article 167 and REEN 2021
Numerous parameters – possibly EU CoC?

UK Climate Change Agreement 2013 (colos only)

% reduction on PUE

7) Voluntary agreements

EU Climate Neutral Data Center Pact 2023

PUE

Labels and certification schemes

Australia
Infrastructure rating based on PUE

EU
Certification as well as participation
Many parameters including PUE

Germany
Many parameters including PUE
and server utilisation.
Austrian Ecolabel very similar.

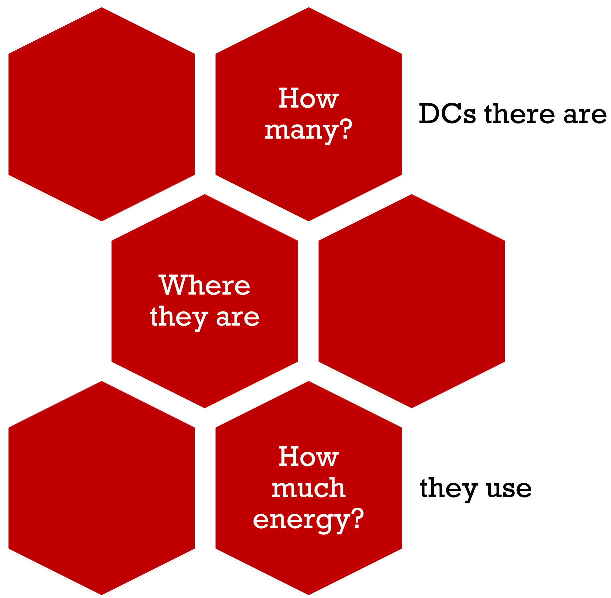
Singapore
4 ratings levels (basic to platinum)
Many parameters including PUE

DC Reporting policies

Benefits to policy makers

Gathers data for government, informs policy making

To date Governments have not known:



Compulsory reporting → Robust evidence base → Effective policies

DC Reporting policies

Broader benefits if results are **published**:

Identify areas of highest impact

Track progress

Drive competition

DC Reporting policies

Supranational and national policies

DC specific

EU (2023)
Information on each DC and aggregate data published

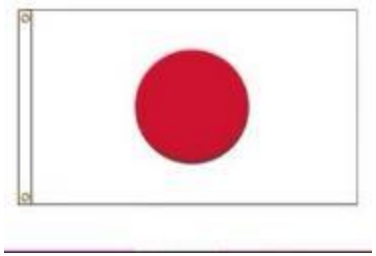
and

Germany (2023)
Data published

Broader obligations

France (2023)
Aggregate data published

and



Japan (2022)
No data published

DC Reporting policies

City, state and province policies

In Canada (2) or US (8)

All buildings related with usage category of

DC

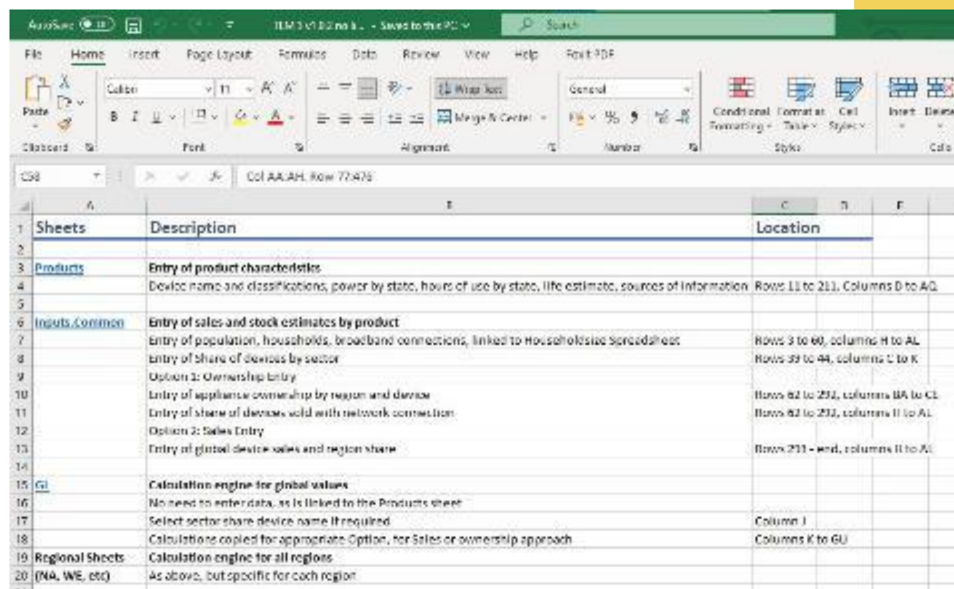
Some quite longstanding (2012) others recent (2024)
Some publish site data in full, others partial or aggregated
Some schemes also place other requirements (e.g. 3rd party review, energy audit)

Modelling EE measures - approach

- Uses EDNA Total Energy Model (TEM).
  A quantitative global model of the 'total energy use' of connected devices

