Written Procedure to Approve EDNA Expenditure

Ballot Due by 19th February 2021

Background

During the October 2020 EDNA meetings and subsequent Management Committee calls, a number of task packages were discussed and developed. Three packages have been proposed:

- **Blue Task Package**
  - Topic: Metrics for Data Centre Efficiency
  - Leaders: Netherlands and Austria
  - Budget: 30,000 Euro.
- **Orange Task Package**
  - Topics:
    - Interoperability
    - Connection with Standardisation
  - Leader: European Commission
  - Budget: 40,000 Euro
- **Green Task Package**
  - Topics:
    - Mobile Devices
    - Emerging Battery Technologies
  - Leader: USA
  - Budget: 40,000 Euro

Refer the 3 attached RFPs which describe the scope of each package/topic, to be undertaken by consultants.

In 2021 EDNA will have around 200,000 Euro uncommitted, before these task packages are committed. If these task packages are approved, EDNA will have around 90,000 Euro uncommitted.

Decision Required

EDNA members are hereby requested to take a decision by written procedure (via email) regarding the approval of the expenditure associated with all 3 of these task packages.

Each EDNA member is requested to register their decision by completing and returning the ballot below (or by directly emailing the appropriate words below) to the EDNA operating agent, Steven Beletich (e-mail steve@beletich.com.au).

The results of this written procedure will be communicated to EDNA members after the deadline (19 February) and will be recorded in the minutes of the next EDNA meeting.

Any abstention from voting will be considered as a vote to approve.

Ballot

Decision - Approval of Task Packages

EDNA member (or alternate) [name] of [country] **approves** the three task packages as outlined in this document and attachments.

or (please strike out as appropriate)

EDNA member (or alternate) [name] of [country] **opposes** the task packages outlined in this document and attachments, for the following reasons [please provide details]:

Remarks

EDNA member (or alternate) [name] of [country] provides the following **remarks** [please provide details]:

Request for Proposal:
Metrics for Data Centre Efficiency

Electronic Devices & Networks Annex
EDNA

Proposals due XXX (in any timezone)

Potential consultants:

- Dr. V. Coroama from ETH
- EnergyConsult
- VHK
- Suggestions from the IEA: Eric Masanet and Jonathan Koomey, who are leading experts on the topic and often collaborate (Eric has expressed interest and will check with Jon). Eric also reviewed the 2019 EDNA TEM report. emasanet@ucsb.edu and jgkoomey@gmail.com.

A. Introduction

The 4E Technology Collaboration Programme (TCP) of the International Energy Agency aims to promote energy efficiency as the key to ensuring safe, reliable, affordable and sustainable energy systems. 4E is an international platform for collaboration between governments, providing technical analysis and policy guidance to its members and other governments concerning energy using equipment and systems.

The 4E Electronic Devices and Networks Annex (EDNA) has these same aims, but is focussed on a subset of energy using equipment and systems - those which are able to be connected via a communications network. The objective of EDNA is as follows:

> ***Provide technical analysis and policy guidance to members and other governments aimed at improving the energy efficiency of connected devices and the systems in which they operate.***

EDNA is focussed on the energy consumption of network connected devices, on the increased energy consumption that results from devices becoming network connected, and on system energy efficiency: the optimal operation of systems of devices to save energy (aka intelligent efficiency) including other energy benefits such as demand response.

This RFP seeks proposals from suitably qualified consultants to undertake the task outlined below.

B. Outline

This task follows the completion of 2 recent EDNA tasks: Intelligent Efficiency for Data Centres & Wide Area Networks (WAN)[1] and Total Energy Model for Connected Devices[2]. The objectives for this task are to:

- Explore existing metrics for data centre efficiency.
- Identify which existing metric(s) would be most suited for use by ~~government~~ policy makers, i.e. which metric(s) would be most suited to base policies on.
    - Background: a lot of work has already been done on data centre metrics, however, for example the PUE is subject to some difficulties. Also, the EU Code of Conduct for Data Centres is essentially a list of options to improve the efficiency of data centres, where improvements relate to the baseline of the data centre in question (and not to a general metric).
- Conduct a gap analysis of existing metrics for data centre efficiency, and make policy recommendations for the modification or development of energy metric(s) to fill any gaps and address any barriers (if this is indeed

[1] https://www.iea-4e.org/document/428/intelligent-efficiency-for-data-centres-and-wide-area-networks
[2] https://www.iea-4e.org/document/429/total-energy-model-for-connected-devices

required). Paying close attention to the issues raised in the EDNA report on data centres and wide area networks.

