This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 649972.

EURECA Training

Module 1: PPI for Public Sector Procurers and ICT Managers

Plus introduction to energy and environment issues of data centres

Target Audience: Procurement/DC ICT/Legal/CSR/Environment

Version 2.0, 28 July 2017, Contact: https://www.dceureca.eu

Copyright © 2017 EURECA Project

Agenda

- Starting questions
- Structure of the EURECA courses
- Learning outcomes
- Course contents
  - Public procurement – conventional, PPI, PCP
  - Background – the societal challenge and policy setting
  - Energy & Greenhouse gasses and Data Centres
  - Environmental topics – beyond climate and energy
  - Measuring the unmeasurable – KPIs for innovations
  - EURECA support to public procurement
- Starting questions to be answered
- References and further reading

Agenda

- **Starting questions**
- Structure of the EURECA courses
- Learning outcomes
- Course contents
  - Public procurement – conventional, PPI, PCP
  - Background – the societal challenge and policy setting
  - Energy & Greenhouse gasses and Data Centres
  - Environmental topics – beyond climate and energy
  - Measuring the unmeasurable – KPIs for innovations
  - EURECA support to public procurement
- Starting questions to be answered
- References and further reading

Starting Questions

- Which environmental impact and resource use issues of main relevance for Data centres do you know?
  - Climate change – land use – particle emissions – ozone depletion – water scarcity ?

- Considering use stage electricity consumption only, about which share of electricity consumed in the EU is consumed by Data centres & Server rooms?
  - 0.1% - 0.2% - 0.5% - 1% - 2% - 5% ?

- Which indicators, measures or methods can be used to meaningfully compare different Public Procurement for Innovation (PPI) offers regarding their overall environmental performance?
  - Power Usage Effectiveness (PUE) – Carbon Usage Effectiveness (CUE) – „Free of halogenated compounds and heavy metals“ – Life Cycle Assessment/ Environmental footprint – Energy Star – Water footprint ?

Agenda

- Starting questions
- **Structure of the EURECA courses**
- Learning outcomes
- Course contents
  - Public procurement – conventional, PPI, PCP
  - Background – the societal challenge and policy setting
  - Energy & Greenhouse gasses and Data Centres
  - Environmental topics – beyond climate and energy
  - Measuring the unmeasurable – KPIs for innovations
  - EURECA support to public procurement
- Starting questions to be answered
- References and further reading

Overview EURECA training KIT

EURECA Training Toolkit

Procurement

- Module 1: PPI for Public Sector Procurers and ICT Managers
- Module 2: Business Case Development
- Module 3: Legislation and Policies
- Module 4: Procurement Strategy
- Module 5: Tendering
- Module 6: Data Centre Contracts and Risks

Technical

- Module 7: Data Centre KPI's and Standards
- Module 8: The EU Code of Conduct for Energy Efficiency in Data Centres
- Module 9: The Data Centre Maturity Model

Agenda

- Starting questions
- Structure of the EURECA courses
- **Learning outcomes**
- Course contents
  - Public procurement – conventional, PPI, PCP
  - Background – the societal challenge and policy setting
  - Energy & Greenhouse gasses and Data Centres
  - Environmental topics – beyond climate and energy
  - Measuring the unmeasurable – KPIs for innovations
  - EURECA support to public procurement
- Starting questions to be answered
- References and further reading

Learning Outcomes

- Public procurement – conventional, PPI, PCP:
  - ➢ Differentiating conventional, PPI and PCP – what is needed when?
- Background of the EURECA project – the societal challenge and policy setting:
  - ➢ Why the focus on public procurement of energy-efficient and environmentally sound Data Centres?
- Energy & Greenhouse Gases and Data Centres:
  - ➢ How Data Centres drive energy consumption and greenhouse gas releases.
- Environmental topics – beyond climate and energy:
  - ➢ Quick look at other issues, from acid rain and summer smog to human toxicity.
- Measuring the unmeasurable – KPIs for innovations:
  - ➢ How to capture the environmental and cost performance of innovative products that escape conventional KPIs and award criteria.
- EURECA support to public procurers:
  - ➢ How EURECA supports public procurers – overview of the whole package.

Agenda

- Starting questions
- Structure of the EURECA courses
- Learning outcomes
- **Course contents**
  - Public procurement – conventional, PPI, PCP
  - Background – the societal challenge and policy setting
  - Energy & Greenhouse gasses and Data Centres
  - Environmental topics – beyond climate and energy
  - Measuring the unmeasurable – KPIs for innovations
  - EURECA support to public procurement
- Starting questions to be answered
- References and further reading

Agenda

- Starting questions
- Structure of the EURECA courses
- Learning outcomes
- **Course contents**
  - **Public procurement – conventional, PPI, PCP**
  - Background – the societal challenge and policy setting
  - Energy & Greenhouse gasses and Data Centres
  - Environmental topics – beyond climate and energy
  - Measuring the unmeasurable – KPIs for innovations
  - EURECA support to public procurement
- Starting questions - answered
- References and further reading

EU PS Procurement perspective

Source: Eurostat

By 2015, GDP in the EU-28 had reached EUR 14.6 trillion (EUR 14 635 billion)

- 250,000+ EU based public authorities
- Public expenditure on goods, works, and services (which includes ICT): approx. 19% of EU GDP = more than €2.3 trillion
- **ICT public procurement** about €50.3 billion in 2011, **about €56 billion in 2015**

(* based on 2014 statistics)

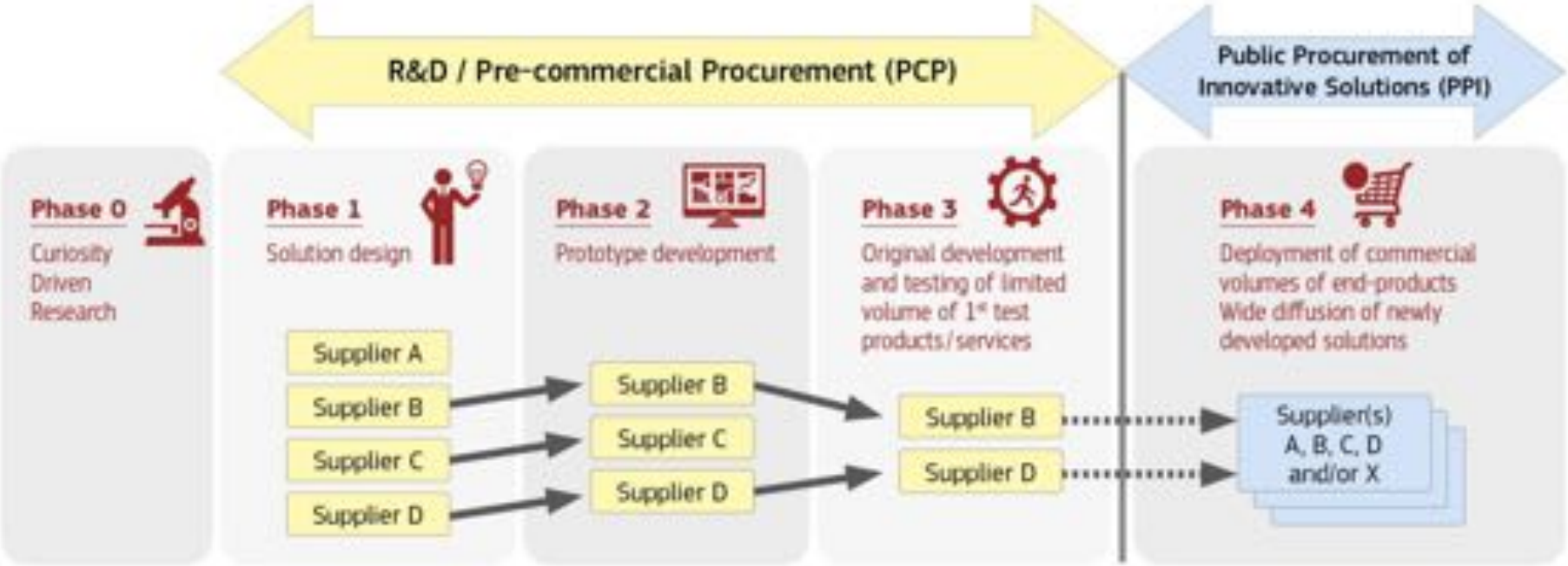
Source: EC Single Market Strategy

Delineation of PCP and PPI

- **Pre-Commercial Procurement (PCP) can be used when there are no near-to-the-market solutions yet and new R&D is needed**. PCP can then compare the pros and cons of alternative competing solution approaches. This will in turn enable to de-risk the most promising innovations step-by-step via solution design, prototyping, development and first product testing.
- **Public Procurement of Innovative solutions** (**PPI**) is used when challenges can be addressed by innovative solutions that are **nearly or already in small quantity in the market and do not need new Research & Development** (R&D)
- PCP can often be followed by PPI