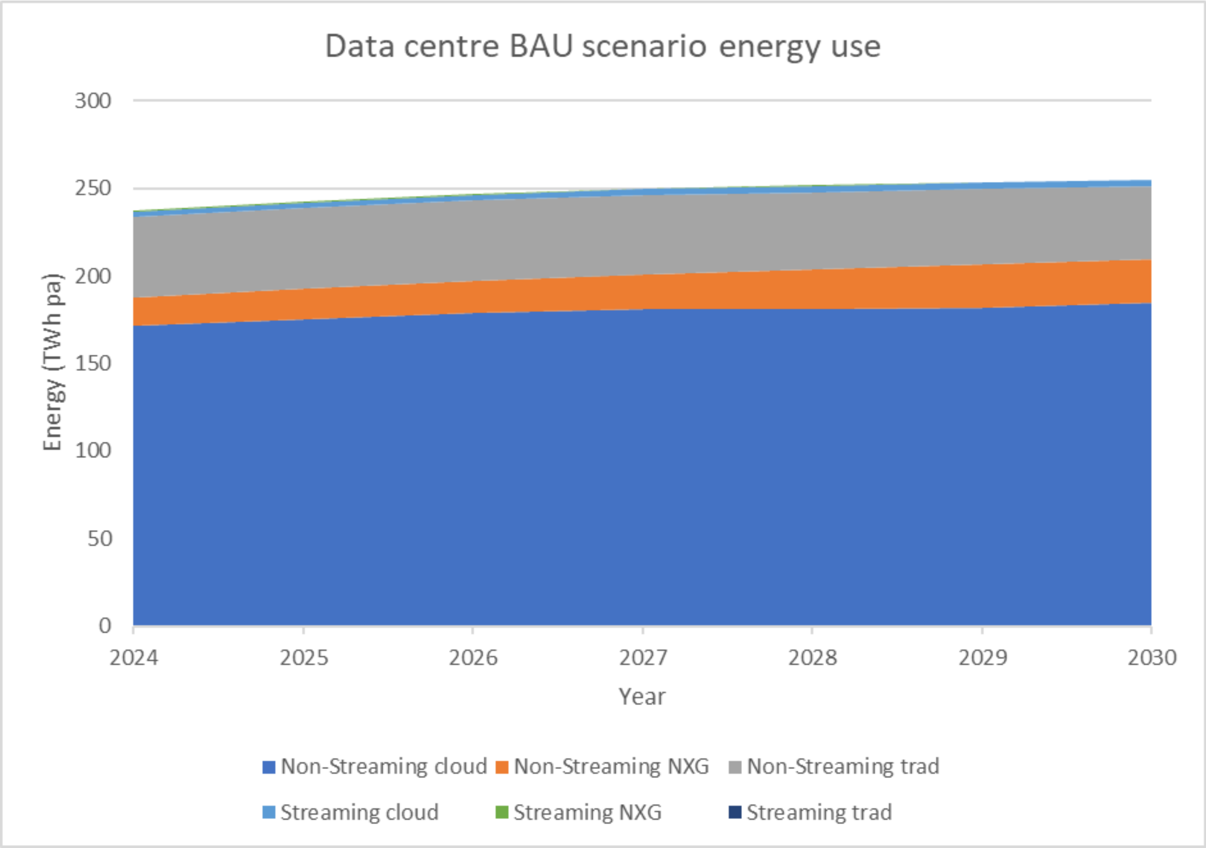
- Includes three data centre types
  - Enterprise, Cloud and Next Generation

- Two types of data flow
  - streaming and non-streaming



xible
es EDNA

TEM Business As Usual results



Energy use almost flat despite data flows increasing by > 3 times (non streaming) or > 4 times (streaming)
Assumes historic (high) rate of server efficiency continues
Very little energy use from streaming (almost no data processing)

NOTE

TEM includes data mining for crypto currencies but not considered in this analysis

Modelling EE measures - approach

- All policies start in 2025 (TEM currently to 2030)
- Five different policy measures – plus one with combination of all five
- Most measures limited evidence so single value modelled
- Exception is PUE – modelled three levels of stringency

NOTE

Not a bottom up model - measures applied to complete population not just new data centres

Scenarios

Scenario 1: Move from enterprise to cloud

- Used in cloud first policies

Scenario 2: Set minimum PUE

- Used in Government permitting, MEPS, obligations, procurement, incentive schemes, voluntary agreements, labels and certification
- Values of 1.5, 1.3, 1.2