- Background: the EDNA report on data centres and wide area networks concludes that maximising efficiency can only be achieved by comparing the product efficiency at the range of utilisation levels which the device is expected to operate in, and this is most easily determined with knowledge of the complete efficiency curve, rather than a single number. A standardised reporting format (e.g. JSON or API) to access the power and performance data for each type of equipment would be much more useful for making detailed comparisons.

- Examine the data sources required to calculate the preferred metrics (above).
- For any proposed metric, provide an example of a small (possibly hypothetical) case study on how to calculate/assess the metric with a typical data centre.

Please note:

- Setting clear boundaries will be an important early step of the work. Metrics should relate to efficiency rather than emissions and should cover the data centre building, ICT equipment and any integrated power generation.
- It is not necessary to actually develop a new metric - simply to make policy recommendations if indeed new or modified metrics are considered necessary.
- It is recognised that there is likely to be considerable existing research available that deals with related issues. Thus a significant literature review is expected as a first step, and this is incorporated into the milestones below.
- Note that the report should be written for a semi-technical audience and should conclude with a set of actionable policy recommendations, or at least issues for policy makers to consider.

C. Project Deliverables, Timeline and Fees

The project shall be undertaken within a budget cap of 30,000 Euro including all taxes and charges (noting that invoices shall be paid in Euros, from Australia).

The proposed milestones for the project are as follows:

1. February 2021: **engage consultant** and hold kick-off meeting.
2. April 2021: completion of **literature review** and resulting **scoping report** (for approval by EDNA) which contains a summary of the literature review, and the proposed approach to completing the task (scope, approach, potential metrics, table of contents for report, etc.)
3. April 2021: set of **slides** covering the above, for presentation by consultant at EDNA management meeting (by video link), including a specific set of questions requiring EDNA response.
4. July 2021: **1st draft report** for detailed comment by EDNA operating agent, EDNA Chair and 2-3 task leaders. A single, consolidated list of comments will be provided.
5. September 2021: **2nd draft report** for comment by all EDNA members. A single, consolidated list of comments will be provided. Note that minimal comments are expected.
6. November 2021, **3rd draft report** for comment by industry. A single, consolidated list of comments will be provided (vetted by EDNA).
7. November 2021: set of detailed **slides**, for presentation by consultant at EDNA management meeting (by video link).

8. December 2021: **final report** including executive summary.
9. December 2021 – March 2022: presentation of findings by consultant at a **webinar** (webinar to be organised by EDNA).

The successful consultant shall work under the supervision of the 4E EDNA Annex with the EDNA Operating Agent as the key point of contact.

D. Criteria and Requirements

The successful consultant shall be chosen based on the following criteria:

1. In depth knowledge of the subject matter.
2. Experience in delivering similar studies, and in the synthesis and dissemination of technical / policy information.
3. Experience in developing energy efficiency policy recommendations.
4. Quality of proposed methodology.
    - Breadth and depth of scope.
    - Innovativeness of methodology.
    - Utilisation of existing sources of information including EDNA reports.
5. Demonstrated command of English language and experience in writing reports in plain English for a semi-technical audience.

The following information, at a minimum, shall be provided in the proposal:

- A proposed methodology for the topics.
- A budget breakdown covering each individual activity. Note that EDNA may choose to include an additional budget amount for the preferred consultant, in order to deepen the scope in a particular area.
- A timeline for deliverables.
- Overview of the proposed personnel and their relevant experience, including CVs.
- References for relevant, recent work.

E. Where and When to Send Proposals

Submit proposals by email to steve@beletich.com.au on or before the date at the top of this RFP. Please ensure that a confirmation email is received.

F. Who Can Submit Proposals and How Will Proposals be Evaluated?

This RFP has been sent to potential bidders nominated by EDNA member countries. An EDNA review team will assess the proposals.

G. Important Considerations

Proposals will not be compensated. IEA - 4E EDNA will not provide any reimbursement expenses related to the preparation of this Request for Proposals. This RFP and any further information furnished by IEA - 4E EDNA to candidates must be treated as confidential, and not be used for any purpose other than for this RFP. The review team reserves the right to request that all material be returned to it at the end of the current process. The review team reserves the right to request that a given candidate specify the content of its proposal. The review team is under no obligation to accept any proposal, or part thereof, that is received in response to this RFP. The review team reserves the right to accept or reject minor shortcomings in the contents of any proposal and reject, without penalty or justification, any proposal received after the deadline for submission. An acknowledgement of receipt of proposals will be emailed. The contract for the services of the technical expert will be with the IEA - 4E EDNA Operating Agent (Beletich Associates).

H. Other Potential Resources

Refer attached paper - Energy Efficiency Policy for Data Centres.