Source: https://ec.europa.eu/digital-single-market/en/innovation-procurement

Key characteristics of PCP and PPI



Source: https://ec.europa.eu/digital-single-market/en/innovation-procurement

Benefit of PPI

- Improving the quality and/or efficiency of public services – beyond off-the-shelf purchase
- Accelerating availability of more sustainable solutions also for private actors, for the benefit of society
- Helping innovative (start-up) companies to grow
- Incentivizing companies to invest in innovation

From: The EAFIP Toolkit (www.eafip.eu), modified

Benefit of PCP (mid to long-term)

- Improving the quality and/or efficiency of the public services
- Higher quality and cheaper products
- Reduced risk of failure in large scale follow up PPI procurements
- Increased efficiency of public R&D expenditure and intensity of private R&D expenditure
- Facilitating access of SMEs to the procurement market, speeding up time-to-market and attracting financial investors for firms
- Increased interoperability/ impact on standardization/ reduction of supplier lock-in
- Impact on competition structure in the market

From: DG CONNECT (2015): Quantifying the impact of PreCommercial Procurement (PCP) in Europe based on evidence from the ICT sector , ISBN 978-92-79-51772-3

PCP and PPI are complementary

	PCP	PPI
When	The identified challenge requires R&D to get new solutions developed and tested. No commitment to deploy (PPI) yet.	Challenge requires solution which is near to the market or already on the market in small quantity but does not meet public sector requirements for large scale development yet. No R&D involved (R&D already d[illegible] ded to solve challenge)
What	Public procurer buys R&D to steer development of solutions to its needs, gather knowledge about pros/cons of alternative solutions, avoid sup[illegible] in later (create competitive supply [illegible]	Public p[illegible] ching customer/ early adopter/ [illegible] ovative products and services that are [illegible] arriving on the market (not widely commercially available yet)
How	Public procurer [illegible] eral suppliers in parall[illegible] native solution approaches) [illegible] petition evaluating progress after [illegible] ical milestones (design, prototyping, testing). IPR related risks and benefits of R&D are shared between procurer and suppliers to maximize incentives for wide commercialization.	Public procurer announces the intention to buy a critical mass of innovative solutions to trigger industry to bring products on the market with desired quality/ price ratio within a specific time. After verification if the market was able to deliver the desired quality/price – e.g. via a test and/or certification – the public procurer buys a significant volume of innovative solutions.

Horizon 2020 funding for PCP and PPI by EU funds for public authorities

From: The EAFIP Toolkit (www.eafip.eu)

Main steps of PPI (general)

- **Needs identification and assessment**
- Prior art analysis
- IPR search
- Analysis of the regulatory, certification, standardization environment
- Drafting a business-case
- **Open market consultation**
- IPR and confidentiality strategies
- Drafting the tender documents
- **Conducting the procurement procedure**
- Monitoring and evaluating the contract performance
- Managing after contract issues

EURECA developments geared to support many of the steps and aspects!

From: The EAFIP Toolkit, modified (www.eafip.eu)

Agenda

- Starting questions
- Structure of the EURECA courses
- Learning outcomes
- **Course contents**
  - Public procurement – conventional, PPI, PCP
  - **Background – the societal challenge and policy setting**
  - Energy & Greenhouse gasses and Data Centres
  - Environmental topics – beyond climate and energy
  - Measuring the unmeasurable – KPIs for innovations
  - EURECA support to public procurement
- Starting questions to be answered
- References and further reading

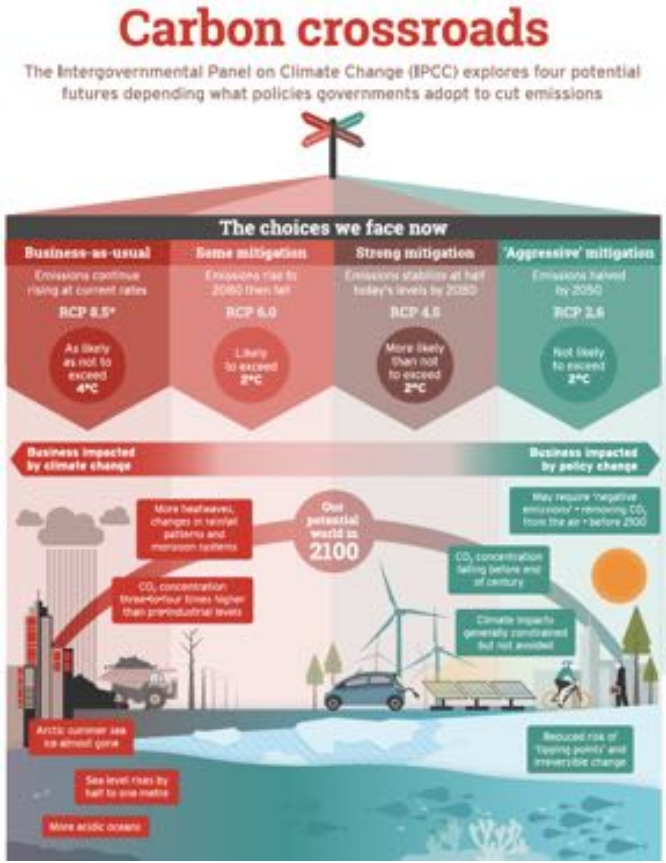
Major societal challenges

Impacts of unsustainable development on mankind and nature:

extreme weather events with high cost, social impacts, ecosystem damages

PE International 2010 (www.thinkstep.com), modified

Major societal challenges



- 7 billion people live on the planet and need to eat and the population is growing rapidly
- Modern society demands increasing amounts of materials and energy carriers for products – with increasing emissions as consequence, leading to Climate change, water scarcity, air pollution, reduced land productivity, loss of biodiversity, …
- Distribution of wealth and the access to products to meet even basic needs is highly unequal
- Current production and consumption patterns are not sustainable

Source: http://www.cisl.cam.ac.uk/business-action/low-carbon-transformation/ipcc-climate-science-business-briefings/pdfs/infographics/science-report-infographic-web-en.pdf

The policy setting of EURECA:
EU 2020 Climate & Energy targets

- The 2020 package is a set of binding legislation to ensure the EU meets its climate and energy targets for the year 2020.
- The package sets three key targets:
  - 20% cut in greenhouse gas emissions (from 1990 levels)
  - 20% of EU energy from renewables
  - 20% improvement in energy efficiency

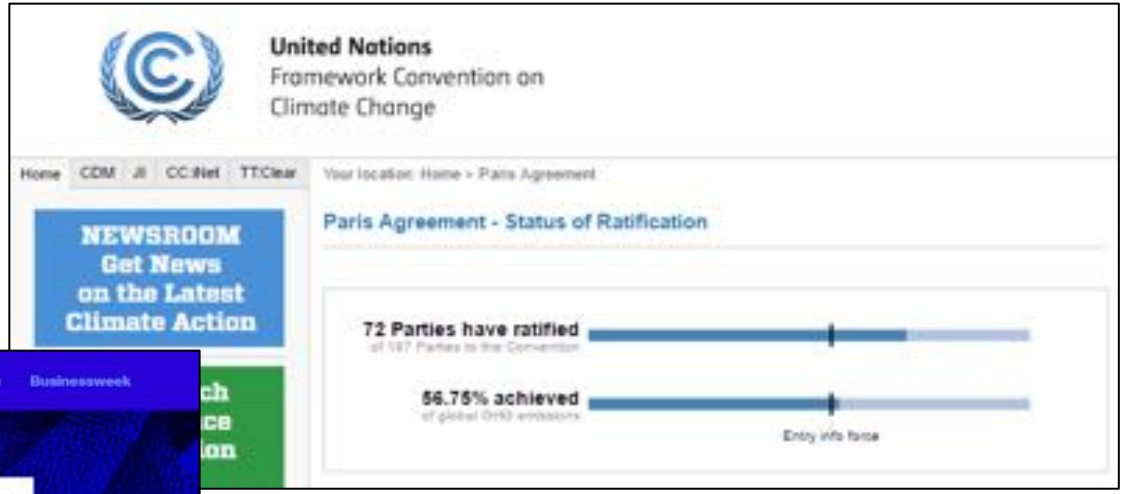
- The targets were set by EU leaders in 2007 and enacted in legislation in 2009. They are also headline targets of the Europe 2020 strategy for smart, sustainable and inclusive growth.
- The EU is taking action in several areas to meet the targets.
- Meeting the targets still needs additional effort.

The policy outlook:
EU 2030 Climate & Energy targets

- The 2030 climate and energy framework sets three key targets for the year 2030:
  - At least 40% cuts in greenhouse gas emissions (from 1990 levels)
  - At least 27% share for renewable energy
  - At least 27% improvement in energy efficiency
- The framework was adopted by EU leaders in October 2014. It builds on the 2020 climate and energy package.
- It is also in line with the even much more ambitious, longer term perspective set out in the Roadmap for moving to a competitive low carbon economy in 2050, the Energy Roadmap 2050 and the Transport White Paper.