Scenario 3: Increase high activity utilisation

- Used in Government permitting schemes, public procurement

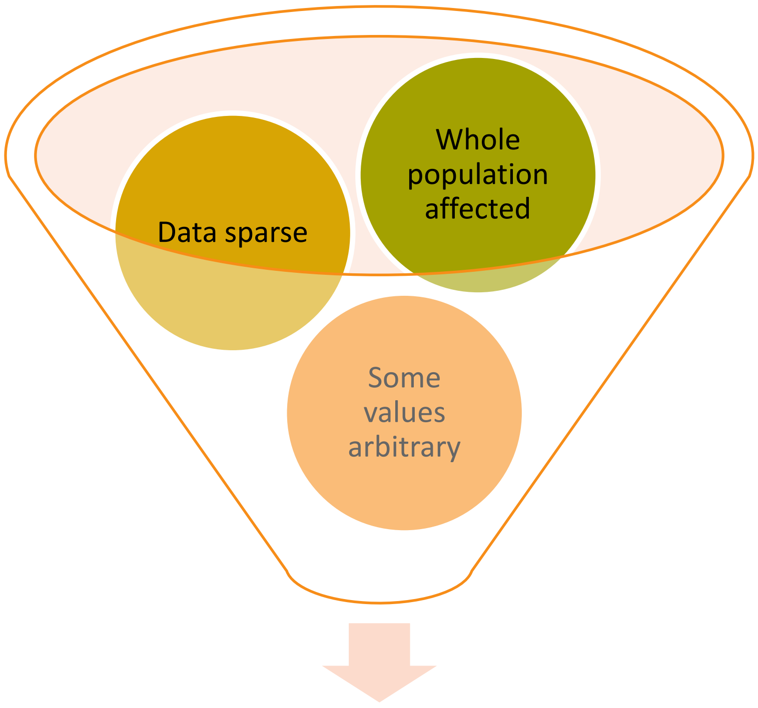
Scenario 4: MEPS for server efficiency

- Used in Government permitting, public procurement

Scenario 5: Increasing low utilisation equipment shutdown

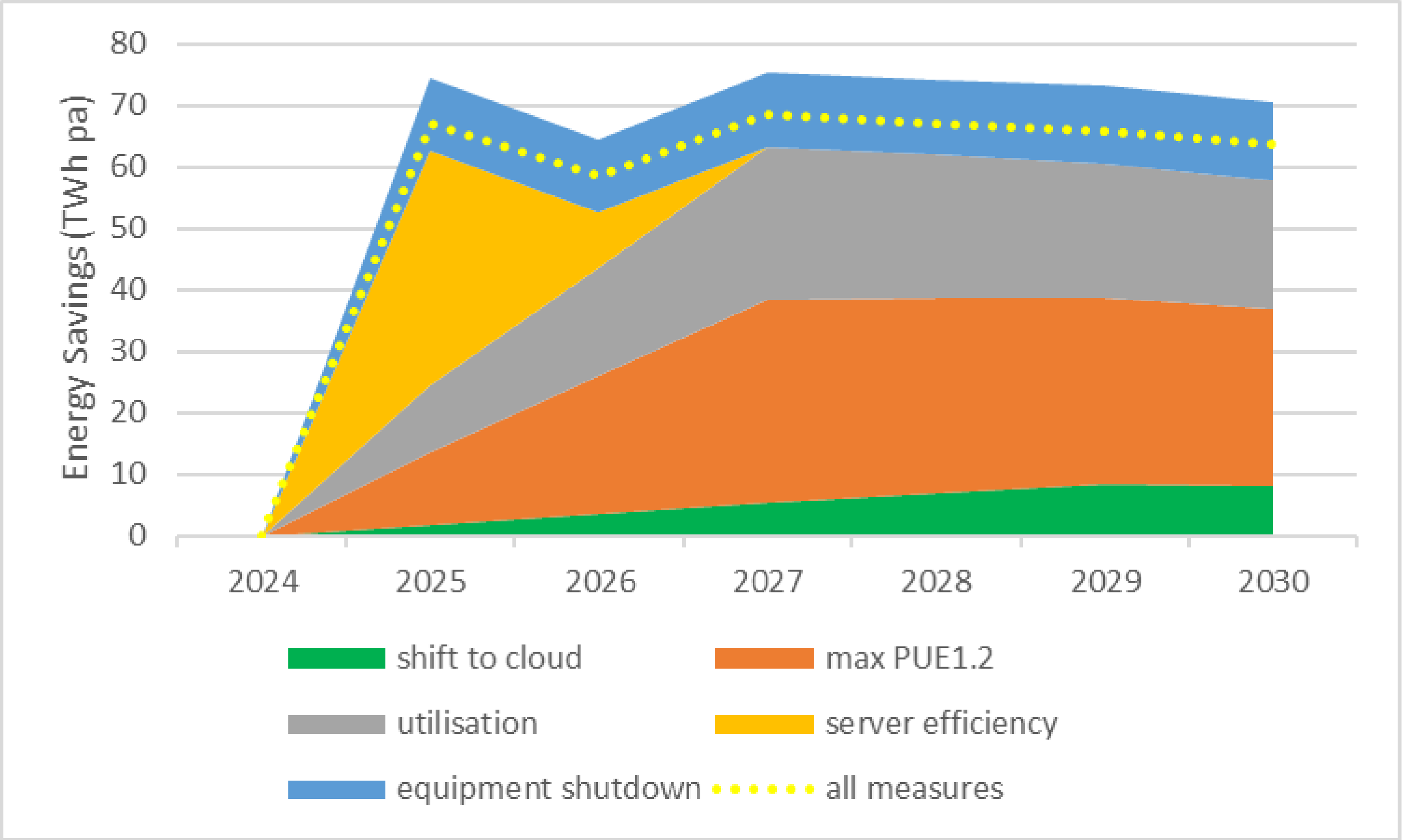
- Used in no known policies

Bear in mind



Results are indicative

Energy savings by scenario