Electronic Devices & Networks Annex
EDNA

Energy efficiency policy for data centres

Hans-Paul Siderius (Netherlands Enterprise Agency) – 24 September 2020

1 Introduction

Data centres have a large energy consumption[1] that has been attracting attention from policy makers already for a long time. In the meanwhile initiatives started to improve the energy efficiency (and resource efficiency) of data centres, e.g. The Green Grid[2] (US) or the EU Code of Conduct for Data Centres[3].
However, it seems that the adoption of these (voluntary) initiatives cannot keep up with the growing importance, also regarding energy and resource consumption, of data centres and the internet in general through the take-up of cloud solutions and the Internet of Things. Sometimes, the (increasing) energy consumption of data centres is qualified or justified by claiming that the digitalization of processes, often indicated as "smart" or "intelligent", that data centres enable, saves much more energy than data centres use. However, since the internet and therefore data centres are intertwined with all aspects of society, such claims are difficult to prove or disprove. In any case, given the importance of achieving the climate goals, realizing energy savings in all sectors is important[4].

EU product efficiency policy, notably through energy labelling and ecodesign regulations, is a success. Yet, policy making for data centres seems difficult. The two main reasons are:

1. A data centre is a system (and not a single "product").
2. It is difficult to quantify the function(s) of a data centre.

These two aspects are elaborated upon in the next sections. The final section provides some suggestions for efficiency[5] policies for data centres.

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[1] Earlier reports predicted a large increase in energy consumption, however more recent reports, e.g EDNA (2019, p. 42) projects a flat energy consumption around 220 TWh/year till 2030 for world wide data centre energy use; however, this projection assumes large efficiency gains. Note that the recently published ICT Impact study (VHK and Viegand Maagoe, 2020) has a limited time horizon (2025). It estimates that after a decrease in the period 2015-2020 (from 45 TWh/year to 40 TWh/year) the electricity consumption of data centres in the EU is expected to increase in the period 2020-2025 (from 40 TWh/year to 43 TWh/year).
[2] https://www.thegreengrid.org/
[3] https://ec.europa.eu/jrc/en/energy-efficiency/code-conduct/datacentres
[4] Another issue is the claim of companies that their data centres are powered by "green energy" , i.e. carbon-free/neutral energy from wind or solar pv (and sometimes – indirectly – implying that no further attention needs to be paid to energy efficiency). What such a claim means is that for every kWh their data centres use, a kWh from a wind or solar pv farm is purchased, adding that these farms were specifically built for this purpose. However, wind and sun are variable renewable energy sources of which the production is not driven by demand but by nature: at times with no wind and no sun, no renewable power is generated whereas the data centres still need to operate. So unless an appropriate storage system, e.g. hydro, is in place, these data centres still use non-renewable energy.
[5] This paper will focus on energy efficiency of data centres. As indicated resource efficiency is another environmental aspect of data centres. The UBA study (Schödwell etal. 2018, p. 31) shows that – apart from raw materials use – the use phase of data centres has most environmental impact (varies from 75 % to 95

2 Data centres as a system

Various, more or less detailed definitions of a data centres exist, but simply said a data centre is a building that contains products providing data storage, processing and transport services, whereby the building infrastructure provides the power distribution, environmental control and security for the products to realize the desired (availability of) services (see Figure 1). The products include both hardware and software.

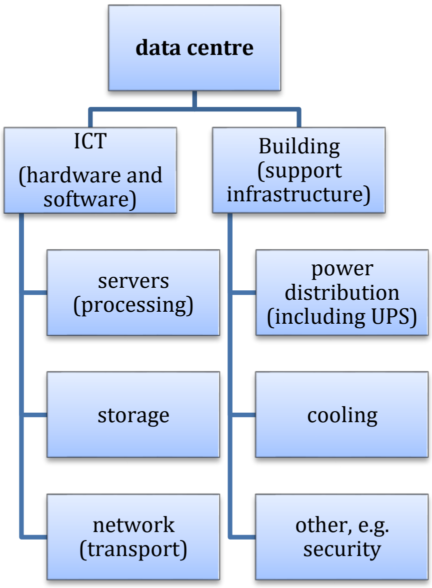

Figure 1 Data centre components

The ownership/operation of a data centre can be distinguished as follows:

- Operation of the building infrastructure
- Operation of the hardware
- Operation of the software

Each of these can be in hands of different actors/entities. Three common configurations are:

- *Enterprise data centre*: the building, hardware and software all have the same owner.
- *Co-hosting data centre*: the building and the hardware are provided by the data centre operator/owner, the software is operated by (multiple) customers.
- *Co-location data centre*: the building is provided by the data centre operator/owner, (multiple) customers provide their own hardware (servers, storage and network equipment) and software.