Source: DC, DG ENERGY

Paris Climate Agreement to enter into force



Even stricter targets and a quicker pace are expected, despite some current adverse developments, that are very likely temporary

Agenda

- Starting questions
- Structure of the EURECA courses
- Learning outcomes
- **Course contents**
  - Public procurement – conventional, PPI, PCP
  - Background – the societal challenge and policy setting
  - **Energy & Greenhouse gasses and Data Centres**
  - Environmental topics – beyond climate and energy
  - Measuring the unmeasurable – KPIs for innovations
  - EURECA support to public procurement
- Starting questions to be answered
- References and further reading

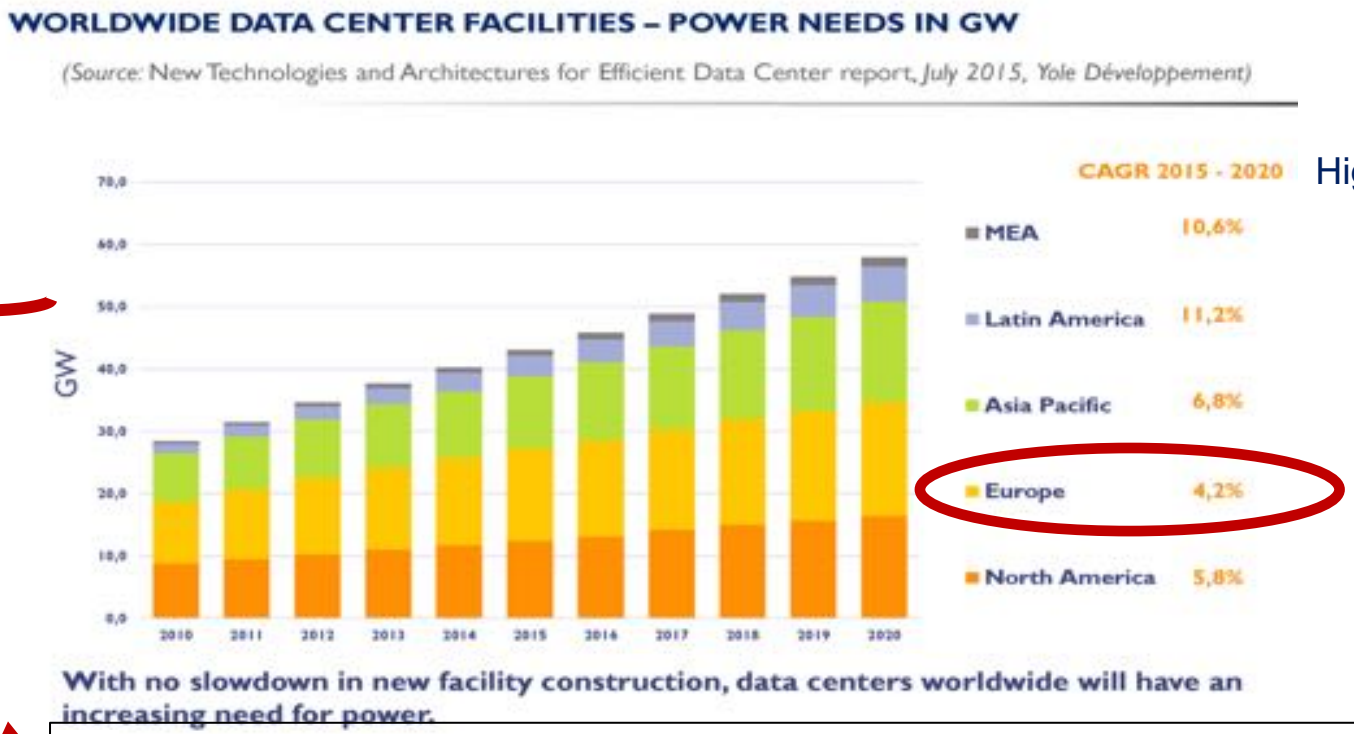
EU Energy Data – Defining energy

Energy can take many forms and may undergo several processes before it can be used by us, but all go back to the primary energy.

Therefore, in our project we define "energy consumption" in terms of Primary Energy:

"Primary energy (PE) is an energy form found in nature that has not been subjected to any conversion or transformation process. It is energy contained in raw fuels (e.g. coal, crude, wood, nuclear fuels, …), and other forms of energy received as input to a system (e.g. solar power, hydropower, …). Primary energy can be non-renewable or renewable."

ICT is a power-hungry sector, with Data Centres at its core



High growth rate

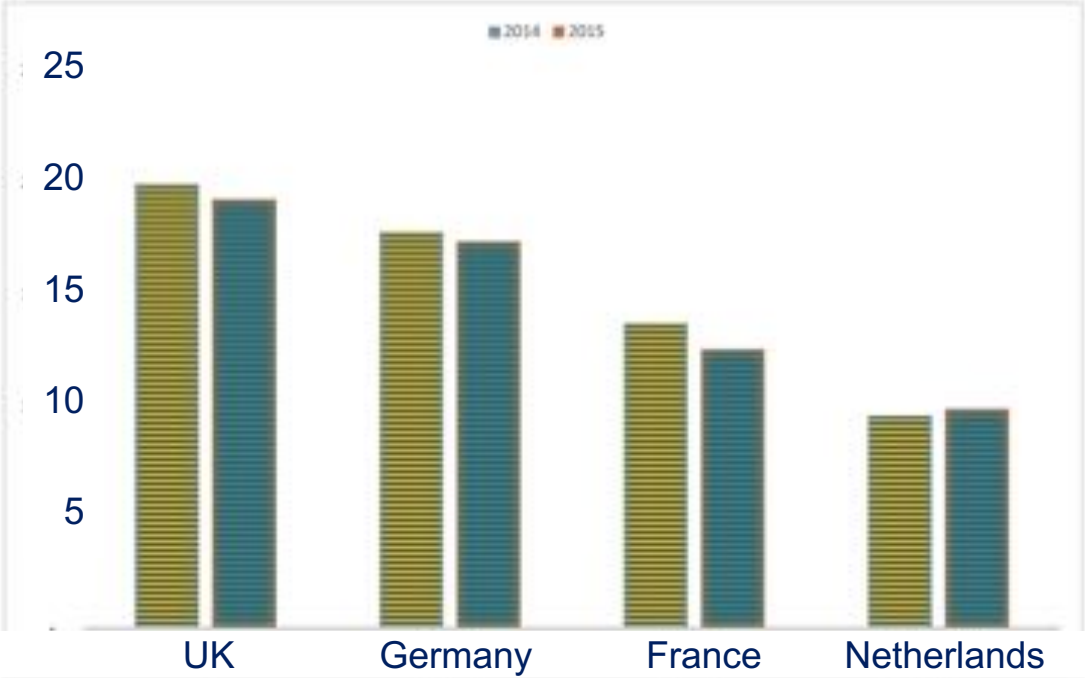
50 GW = 438 TWh / yr = electricity consumption of France = 1.7% of global electricity.
(Share of European DCs is > 2% of European electricity consumption)

Where are data centres concentrated?

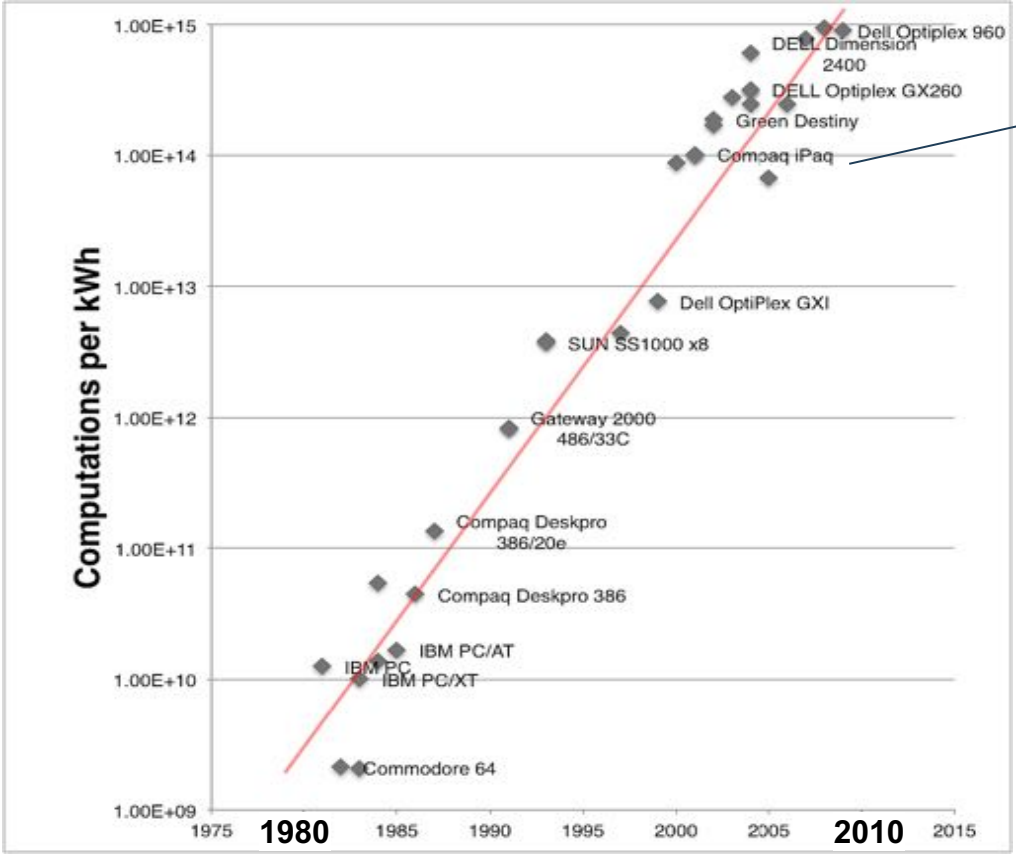
4 Key markets control 59% of m2 space in Europe at end 2015