Significant savings from all measures

Combination less than sum of all

Most savings less with time

Savings 28% (2025) to 25% (2030) of BAU

Continuing increases in server efficiency?

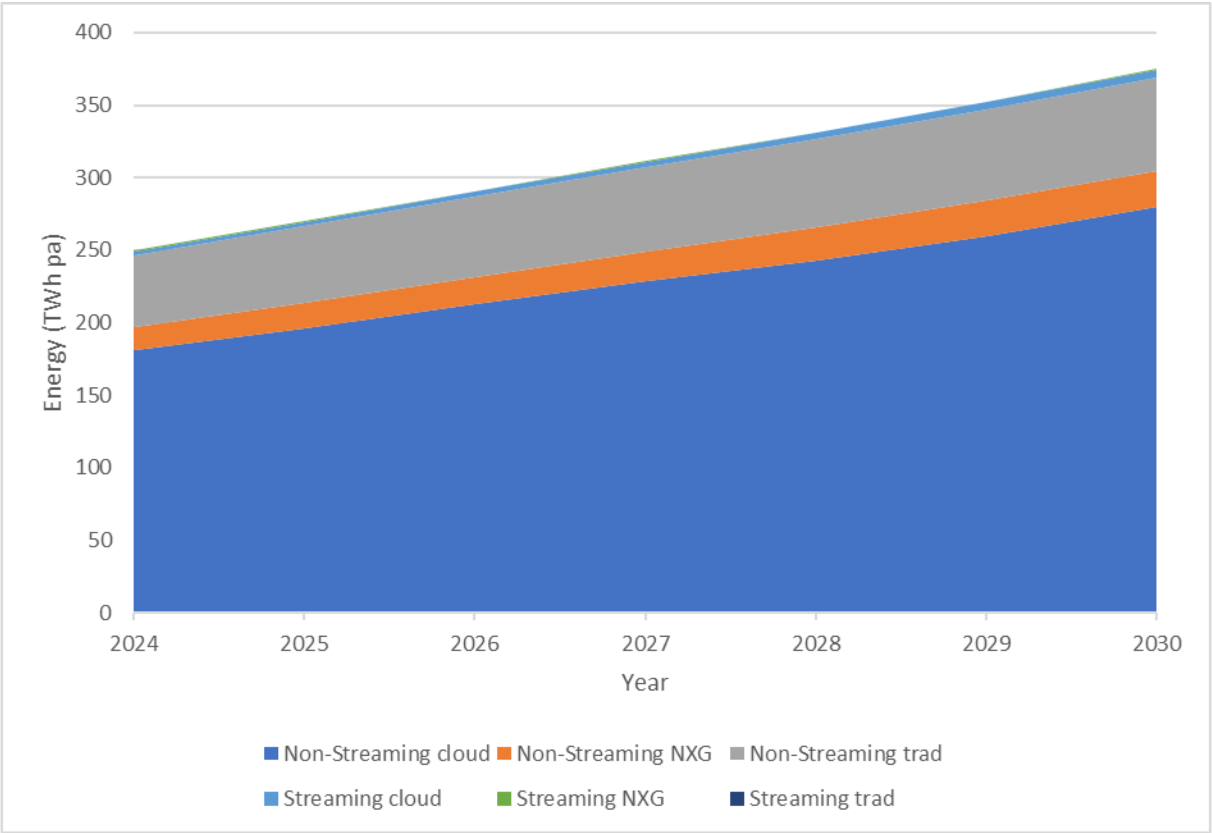
TEM BAU assumes continuing Moore's Law (doubling of efficiency every 2 years)

Technological limits reached – speed of efficiency increase no longer available?

What is effect on DC energy use and savings from measures if efficiency rates slow?