The different configurations of ownership create problems for regulating data centres. All elements of a data centre interact in determining the total energy consumption. Requirements on data centre owners (only) will affect different things in different types of data centres. Requirements on different actors, owners and customers, for the same data centre requires additional rules on responsibilities. Ideally, requirements should be

% for different types of data centres) and that also for the raw materials use 35 % to 55 % is determined by the use phase.

agnostic to the type of ownership, also because many variations are possible and specifying requirements for each variant will quickly outgrow any regulatory capacity. Second, matching support infrastructure with the ICT equipment is important and can be challenging. Certainly in co-location data centres the support infrastructure is designed to support the full ICT capacity of the data centre, whereas in the beginning probably only part of the full capacity will be installed. Also in this case, the data centre owner has less control over the energy efficiency of the ICT equipment and thereby the load on the cooling system.

Historically building and appliance (product) regulation have been – and still are – two different areas of competence in most countries. Energy efficiency regulations for data centres need to take the these areas into account, including the interaction between them. In general the support infrastructure has a longer life time and is less flexible than the ICT equipment. Also buildings are placed at a certain location which e.g. influences the available cooling options.

3 Quantifying the functions of a data centre

Energy is used in technical systems, e.g. a data centre, to provide energy services. Basic energy services related to data centres are data processing, storage and transport, and generating cold and light. However, the customers of a data centre (and their customers) are not interested in these energy services but in the functions these services provide, e.g. watching a movie, paying in a (online) shop, communicating with friends, writing a report with colleagues[6] (see Figure 2). The difference between energy service and energy function is most clear when looking at the role of the user: the performance of an energy function that is not used by the user is zero, whereas the performance of the energy service would still be delivered.

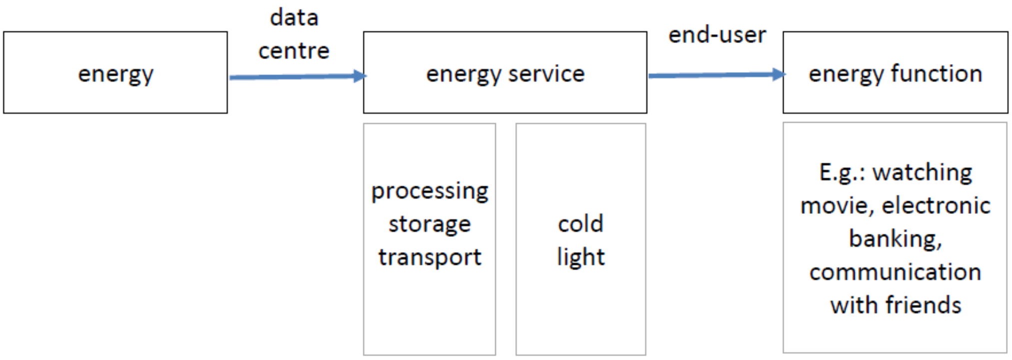

Figure 2 Energy services and energy functions

Quantifying energy efficiency means relating the performance of a product or a system to the energy (or power) consumption of that system (when delivering that performance). Whereas measuring the power and energy consumption of (components of) a data centre is feasible, quantifying the performance, especially of the energy *functions* is difficult at least or even impossible. Note that this also holds for other

[6] Note that these functions can often be described on a more abstract level, e.g. providing entertainment, being connected with other people, which can also be implemented in a way *not* involving data centres (although in modern societies it is not easy to completely avoid the use of internet/data centres).

products, e.g. quantifying the function "entertainment" that a television provides[7]. Therefore, in many cases a relation is assumed between the energy function and the energy service of the product, e.g. in case of the television: providing a moving picture (light) of a certain size (the screen size) and a certain resolution is a proxy for the energy function.

Regarding data centres quantifying the energy services for the ICT part (data processing, storage and transport) is already difficult. As an example consider the metric for data centre efficiency[8] provided by Green IT Promotion Council in Japan (2012); see Textbox 1).

$$DPPE = \frac{Data\ Center\ work}{Data\ Center\ energy} = \frac{IT\ utilization\ rate\ \times IT\ work\ capacity}{Data\ Center\ energy}$$

$$= IT\ utilization\ rate\ \times \frac{IT\ work\ capacity}{IT\ energy} \times \frac{IT\ energy}{Data\ Center\ energy}$$

$$= ITUE\ \times ITEE\ \times \frac{1}{PUE}$$

where:

- ITUE is the *utilization rate of the equipment*, approximated to $\frac{IT\ energy\ actual*}{IT\ energy\ max**}$ with *=measured and **=rated;
- ITEE is the *processing capacity per unit of power*: $\frac{total\ rated\ capacity\ of\ IT\ equipment}{total\ rated\ power\ of\ IT\ equipment}$ $= \frac{\propto \times server\ capacity + \beta \times storage\ capacity + \gamma \times network\ capacity}{total\ rated\ power\ of\ IT\ equipment}$ with α = 7,72 W/GTOPS, β = 0,0933 W/Gbyte and γ = 7,14 W/GBps.