Source: Broadgroup

[%] of EU data centre floor space



Data Centre hardware becomes more energy efficient…



Examples of hardware

"The energy efficiency of hardware doubles every 1.5 years." *(Koomey's law)*

In other words, the hardware (end-user computers and servers etc.) can do double work (computation) at the same energy consumption, every 1.5 years.

…but we all use more digital services

Consider this…

How the digital media world moves every 60 seconds!

Source: http://www.slideshare.net/Pisocialmedia/october-ppt (2015)

And more still to come …

SMART *GRID*

… HOUSES
… MOBILITY
… LOGISTICS
… MANUFACTURING
… etc.

Source, modified: Amsterdam Smart City (https://amsterdamsmartcity.com)

While every smart device uses one or more data centres at some point – the "Internet of the Things" is coming on top

…including an increasing e-Government

EU e-government report: countries should follow Estonia's footsteps

However: Important is to ensure that efforts for improved energy-efficiency and environmental performance do not negatively affect the functional performance of the data centre services.

Source: European Commission

Agenda

- Starting questions
- Structure of the EURECA courses
- Learning outcomes
- **Course contents**
  - Public procurement – conventional, PPI, PCP
  - Background – the societal challenge and policy setting
  - Energy & Greenhouse gasses and Data Centres
  - **Environmental topics – beyond climate and energy**
  - Measuring the unmeasurable – KPIs for innovations
  - EURECA support to public procurement
- Starting questions to be answered
- References and further reading

Environmental topics – the bigger picture

"What's the largest multinational of Europe? There is no other that produces so much food, provides us with so many services and products, and offers so many jobs... IT'S NATURE"

Video from European Commission's Directorate General for the Environment: https://www.youtube.com/watch?v=wMIUglBligI&feature=youtu.be

There are several environmental impact categories and indicators, widely used in Life Cycle Assessment studies and Environmental Footprinting, that focus on assessing impacts on life's ecosystem services which we depend on.

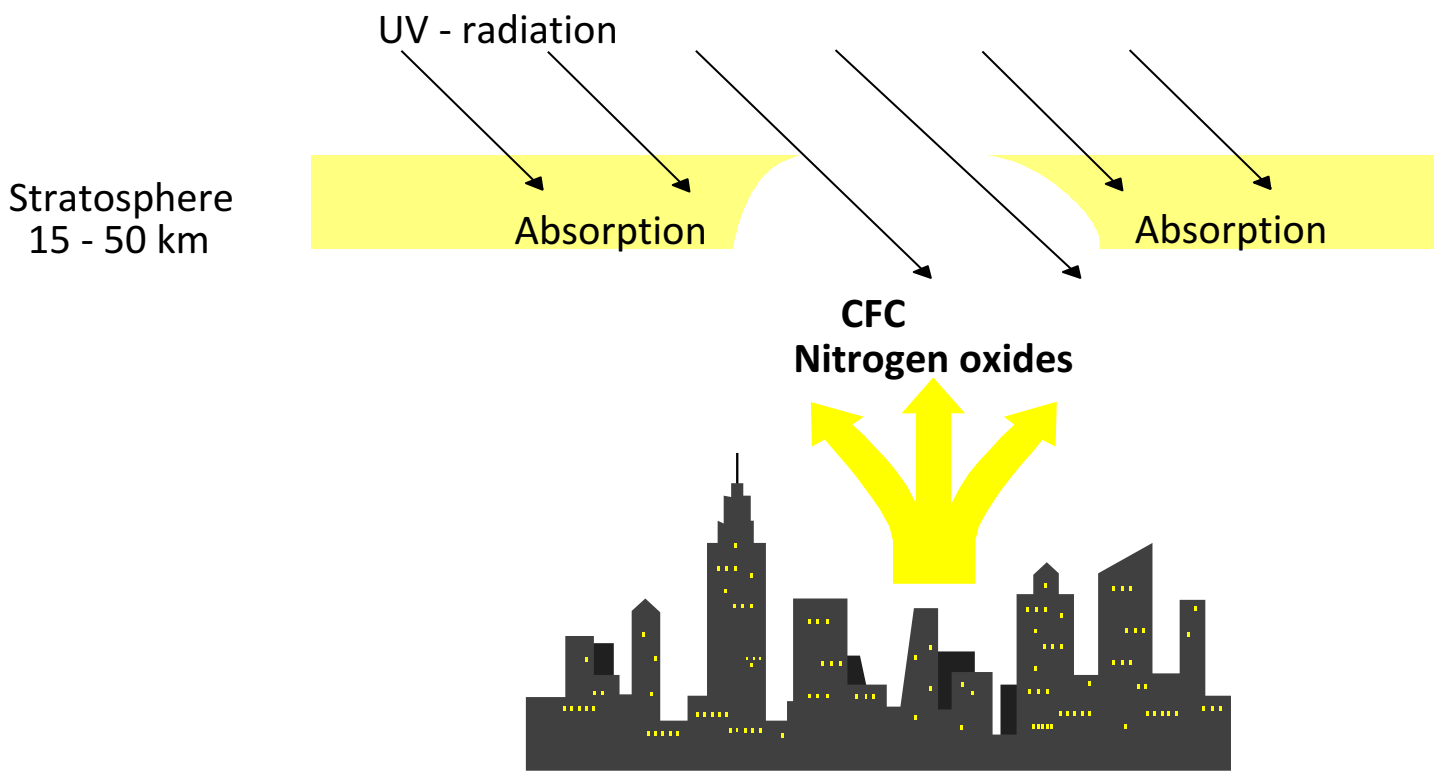
Environmental topics

Those most relevant ones for Data Centres AND with relative robust assessment methods are indicated in **bold**

Impact category	Short description	Examples
Climate Change / Global Warming Potential (GWP)	Emissions into air; influencing the earth's atmosphere balance	All GHG's
Ozone Depletion Potential (ODP)	Emissions into air; depleting the earth's protective ozone layer	HFC's, CFC's, ...
Acidification Potential (AP)	Emissions into air (causing 'acid rain') or acidification of waterbodies	NO_x, SO_2.....
Eutrophication Potential to land, waterbodies (EP)	Excessive nutrients in waterbodies (lakes and seas) and soils causing depletion of oxygen in the environment's ecosystem	Nitrogen (N), Phosphorus (P), …
Photochemical Oxidant Creation Potential (POCP)	Emissions into air; generating ozone near the ground	CHn, NOx, ...
Human toxicity: Potential toxicity damage to human beings (HTP)	Emissions into soil, air and water; harmful to health and genetic material in a cell or organism	HMs, Dioxins
Ecotoxicity: Potential toxicity damage to aquatic and terrestrial ecosystems (AETP / TEPT)	Emissions in soil, air and water; disturbing the local ecosystem balance of flora and fauna	HMs, Acids.....
Land use	Occupation and modification of natural environment for specific use	Agriculture, open pit mining, roads...
Water scarcity	Lack of (access to) water resources to meet water needs within a region.	Water lost from the catchment to air or else.
Material and energy resource depletion	Non sustainable consumption of fossil fuels, metal ores, minerals, etc.	Crude oil, copper ore...
Ionising radiation	Emissions into air, water and soil of radioactive substances	C-14, I-131, ...
Particulate matter / respiratory inorganics	Emissions into air of fine particulate matter and of substances that form particles after emissions	PM2.5, SOx, ...