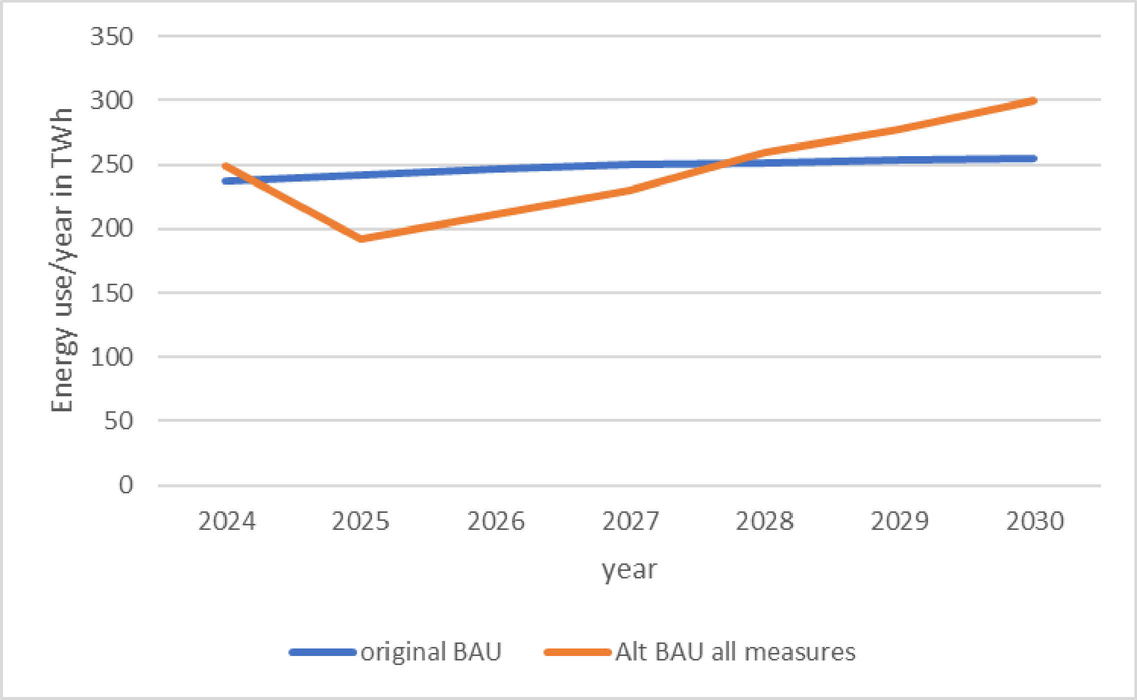
Try measures with alternative BAU, server efficiency increases slowed to 60% of original from 2024

Alternative TEM BAU



Energy use increases substantially from 2024.
In 2030 energy use is nearly 50% higher than in original case

Comparing original BAU with alternative with all measures



- Initially energy use is lower
- After 2028 energy increases due to lower increases in server efficiency > savings from all measures

Mapping measures to policies

Scenario/measure	Policies that could mandate adoption	Policies that could encourage adoption
1: Flow switching	Cloud first	Public procurement
2: Reducing average PUE	Government permitting, MEPS, public procurement, voluntary agreements	Obligations, incentives
3: Increasing utilisation	Government permitting, public procurement	Obligations, incentives
4. Increasing server efficiency	Government permitting, public procurement	Obligations, incentives
5: Low utilisation shutdown	Public procurement	Government permitting, obligations, incentives

Issues for policy makers
Challenges

Should be addressed by mandatory reporting

- How many data centres, where, how much energy?
- Lack of performance data
- Lack of suitable metrics

- International market – possible to avoid regulation?
- High reliability and availability needed
- Complex systems, changing over time

- Varied applications
- Rapidly changing applications
- Fast moving technology
- Wide size range

Issues for policy makers #1

Several policies applied.
New so impact uncertain.

Procurement guidelines and certifications can help address customer information gap.

Can extend/adapt existing policies to DC

Issues for policy makers #2

Continuing pace of increase in server efficiency critical to contain energy use.

Modelling suggests scope for savings
Some existing measures (PUE), some novel (shutdown in low utilisation).