Textbox 1 Metric for data centre efficiency

Apart from the issue how to establish/choose the coefficients (α, β, γ), the measurement of the energy consumption is a problem. Several standards require measurement periods up to 12 months to establish a value for a metric. Although actual energy consumption will vary with the utilization of the equipment and the data centre in general and therefore averaging over a certain period is useful, for application in policies, including verification of requirements, a 12 month period is not acceptable. Furthermore, it is highly unlikely that in 12 months nothing will change in the (hardware) configuration of a data centre which questions the validity of the measurement.

Fundamentally these formulas show that the core of the metric is the performance part ITEE which is expressed in energy services. The relation with energy functions is unknown or at least not obvious. Software plays an important role. The impact of software that delivers a function, e.g. streaming a movie, with less processing and less storage, would result in a lower, i.e. worse, DPPE whereas the function efficiency would

[7] Even a more direct aspect of performance of a television, e.g. picture quality, is already very difficult to quantify in an objective way.
[8] DPPE: Data center Performance Per Energy ; this metric also includes green energy which is not considered here.

increase because the same function would be achieved with less energy. Another example is that some functions claim more services than others. The security and availability requirements for banking functions (online payments) require more services, e.g. processing for encryption and redundancy of support systems, than web browsing.

4 Outlook and suggestions for efficiency policy

The foregoing shows that data centres and their components can be defined in a way to be useful for policy. The main issue is the different configurations of owner and customer(s) that hampers the definition of an addressee for policy making.
However, more problematic bottle-necks for policy making are in quantification of the (energy) functions of a data centre, both theoretically and practical. Theoretically, the relation between energy services and energy functions is challenging, whereas practically the measurement of certain metrics involves a measurement period that is too long to be useful.

In the rest of this section, suggestions for policy will be guided by principles of transparency and simplicity. Transparency because making (limited) data on energy consumption and efficiency of data centres public may in itself already drive improvements.
Simplicity because this avoids being slowed down by details that may be interesting for the individual case but not for the overall picture. This means that it is important that the average efficiency of data centres improves[9] but it is not necessary that the efficiency of each individual data centre improves.

The first suggestion is to forget about the holy grail of quantifying the energy functions of a data centre; quantifying energy services is already challenging enough. This means that policy does not need to pay attention to whether the data centre is used for web surfing, for video streaming, cloud services or any combination of these and other functions. It also means that software will be out of scope[10].
A related simplification is not to take the location into account. This means e.g. that data centres in a colder climate zone have more efficient cooling options available and score better on an efficiency metric than data centres in other climate zones. However, this reflects the international data centre market where location is an important factor, although other location factors than climate are considered.
Another simplification would be to use rated/specified characteristics of products wherever this is possible, i.e. to use the specifications of the manufacturer of the product and not to measure these during use.
The fourth is that metrics can be based on “rolling” measurements; this means that e.g. if the actual IT energy consumption is based on an average of 12 months, at any point in time this average can be calculated by using data from the last 12 months. Thus only in the first year of operation of a (new) data centre no complete data is available. This does not only hold for energy measurements but also for rated capacity and rated power of equipment. This will smooth the impact of changes in equipment that occur at a certain

[9] Or better that the total energy consumption of data centres decreases.
[10] Note that this does not mean that software is not important and improving software can be a useful tool to reduce energy consumption.

point in time, but it also means that achieving a certain target cannot be done by making changes only on the day before the requirement comes into force.
A final suggestion regarding simplicity is to keep the number of metrics/variables to be used for policy purposes low. Especially for the building support structure it is easy to define a large number of detailed variables to be measured, which may be of great use to manage the data centre operations but policy makers are not interested whether the energy is used in the UPS or the cooling system.

A small number of metrics/variables to be reported also increases the feasibility of achieving transparency regarding the individual variables. It is well known that data centre owners are not keen on making data on energy consumption and performance public.
The dataset available for varication purposes can be larger than the dataset made publicly available.

The above does not say anything about requirements, other than requirements on data availability. A couple of options exist for setting requirements at EU level:

- No (other) requirements are set: as indicated above, making data public available that enables e.g. NGOs to publish the best or the worst data centres or local authorities to set requirements may already drive improvements of data centre efficiency.
- No minimum requirements are set, but an EU energy label is used to rate the energy efficiency of data centres from A to G.
- Both an EU energy label and minimum efficiency requirements are set.
- Only minimum requirements are set.