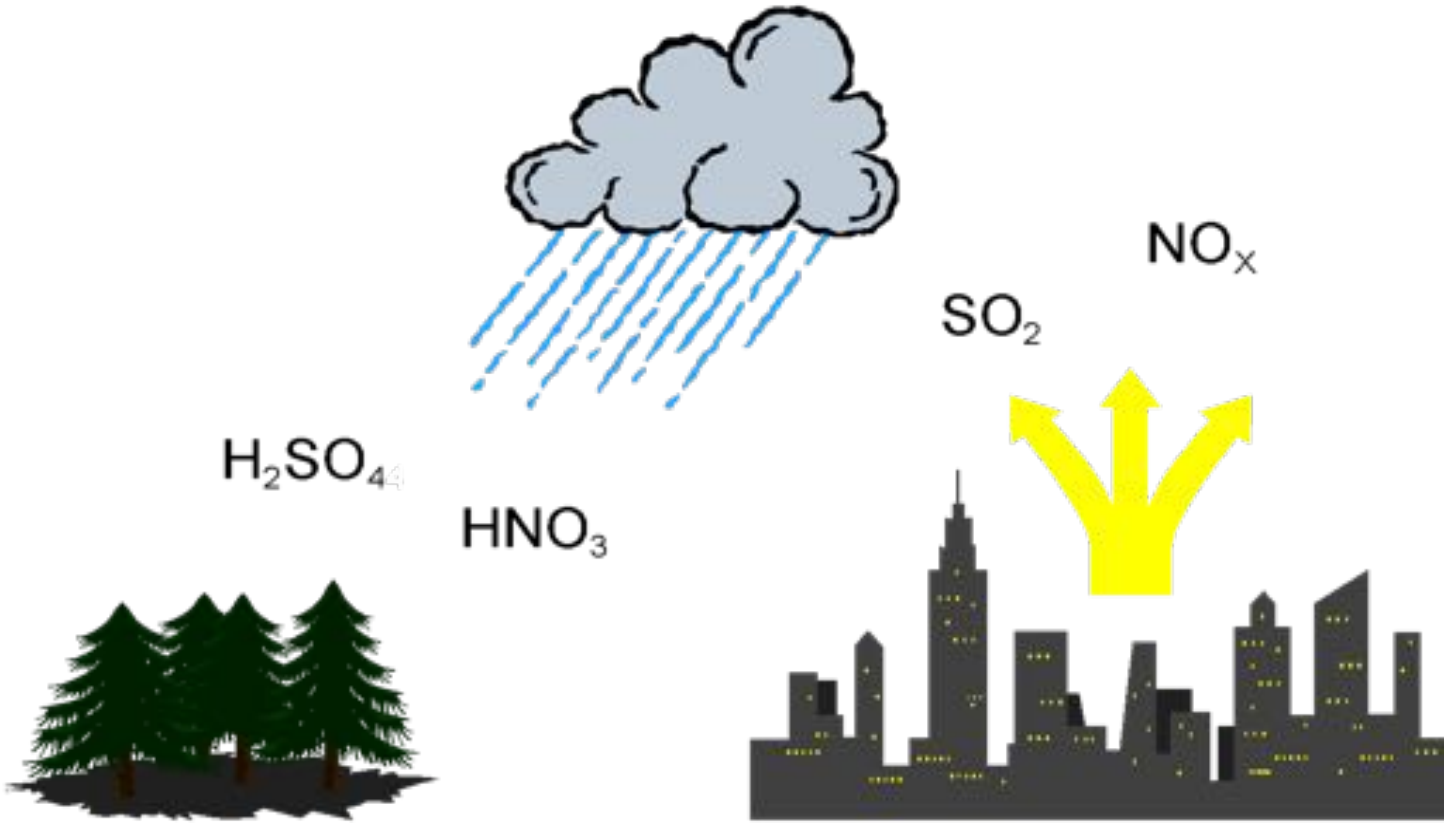
Environmental topics

Stratospheric ozone depletion, Ozone Depletion Potential (ODP)



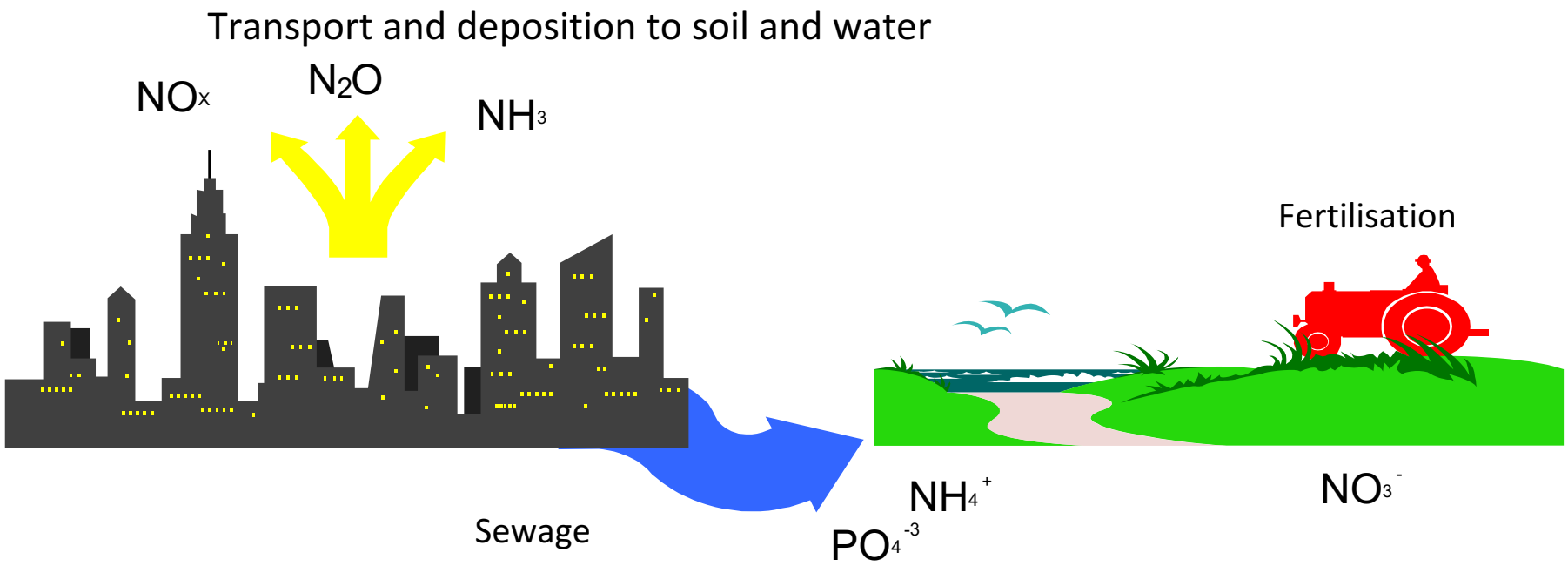
Environmental topics

Acidification, Acidification Potential (AP)



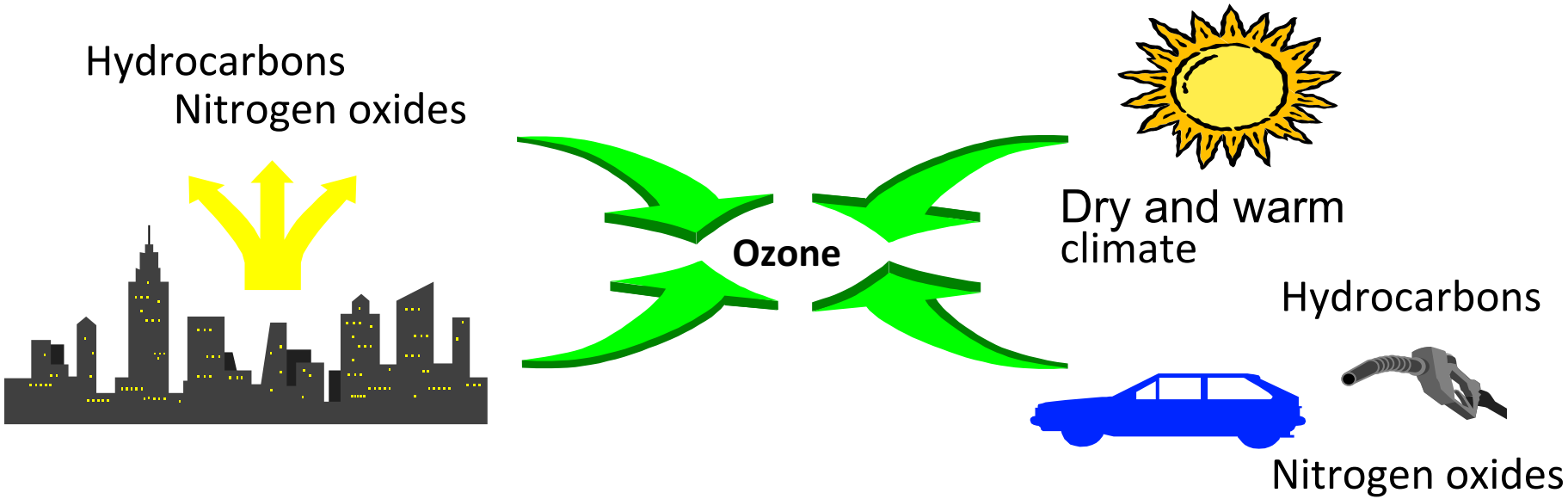
Environmental topics

Eutrophication of land, freshwater, and seawater... Eutrophication Potential (EP)