Report available

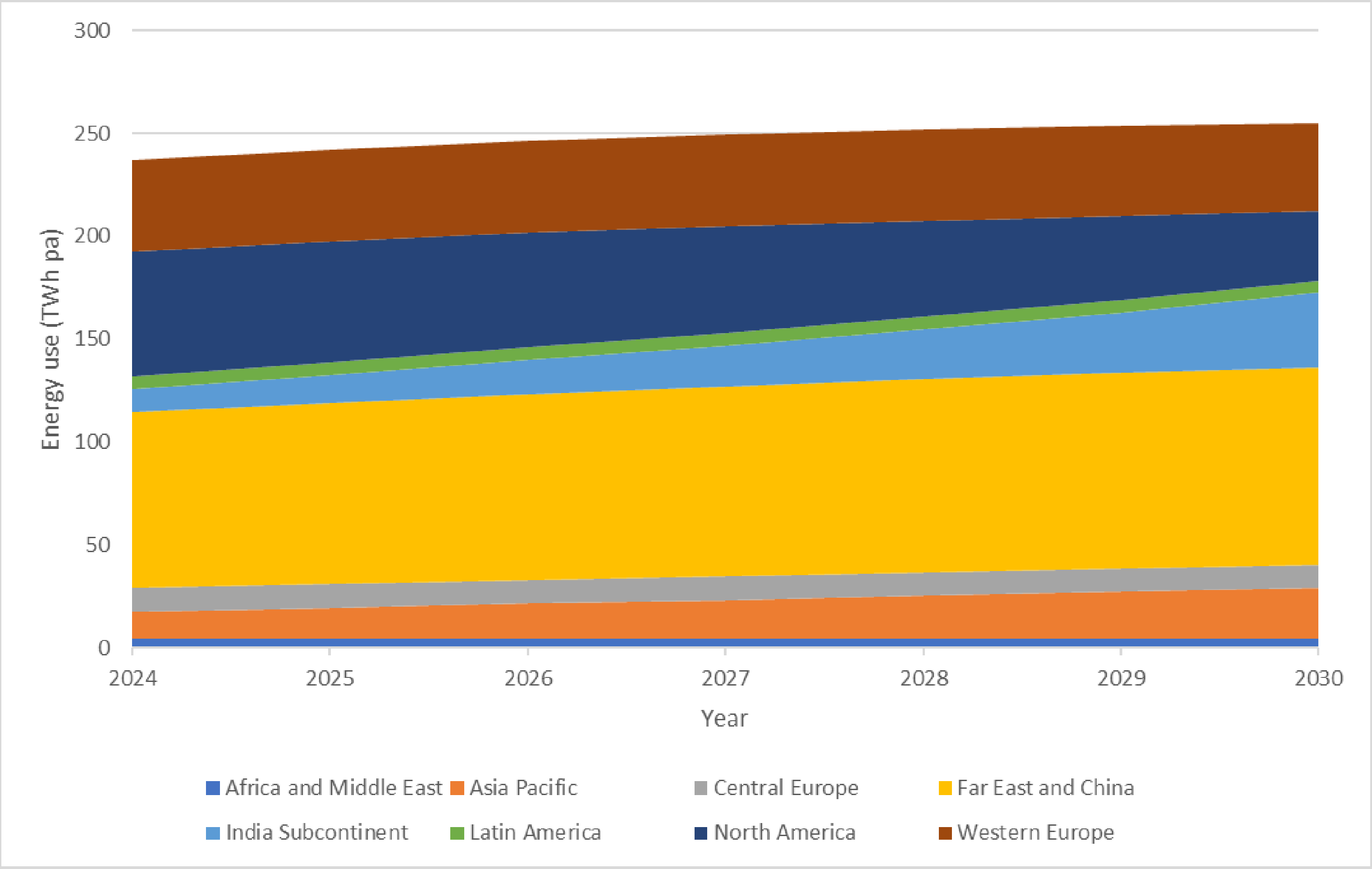
Can be downloaded from

https://www.iea-4e.org/edna/publications/

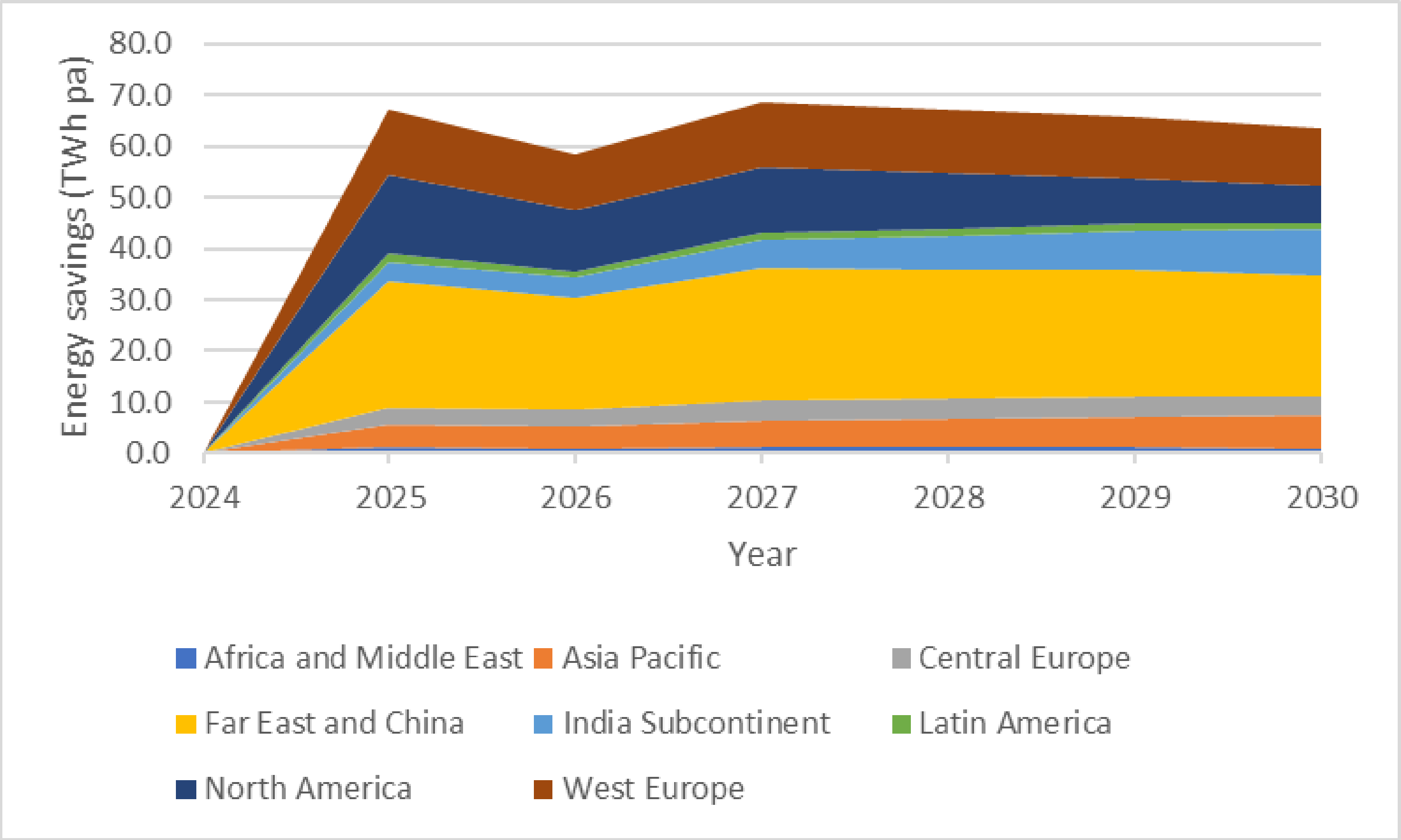
4E Efficient, Demand Flexible Networked Appliances EDNA