EU minimum efficiency requirements seem less appropriate because the requirements – at least those following from the suggestions in this paper – are based on the efficiency of energy *services*, from which the efficiency of energy *functions* may deviate in certain situations. Hard minimum efficiency requirements under ecodesign would also mean that the data centre can not be operated when or as long as the requirement is not met. Also, if minimum efficiency requirements are set under ecodesign, it is not possible for individual Member States to set such requirements which can be better tuned to a specific situation. Note that both an EU energy label and minimum requirements would require some creativity in the interpretation of placing on the market or putting into service, since the system in scope changes during its lifetime.
Finally, energy efficiency policy should be accompanied with requirements on resource efficiency and renewable energy.

References

EDNA. 2019. Intelligent Efficiency for Data Centres and Wide Area Networks. IEA-4E EDNA, http://edna.iea-4e.org

Green IT Promotion Council. 2012. DPPE: Holistic Framework for Data Center Energy Efficiency. https://home.jeita.or.jp/greenitc/topics/release/pdf/dppe_e_20120824.pdf

Schödwell etal. 2018. Kennzahlen und Indikatoren für die Beurteilung der Ressourceneffizienz von Rechenzentren und Prüfung der praktischen Anwendbarkeit. UBA-FB 002590.

VHK and Viegand Maagoe. 2020. ICT Impact study. Contract: ENER/C3/SER/FV 2019-467/01/FWC 2016-542/07/SI2.813170.

Request for Proposal:
Interoperability and Standardisation

Electronic Devices & Networks Annex
EDNA

Proposals due XXX (in any timezone)

Potential consultants:

- Viegand Maggoe have performed the standby/networked standby review study and monitoring of related standards and participated in the ICT impact study
- Vito NV - on interoperability - they performed the Energy Smart Appliances studies.
- Others?

A. Introduction

The 4E Technology Collaboration Programme (TCP) of the International Energy Agency aims to promote energy efficiency as the key to ensuring safe, reliable, affordable and sustainable energy systems. 4E is an international platform for collaboration between governments, providing technical analysis and policy guidance to its members and other governments concerning energy using equipment and systems.

The 4E Electronic Devices and Networks Annex (EDNA) has these same aims, but is focussed on a subset of energy using equipment and systems - those which are able to be connected via a communications network. The objective of EDNA is as follows:

> ***Provide technical analysis and policy guidance to members and other governments aimed at improving the energy efficiency of connected devices and the systems in which they operate.***

EDNA is focussed on the energy consumption of network connected devices, on the increased energy consumption that results from devices becoming network connected, and on system energy efficiency: the optimal operation of systems of devices to save energy (aka intelligent efficiency) including other energy benefits such as demand response.

This RFP seeks proposals from suitably qualified consultants to undertake the 2 related tasks outlined below.

B. Topic 1 - Interoperability

The interoperability of connected devices can hamper the effectiveness of *intelligent efficiency*[1] (IE) as well as *demand flexibility*[2] (DF). The objective of this task is to study the issue of (a lack of) device interoperability and the resultant impact of this on IE and DF. Specifically the task aims to answer the following questions:

- What is a suitable definition for interoperability?
- What is the scope of the problem? To what extend does lack of interoperability limit IE and DF (currently and potentially into the future)?
- What are the causes of a lack of interoperability?
- To what extent do “closed” proprietary device ecosystems limit interoperability? What are the commercial drivers for proprietary device ecosystems? What would be the commercial impacts if ecosystems were required to be “open”?
- What standardisation efforts are underway and where are the gaps?
- What are the implications for (government) policy makers?

[1] Systems of connected devices working together to save energy

[2] Changes in electricity usage by end-use customers in response to changing market conditions

Please note:

- A considerable amount of work has already been undertaken on the topic of interoperability, for example by the European Commission as part of its work on smart appliances[3]. This task should draw heavily from existing literature (including many EDNA reports), distil the issues and present a set of plain English conclusions and concise policy guidance.
- The report should be written for a semi-technical audience and should conclude with a set of actionable policy recommendations, or at least issues for policy makers to consider.
- Scope = typical devices found in home / small office.

C. Topic 2 - Connection with Standardisation

EDNA's work in connected devices intersects considerably with standards. This occurs in many areas, for example:

- Test methods for measuring the energy consumption of edge devices in the network standby state, and associated metrics.
- Test methods for measuring the energy consumption of LAN devices, and associated metrics.
- Measuring/estimating the energy consumption of WANs and data centres, and associated metrics.
- Device communications protocols at the network layer, which affect network standby power.
- Communications protocols at the application layer, which relate to the interoperability of devices.
- Communications protocols at the application layer, which relate to intelligent efficiency and demand flexibility.

The objective of this task is to outline the "lie of the land" for standards and standardisation efforts (e.g. committees, working groups and their constitution/makeup) which relate to EDNA's work. This will allow EDNA to decide which of these it should engage with.