Environmental topics

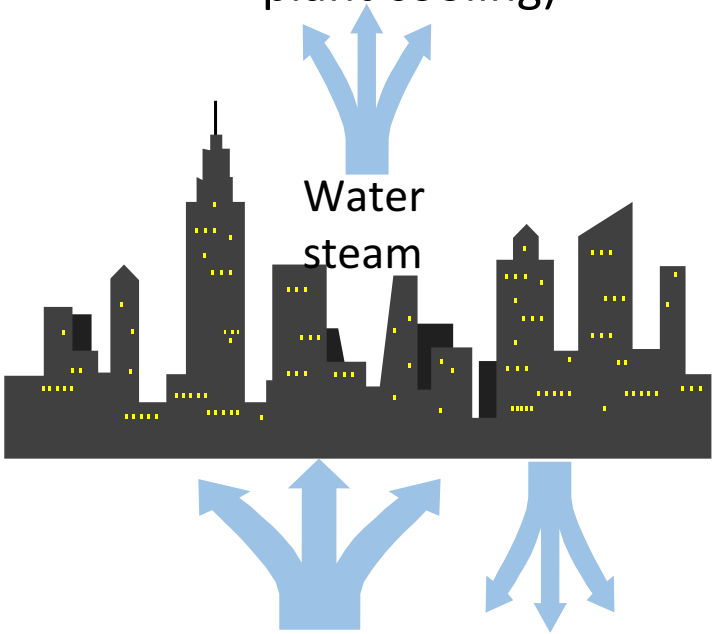
Photochemical Ozone (or: Oxidant) Creation Potential (POCP), „Summer smog“



Environmental topics

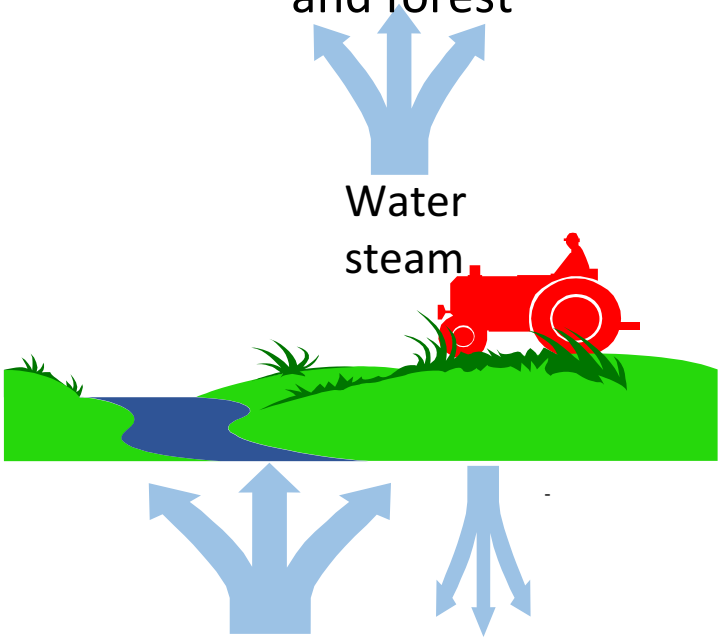
Water scarcity (net water abstraction in relation to water availability)

Evaporation (e.g. chillers, power plant cooling)



Water from/to groundwater, surface water

Evapotranspiration from field and forest



Water from/to groundwater, surface water

Agenda

- Starting questions
- Structure of the EURECA courses
- Learning outcomes
- **Course contents**
  - Public procurement – conventional, PPI, PCP
  - Background – the societal challenge and policy setting
  - Energy & Greenhouse gasses and Data Centres
  - Environmental topics – beyond climate and energy
  - **Measuring the unmeasurable – KPIs for innovations**
  - EURECA support to public procurement
- Starting questions to be answered
- References and further reading

How green is green, how blue is blue?

How can we measure what is **green** (= environmentally preferable)…

How can we measure what is **blue** (= more sustainable)…

… for **innovative products** (goods and services)?

- Conventional KPIs are applicable to conventional products, may often misguide on innovation procurement decisions.
- Many KPIs used for conventional product are unsuitable even for conventional products, let alone innovative products, e.g. Power Usage Effectiveness (PUE), Carbon Usage Effectiveness (CUE), “Free of halogenated compounds and heavy metals” and similar
- A more robust, open assessment is typically needed to get suitable award criteria for innovation...

One of the top 10 ideas changing the world….

HOME | U.S. | POLITICS | WORLD | BUSINESS | TECHLAND | HEALTH | SCIENCE | ARTS | TRAVEL | PHOTOS | VIDEO | SPE

TIME IN PARTNERSHIP WITH CNN

SEARCH TIME.COM

Specials

Special Reports • Best Websites • Worst Cars • Time 100 • Time 100 Roundtable • Design 100
Best TV Shows • Top 10 • ALL Time 100

10 Ideas Changing the World Right Now

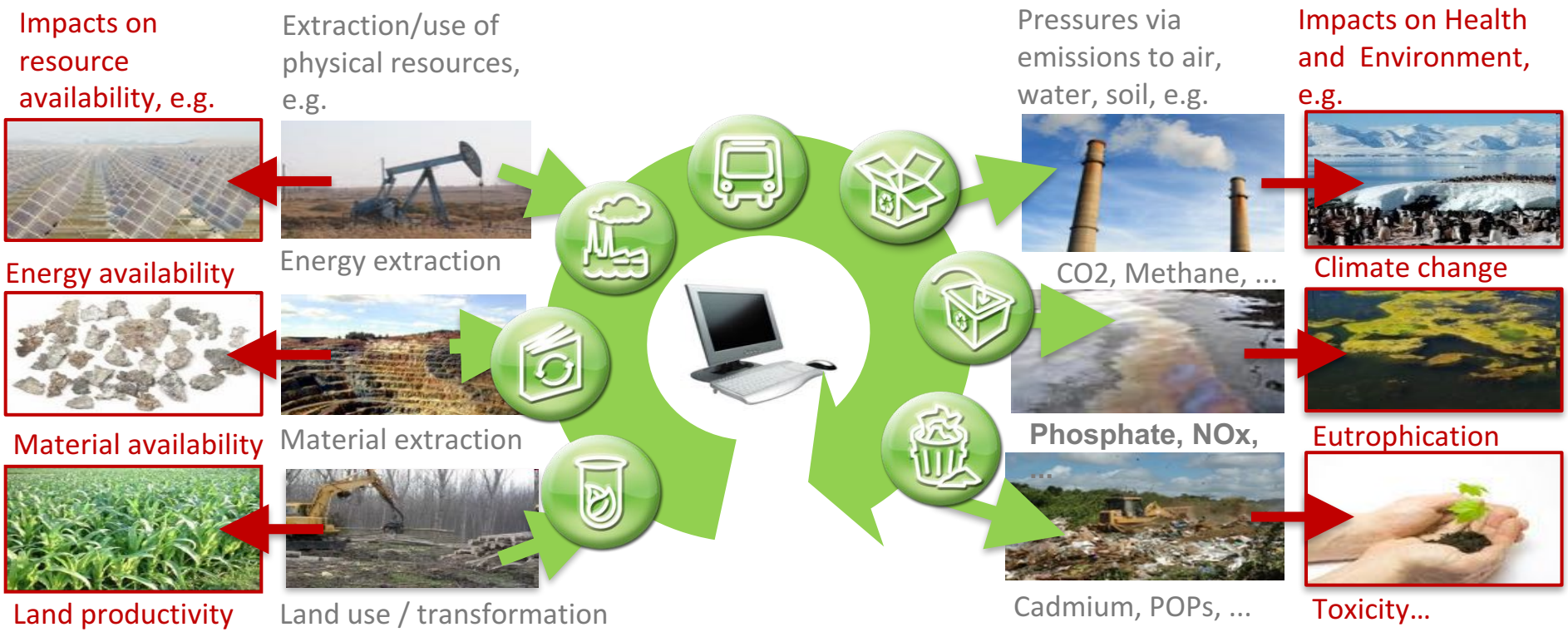
The global economy is being remade before our eyes. Here's what's on the horizon