Extra slides

BAU energy use by region

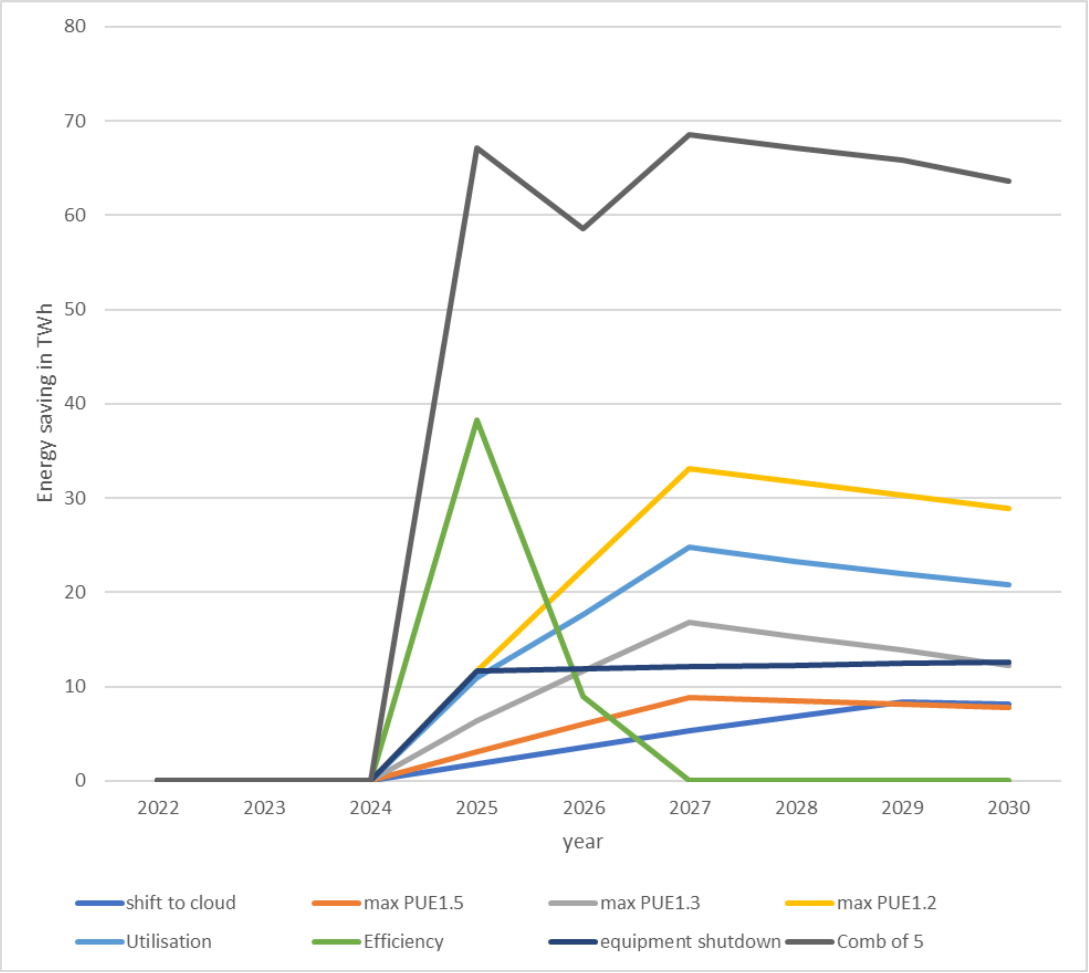


Energy savings by region (combined measures)