Th task will involve discovering, summarising and categorising the relevant standards and standardisation efforts, and presenting these to EDNA in a report, together with a prioritisation of where EDNA should engage. The issues should be distilled, explained and presented in concise, plain English.

D. Project Deliverables, Timeline and Fees

The project shall be undertaken within a budget cap of 40,000 Euro including all taxes and charges (noting that the invoices shall be paid in Euros, from Australia).

The proposed milestones for the project are as follows:

1. February 2021: **engage consultant** and hold kick-off meeting.
2. March 2021: completion of **scoping report** covering both topics (for approval by EDNA) which contains the proposed approach to completing each task (scope, approach, information sources, table of contents for each report, etc.)

[3] Requiring appliances to be "plug-and-play" and ensure interoperability across the board was assessed to be too ambitious

3. April 2021: set of **slides** covering the above, for presentation by consultant at EDNA management meeting (by video link), including a specific set of questions requiring EDNA response.
4. July 2021: 1st **draft report** for each topic, for detailed comment by EDNA operating agent, EDNA Chair and 2-3 task leaders. A single, consolidated list of comments will be provided.
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8. December 2021: **final report** for each topic, including executive summary.
9. December 2021 – March 2022: presentation of findings by consultant at a **webinar** (webinar to be organised by EDNA) - **for topic 1 only**.

The successful consultant shall work under the supervision of the 4E EDNA Annex with the EDNA Operating Agent as the key point of contact.

E. Criteria and Requirements

The successful consultant shall be chosen based on the following criteria:

1. In depth knowledge of the subject matter.
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The following information, at a minimum, shall be provided in the proposal:

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- A budget breakdown covering each individual activity. Note that EDNA may choose to include an additional budget amount for the preferred consultant, in order to deepen the scope in a particular area.
- A timeline for deliverables.
- Overview of the proposed personnel and their relevant experience, including CVs.
- References for relevant, recent work.

F. Where and When to Send Proposals

Submit proposals by email to steve@beletich.com.au on or before the date at the top of this RFP. Please ensure that a confirmation email is received.

G. Who Can Submit Proposals and How Will Proposals be Evaluated?

This RFP has been sent to potential bidders nominated by EDNA member countries. An EDNA review team will assess the proposals.

H. Important Considerations

Proposals will not be compensated. IEA - 4E EDNA will not provide any reimbursement expenses related to the preparation of this Request for Proposals. This RFP and any further information furnished by IEA - 4E EDNA to candidates must be treated as confidential, and not be used for any purpose other than for this RFP. The review team reserves the right to request that all material be returned to it at the end of the current process. The review team reserves the right to request that a given candidate specify the content of its proposal. The review team is under no obligation to accept any proposal, or part thereof, that is received in response to this RFP. The review team reserves the right to accept or reject minor shortcomings in the contents of any proposal and reject, without penalty or justification, any proposal received after the deadline for submission. An acknowledgement of receipt of proposals will be emailed. The contract for the services of the technical expert will be with the IEA - 4E EDNA Operating Agent (Beletich Associates).

I. Potential Useful Resources

- EDNA reports
- European reports on smart appliances.

Request for Proposal:
Mobile Devices and Emerging Battery Technologies

Electronic Devices & Networks Annex
EDNA

Proposals due XXX (in any timezone)

Potential consultants:

- Vito / Fraunhofer did EC prep study. Fraunhofer could cover both topics in this package.
  - Grietus Mulder, VITO/Energyville – grietus.mulder@vito.be
  - Antoine Durand Fraunhofer ISI – antoine.durand@isi.fraunhofer.de
- Others?

A. Introduction

The 4E Technology Collaboration Programme (TCP) of the International Energy Agency aims to promote energy efficiency as the key to ensuring safe, reliable, affordable and sustainable energy systems. 4E is an international platform for collaboration between governments, providing technical analysis and policy guidance to its members and other governments concerning energy using equipment and systems.

The 4E Electronic Devices and Networks Annex (EDNA) has these same aims, but is focussed on a subset of energy using equipment and systems - those which are able to be connected via a communications network. The objective of EDNA is as follows:

> ***Provide technical analysis and policy guidance to members and other governments aimed at improving the energy efficiency of connected devices and the systems in which they operate.***

EDNA is focussed on the energy consumption of network connected devices, on the increased energy consumption that results from devices becoming network connected, and on system energy efficiency: the optimal operation of systems of devices to save energy (aka intelligent efficiency) including other energy benefits such as demand response.

This RFP seeks proposals from suitably qualified consultants to undertake the 2 related tasks outlined below.