Ecological Intelligence

By **BRYAN WALSH** Thursday, Mar. 12, 2009

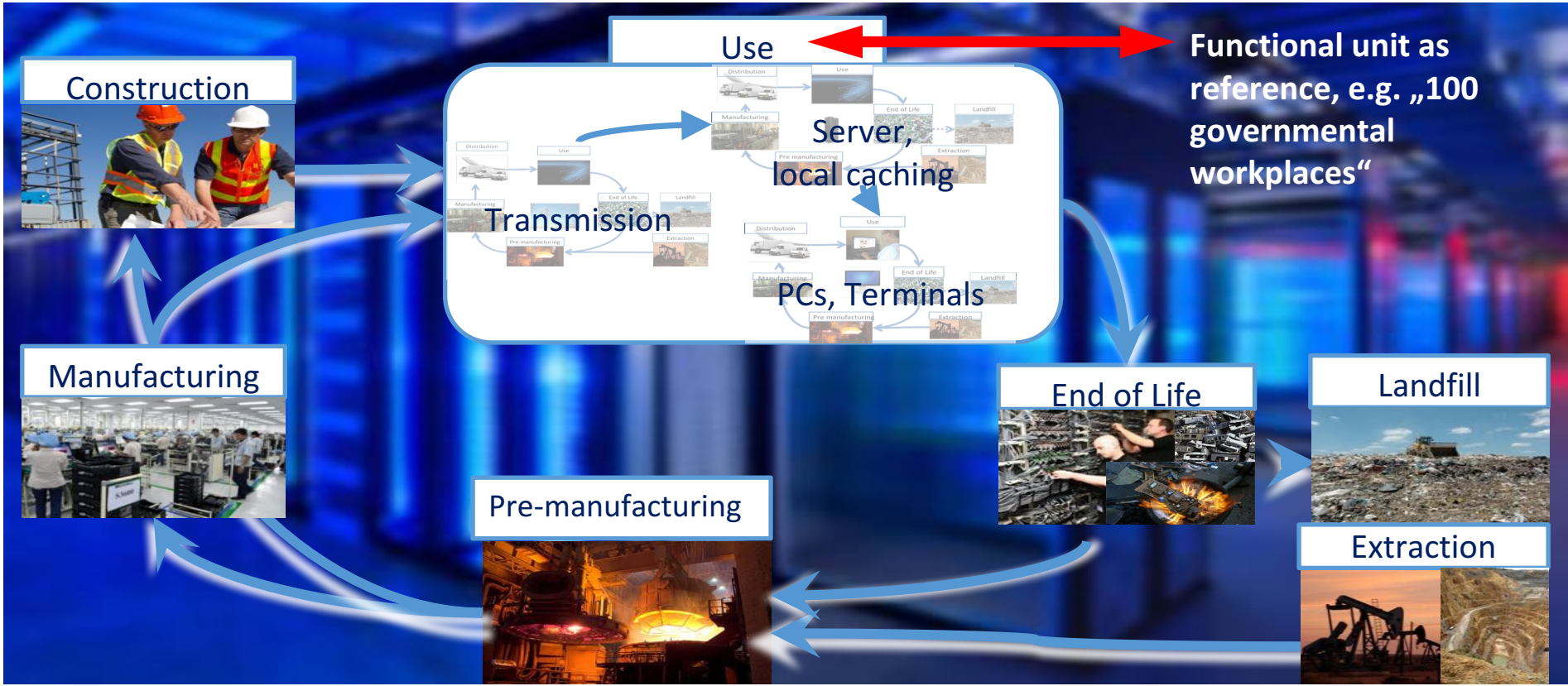
"When it comes to going green,
intention can be easier than action.
…
But what if we could seamlessly calculate the full lifetime effect of our actions on the earth and on our bodies?
…
… have been using a method called ***life-cycle assessment (LCA)*** *to break down that web of connection.*
…"

(Environmental) Life Cycle Assessment (LCA)



EC-JRC 2010, modified

DC life cycle (i.e. supply-chain, use phase, and end-of-life)



Life Cycle Costing (LCC)

Two main components to overall LCC

Total cost of ownership (TCO)

env. Life Cycle Costing

overall Life Cycle Costing

- LCC is core part of procurement, further strengthened in the EU Procurement Directive of 2014
- Both TCO, but also overall LCC (i.e. including the hidden environmental costs) can be used

LCA and LCC – how do they relate?

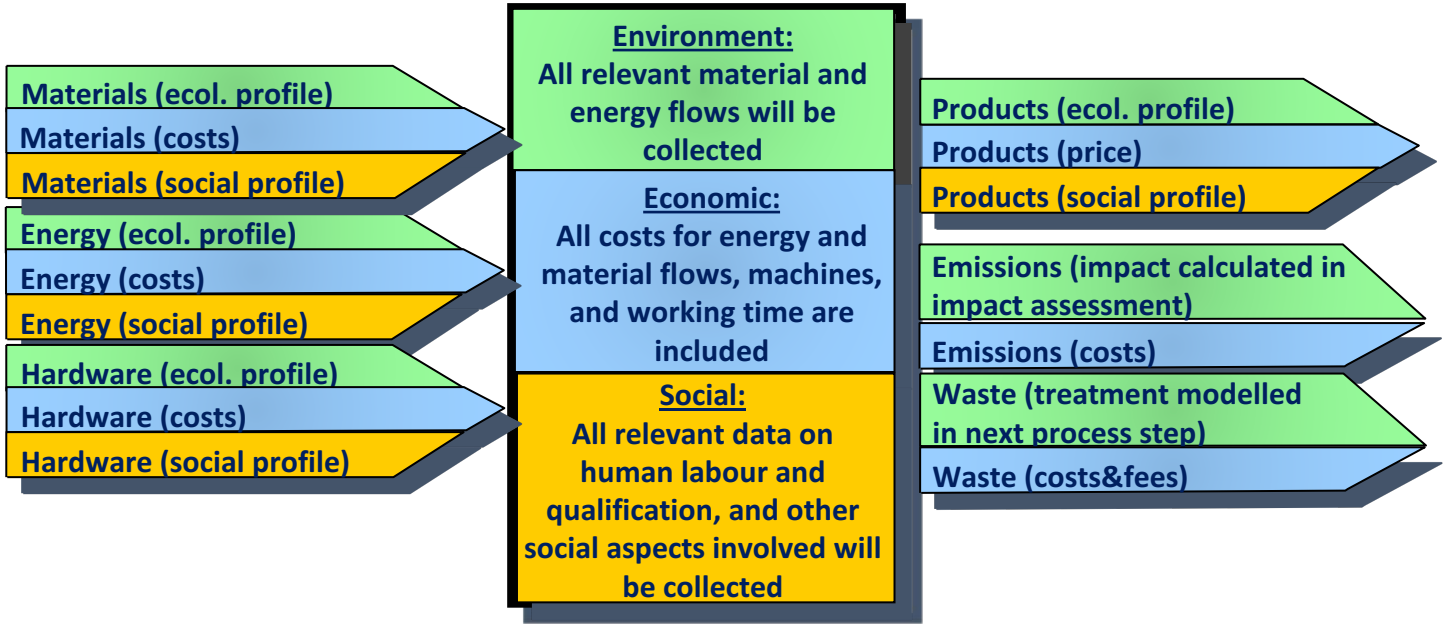
Topic	LCC (TCO)	LCA
Purpose	Determine true cost-efficiency of alternative investments and business decisions, from the perspective of an economic decision maker such as a manufacturing firm or a consumer	Compare relative environmental perform alternative product systems for m d-use function, from a broa
Considered activities	Activities causing direct costs or benefits to the decision maker during the economic life of the investment, as a result of the investment	All n ted to the physical life cycle ing the entire pre-usage supply d the processes supplying use; end-of-life he processes supplying end-of-life steps
Unit	Monetary	Primarily mass and energy; occasionally volume, other physical units → transformed to environmental impacts and resource use (energy, materials, land, water). Monetarisation possible but not consensus.
Time	is critical. Present valuing (discounting) of costs and benefits. Specific time horizon scope is adopted, and any costs or benefits occurring outside that scope are ignored	The timing of processes and their release or consumption flows is traditionally ignored; impact assessment may address a fixed time window of impacts but future impacts are generally not discounted

LCA / Environmental footprinting in award criteria: see EURECA Module 4 (Procurement Strategy), and "EU PEF" and "Blue Angel" in references slide of this module 1

Adding the third dimension – Life Cycle Sustainability Assessment

Combined environmental and economic life cycle data per process (e.g. manufacturing, use, …)
(Note: Social part is not covered quantitatively by EURECA):

Process step (e.g. assembly, use, ..)