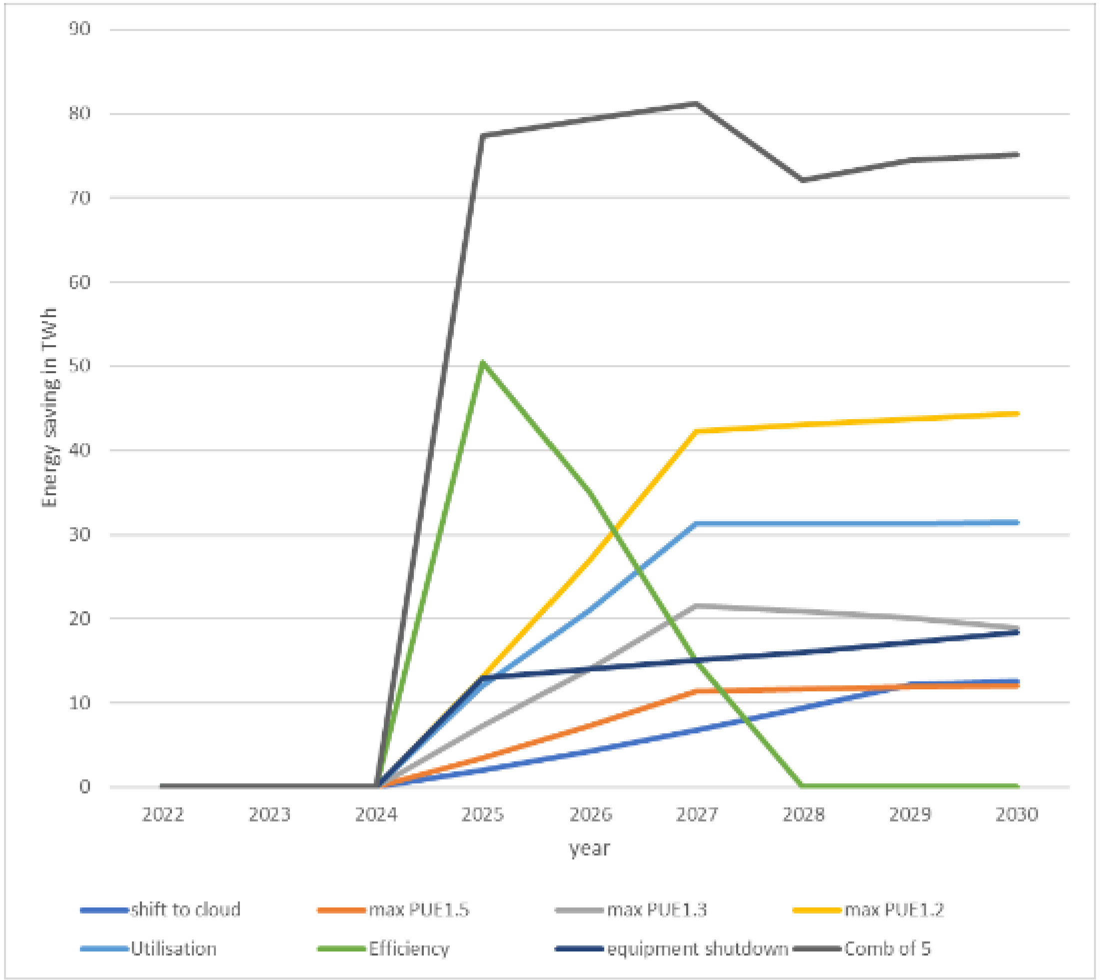


Efficient, Demand Flexible Networked Appliances EDNA

Energy savings by scenario



Energy savings alternative BAU



Efficient, Demand Flexible Networked Appliances EDNA

Issues for policy makers #3

Are hyperscale DCs as efficient as expected?

Procurement can lead way to incorporating more EE measures, ripple effect?

Effectiveness of voluntary agreements?

Scenarios 1 and 2

Scenario 1: Move from enterprise to cloud

- Used in cloud first policies

Data flow 5% ‘extra’ each year up to maximum of 25%

Scenario 2: Set minimum PUE

- Used in Government permitting, MEPS, obligations, procurement, incentive schemes, voluntary agreements, labels and certification

- Values of 1.5, 1.3, 1.2

Applied linearly from 2025, complete in 2027

Scenarios 3 and 4

Scenario 3: Increase high activity utilisation

- Used in Government permitting schemes, public procurement

20% increase on BAU 2025 value unless/until overtaken by BAU increase (NB not enterprise)

Scenario 4: MEPS for server efficiency

- Used in Government permitting, public procurement

20% increase on BAU or next generation technology unless/until overtaken by BAU increase

Scenarios 5 and 6

Scenario 5: Increasing low utilisation equipment shutdown

- Used in no known policies

Increase from 0% to 20% for cloud and next generation

Scenario 6: Combine all five measures

- Used in no known policies
- PUE value of 1.2