B. Topic 1 - Mobile Devices

Mobile device energy usage is likely to increase, particularly with onset of 5G (+ future iterations) and in some cases mobile devices are likely to replace mains powered products. To date, EDNA's focus has been primarily on connected, mains-powered devices. The objective of this task are to:

- Examine the energy used by *mobile* devices (connected and otherwise).
- Investigate policy options to improve their energy efficiency (including the power supply, the battery charging equipment and the device itself, as well as the impact of various battery chemistries).
- Assess the similarities and differences between mobile device energy efficiency policies around the world (note that the US have separate regulations for power supplies, battery charging and various other devices). Compare their scope, test methods, metrics, MEPS, etc. and identify any gaps.
- Identify pathways towards international harmonization of policies for mobile devices.

Please note:

- The scope includes the mobile devices which currently fall under energy efficiency policies around the world. However, this should be refined early in the work, as well as identifying any gaps (i.e. devices which should fall under policies but currently do not).

- The task is to be desk research only, with some outreach (e.g. to government policy makers and industry as required)
- Include a brief examination of techniques used to extend battery longevity.
- The report should be written for a semi-technical audience and should conclude with a set of actionable policy recommendations, or at least issues for policy makers to consider.

C. Topic 2 - Emerging Battery Technologies

This task builds on previous EDNA tasks involving batteries: Network Zero and Energy Harvesting Technologies [links]. Today's very heavily used Li-ion batteries have a series of severe limitations, such as slow charging, limited life and safety issues. In addition, their technology is based on the use of rare materials such as Li and Co, which can lead to environmental and social issues.

The objective of this task is to examine new battery technologies suited to powering small ~~network-connected~~ devices such as IoT, actuators and sensors, and portable devices such as mobile phones and laptops. For example, a new energy storage solution based on carbon nanotube (CNTs) super capacitor might be an emerging technology, which is promising, but at a rather early stage.

Issues to be covered include:

- Overview/exploring of emerging and existing energy storage technologies.
- Analyse the pros and cons of emerging and existing battery technologies, including the aspects of
  - Performance (storge capacity, power density, charging time, etc.)
  - Environmental impacts (very general analysis)
  - Cost
  - Market readiness.

Please note:

- The task is to be desk research only.
- The report should be written for a semi-technical audience and should conclude with a set of actionable policy recommendations, or at least issues for policy makers to consider.

D. Project Deliverables, Timeline and Fees

The project shall be undertaken within a budget cap of 40,000 Euro including all taxes and charges (noting that the invoices shall be paid in Euros, from Australia).

The proposed milestones for the project are as follows:

1. February 2021: **engage consultant** and hold kick-off meeting.
2. March 2021: completion of **scoping report** covering both topics (for approval by EDNA) which contains the proposed approach to completing each task (scope, approach, information sources, table of contents for each report, etc.)
3. April 2021: set of **slides** covering the above, for presentation by consultant at EDNA management meeting (by video link), including a specific set of questions requiring EDNA response.
4. July 2021: **1st draft report** for each topic, for detailed comment by EDNA operating agent, EDNA Chair and 2-3 task leaders. A single, consolidated list of comments will be provided.

5. September 2021: **2nd draft report** for each topic, for comment by all EDNA members. A single, consolidated list of comments will be provided. Note that minimal comments are expected.
6. November 2021, **3rd draft report** for each topic, for comment by industry. A single, consolidated list of comments will be provided (vetted by EDNA).
7. November 2021: set of detailed **slides**, for presentation by consultant at EDNA management meeting (by video link).
8. December 2021: **final report** for each topic, including executive summary.
9. December 2021 – March 2022: presentation of findings by consultant at a **webinar** (webinar to be organised by EDNA) - for topic 1 only.

The successful consultant shall work under the supervision of the 4E EDNA Annex with the EDNA Operating Agent as the key point of contact.

E. Criteria and Requirements

The successful consultant shall be chosen based on the following criteria:

1. In depth knowledge of the subject matter.
2. Experience in delivering similar studies, and in the synthesis and dissemination of technical / policy information.
3. Experience in developing energy efficiency policy recommendations.
4. Quality of proposed methodology.
    - Breadth and depth of scope.
    - Innovativeness of methodology.
    - Utilisation of existing sources of information including EDNA reports.
5. Demonstrated command of English language and experience in writing reports in plain English for a semi-technical audience.

The following information, at a minimum, shall be provided in the proposal:

- A proposed methodology for the topics.
- A budget breakdown covering each individual activity. Note that EDNA may choose to include an additional budget amount for the preferred consultant, in order to deepen the scope in a particular area.
- A timeline for deliverables.
- Overview of the proposed personnel and their relevant experience, including CVs.
- References for relevant, recent work.

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I. Potential Useful Resources

- EDNA reports
- EC prep study on batteries ?