Agenda

- Starting questions
- Structure of the EURECA courses
- Learning objectives
- **Course contents**
  - Public procurement – conventional, PPI, PCP
  - Background – the societal challenge and policy setting
  - Energy & Greenhouse gasses and Data Centres
  - Environmental topics – beyond climate and energy
  - Measuring the unmeasurable – KPIs for innovations
  - **EURECA support to public procurement**
- Starting questions to be answered
- References and further reading

EURECA within the EU funded CSAs/ Networks of procurers (FP7/CIP/H2020)

DATA CENTER eureca PROJECT

HEALTH AGEING

- SAEPP (preparing PCP) — Ambulance ICT
- C4BI (networking) — Cities on healthcare
- PRO4VIP (preparing PCP) — ICT for Visually impaired
- EPP-eHealth (preparing PCP/PPI) — Cities on e-health
- INSPIRE (Training PCP, link with VC) — E-health procurers

TRANSPORT

- P4ITS (Preparing PPI) — Intelligent Transport Systems
- TRANSFORM (Networking) — City/Regional transport

ICT

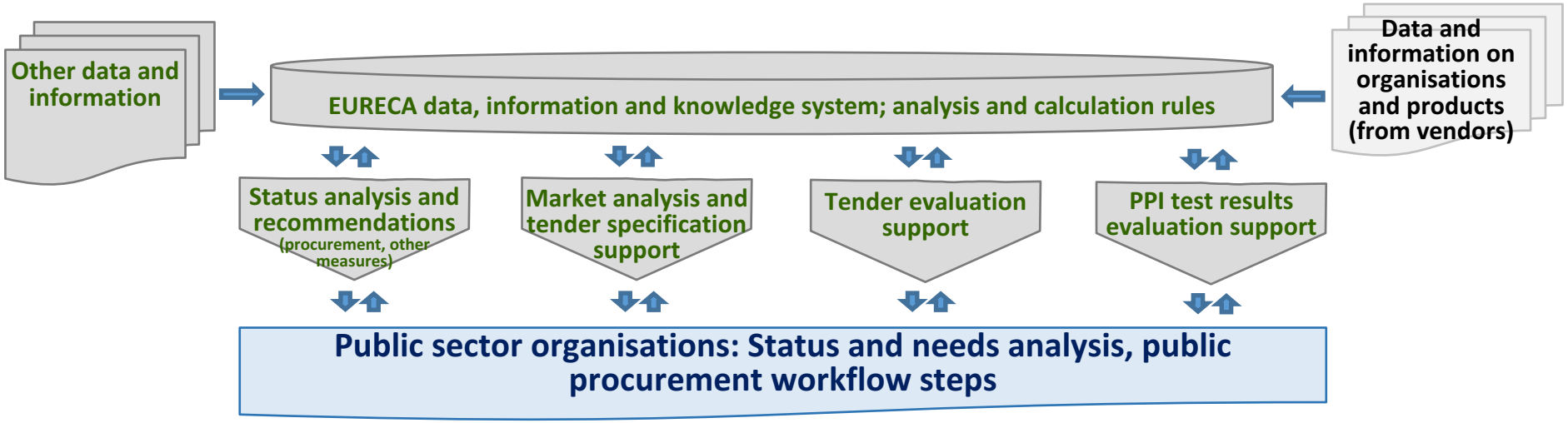
- PICSE (Preparing PCP/PPI) — Cloud computing research cloud
- COMPLETE (Preparing PPI) — Photonics broadband

SUSTAINABILITY

- **EURECA (prep PPI)** — Green data centres
- WATER PIPP — Water procurers
- GREENS (prep PPI) — Energy agencies – CO2
- CEPPI 2 (prep PPI) — Cities – energy consumption
- SPP regions (capacity building) — PPI – sustainability
- InnProBio Forum (capacity building) — PPI – bio based products
- BRODISE — Cities brown field decontamination
- PPI4WASTE — Authorities Waste management

More info on:
http://ec.europa.eu/digital-agenda/en/eu-funded-projects

EURECA framework to support public procurers - overview



EURECA developments

- **Market directory** – to gain a quick overview of what the market offers, where is PPI needed/justified, and what can otherwise directly be procured (and how ambitious the [illegible] can be)
- **Public Procurer Peers Interest group** – exchange experiences, make you[illegible]ective and efficient, showcase your administration's successes: https://ww[illegible]groups/8479187
- **Legislation overview** – starting point of relevant legal co[illegible] and in selected Member States
- **Standards, Labels and Guidance overvie[illegible]** – [illegible]armonised standards and other guidance material in support of DC [illegible]nd use in procurement award criteria development
- **Self-evaluation fun[illegible]ting** – Data Centre Maturity Model based analysis to give you a quick overvi[illegible]and and what are most prominent points for improvement
- **EU C[illegible]** – 150+ best practices to improve your in-house DC management
- **[illegible]erials (including webinar recordings)** – 1.5 days of condensed knowledge on all that [illegible]s for DC-related procurement
- **Events** – Road tour of roll-in and dissemination of EURECA developments across Europe, from Riga to Turin, from London to Barcelona, from Brussels to Berlin, …

See the other EURECA training modules for details

Agenda

- Starting questions
- Structure of the EURECA courses
- Learning outcomes
- Course contents
  - Public procurement – conventional, PPI, PCP
  - Background – the societal challenge and policy setting
  - Energy & Greenhouse gasses and Data Centres
  - Environmental topics – beyond climate and energy
  - Measuring the unmeasurable – KPIs for innovations
  - EURECA support to public procurement
- **Starting questions to be answered**
- References and further reading

Starting Questions - answered

- Which environmental impact and resource use issues of main relevance for Data centres do you know?
  - Climate change – land use – particle emissions – ozone depletion – water scarcity ?

- Considering use stage electricity consumption only, about which share of electricity consumed in the EU is consumed by Data centres & Server rooms?
  - 0.1% - 0.2% - 0.5% - 1% - 2% - 5% ?

- Which indicators, measures or methods can be used to meaningfully compare different Public Procurement for Innovation (PPI) offers regarding their overall environmental performance?
  - Power Usage Effectiveness (PUE) – Carbon Usage Effectiveness (CUE) – „Free of halogenated compounds and heavy metals“ – Life Cycle Assessment / Environmental footprint – Energy Star – Water footprint – Carbon footprint ?

Agenda

- Starting questions
- Structure of the EURECA courses
- Learning outcomes
- Course contents
  - Public procurement – conventional, PPI, PCP
  - Background – the societal challenge and policy setting
  - Energy & Greenhouse gasses and Data Centres
  - Environmental topics – beyond climate and energy
  - Measuring the unmeasurable – KPIs for innovations
  - EURECA support to public procurement
- Starting questions to be answered
- **References and further reading**

References & Further Reading

Public procurement – conventional, PPI, PCP:

- European Commission, public procurement: https://ec.europa.eu/growth/single-market/public-procurement_en
- European Commission, PPI: https://ec.europa.eu/digital-single-market/en/innovation-procurement
- European Commission „GPP of data centres“, procurement criteria for ‚green‘ DCs (ongoing in 2017): http://susproc.jrc.ec.europa.eu/Data_Centres/index.html
- EAFIP project, guidance, events, support on PPI (general): http://eafip.eu/
- PPI support website (general), with news, events, further resources: https://www.innovation-procurement.org
- National Contact Points for Horizon 2020, PPI and PCP funding: http://ec.europa.eu/research/participants/portal4/desktop/en/support/national_contact_points.html
- ICT proposers‘ day – annual event to find partner for EU funded PPI projects, with ca. 1500 participants, e.g. 2017: → https://ec.europa.eu/digital-single-market/en/news/ict-proposers-day-2017

Background:

- EU2020: http://ec.europa.eu/europe2020/index_en.htm
- EU2030: https://ec.europa.eu/energy/en/topics/energy-strategy/2030-energy-strategy

Energy & Greenhouse Gases and Data Centres:

- EEA info on Climate change data, trends, mechanisms: http://www.eea.europa.eu/themes/climate/dc
- On global data centre energy consumption growth: http://www.datacenterdynamics.com/content-tracks/design-build/the-truth-is-data-center-power-is-out-of-control/95425.fullarticle

Environmental topics – beyond Climate and Energy:

- Michael Z. Hauschild, Mark A.J. Huijbregts (eds.): Life Cycle Impact Assessment. Monograph in book series: LCA Compendium – The Complete World of Life Cycle Assessment. 2015, 1st edition. 978-94-024-0404-3. Springer Netherlands.

Measuring the unmeasurable – KPIs for Innovations:

- EU PEF/OEF, including specific rules for life cycle footprint calculations of UPS, batteries, and hard disks: http://ec.europa.eu/environment/eussd/smgp/policy_footprint.htm
- Single Market Act: https://ec.europa.eu/growth/single-market_en
- Blue Angel for Energy-efficient DCs; the criteria can also be singled out and combined for GPP: https://www.blauer-engel.de/en/products/office/data-center-operation
- Marc-Andree Wolf, Rana Pant, Kirana Chomkhamsri, Serenella Sala, David Pennington (2012): International Reference Life Cycle Data System (ILCD) Handbook - Towards more sustainable production and consumption for a resource-efficient Europe. JRC Reference Report, EUR 24982 EN. European Commission, Joint Research Centre. Luxembourg. Publications Office of the European Union; 2012.
- Marc-Andree Wolf, Kirana Wolf (2016): LCA of data centres – not only the use stage matters. Presentation held at EcoBalance Conference October 2016, Kyoto. Access slides at: http://maki-consulting.com/2017/01/13/presentation-at-ecobalance-2016-kyoto-on-lca-of-data-centres-relevance-of-use-stage-vs-production/

EURECA support to public procurement:

- EURECA website, tool, market directory, training material, etc.: https://www.dceureca.eu/