

[Rel-19 EnergySys] SA2/SA5 Work Split for Enhancements on Energy Saving and Energy Efficiency - Version 0.0.4

SA2

<https://nwm-trial.etsi.org/#/documents/8906>

# 1 Introduction

This NWM discussion is prepared to collect companies views and coordinate the SA2/SA5 work split related to energy-related features in Rel-19, as per the agreement in SA#104. TSG SA tasked SA2 and SA5 to have cross working group discussion to resolve the issue and complete Rel-19 study on FS\_EnergySys.

Technical discussions on solutions to enable the support of the assigned features may follow in each WG after this NWM discussion and related decisions.

*\* For the cross-WG discussion, a new email list “3GPP\_SA2\_SA5\_ENERGYSYS\_DISCUSS” has been set up now. All discussions during/after NMW discussion should happen using this email list.*

# 2 Questions for SA2/SA5 Work Split

The following list of questions are prepared to collect companies’ views on SA2/SA5 work split regarding Rel-19 energy-related features. Companies are requested to submit their views by answering the questions and/or providing alternative way-forward proposals.

## 2.1 Collection and calculation of energy consumption information

**Question 1:** Which working group will be proper to collect and caluate the User Plane energy consumption in the following different granularities?

(Companies should clearly identify the needed information to be collected and any needed calculations, and the group responsibility for each. Companies may also include more information in their response on what they think the suggested WG should address in the corresponding work, to help others understand the proposal.)

**Table 1: Collection and calculation of User Plane energy consumption**

Energy consumption granularity	SA2	SA5

<p><b>Q.1.1:</b> Average per UE <i>(estimated average energy consumption per UE, e.g., total energy consumption divided by the number of UEs for a certain time period, at a certain network node or in the whole 5G network, etc.)</i></p>		
<p><b>Q.1.2:</b> Per specific UE <i>(estimated energy consumption related to a specific UE, e.g., sum of related portion of energy consumptions that are collected from all UPFs serving Network Slice or PDU sessions of a specific UE and those from all RAN nodes serving the UE for a period, etc.)</i></p>		
<p><b>Q.1.3:</b> Per PDU session of the UE</p>		
<p><b>Q.1.4:</b> Per QoS flow of the UE (including per application)</p>		
<p><b>Q.1.5:</b> NF (only UPF and gNB)</p>		
<p><b>Q.1.6:</b> Network slice</p>		
<p><b>Q.1.7:</b> Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)</p>		

**Feedback Form 1:**

<p><b>1 – Nokia UK</b></p> <p><b>Q.1.1:</b> Average per UE Nokia sees no need to pursue this in the scope of this work</p> <p><b>Q.1.2:</b> Per specific UE <b>SA2</b> (Potential SA2 involvement only to trigger ULI reporting for all the sessions of the UE) <b>SA5 (Lead Group)</b> (Assuming this is e.g. calculated by apportioning per UE the Energy consumed in UP by dividing total energy consumption over a period over affected UP nodes (gNBs and UPFs) used by the UE in the period</p>
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(based on existing SA5-defined OAM information) by total data volume handled by these UP nodes and multiplied by the data volume of the PDU sessions for the UE in these nodes (based on existing SA5 OAM charging data collection) – this requires charging information and OAM information post processing – whether this is based on new agreed KPI definition is to be discussed in SA5, as well as any requirement of time alignment between energy information and charging data collection)

**Q.1.3:** Per PDU session of the UE

**SA2**

(Potential SA2 involvement only to trigger ULI reporting for the session)

**SA5** (Lead Group)

Same as for Q.1.2. with the difference this is only for the UP functions of a single PDU session.

**Q.1.4:** Per QoS flow of the UE

(including per application)

**SA2**

(Potential SA2 involvement only to trigger ULI reporting for the affected session of the UE, and flow-based charging)

**SA5**(Lead Group)

Same as for Q.1.2. with the difference this is only for the UP functions used by the QoS flow over the UE PDU session of the QoS flow.

**Q.1.5:** NF (only UPF and gNB)

**SA5**

(Existing capability)

**Q.1.6:** Network slice

**SA5**

(Existing capability)

**Q.1.7:** Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)

**SA5**

Based on additionally considering the Renewable energy ratios per UP node (during the considered time period) used for the calculations for the energy consumption estimates to derive the renewable energy consumed in Q.1.2, Q.1.3, Q.1.4, Q.1.5, Q.1.6.

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**2 – HuaWei Technologies Co.**

**Q.1.1**  **Average per UE**

**SA2**  In SA2 there is no use cases/necessity foreseen on this, and there is no need to have any enhancement in SA2.

**Q.1.2:** **Per specific UE**

**SA2:** This is the scope of SA2 work.

We think SA2-based calculation is the one since 1) 5GC NF can re-use currently available information (e.g. I-UPF) and functionality (e.g. exposure framework); 2) SA2-based is more compatible for future added-on features (e.g., control plane EC, ...); 3) SA2-based achieves scalability for smaller granularities (e.g., per application flow as mentioned by SA1);

And the details can be found in KI#1 conclusion of TR 23.700-66.

In addition, we would like to clarify that for a certain RAN node SA5 will not differentiate the EC for UP and CP, therefore, we respectively ask that if a better form of question 1 could be “**Question 1:** Which working group will be proper to collect and calculate the energy consumption at RAN node, and the User Plane energy consumption at 5GC in the following different granularities?”

**SA5:** SA5 is not assumed to proceed for specific UE.

We don't think this option can fulfil the requirement since:

1) Exposure interface is not supported by charging system now, and we would have to be supported otherwise the discussed features (e.g., KI#1/KI#2/KI#3) cannot be supported. And it seems that there is no such plan for SA5 Charging group in this release.

2) Charging-based calculation may increase frequency of interaction between CHF and 5GC to satisfy the purpose of e.g., policy control, which seems to be hard to realize.

3) There will be higher efforts for potential enhancements in the future (e.g., any new use case needs (e.g., EC on CP processing, new requirement in 6G) to go into CDRs and requires SA5 standardization).

4) Enhancement of charging function for calculation of the Energy consumption adds complexity (as it is not related to its original functionality).

5) Charging System and 5GC may belong to different business unit of operator, it is hard and costly to meet the need of 5GC purpose by depending on charging system. may come from specialized vendor and has different life cycle

#### **Q.1.3: Per PDU session of the UE**

**SA2:** We don't see this is an urgent demand of supporting such, but we can support such as Q.1.2

**SA5:** See Q.1.2

#### **Q.1.4: Per QoS flow of the UE (including per application)**

**SA2:** The per QoS flow of the UE is the basis for any higher granularity and thus also for the per specific UE (due to the fact that only the QoS Flows carrying Internet/best-effort/application traffic should be counted but not those carrying operator services).

**SA5:** See Q.1.2.

#### **Q.1.5: NF (only UPF and gNB)**

**SA2:** No need to have in SA2 – Since OAM can already support such

**SA5:** measurement and evaluation is performed by OAM. Note that OAM will not differentiate CP/UP part of the CN NF energy consumption, the EC is the global EC of the Node

#### **Q.1.6: Network slice:**

**SA2:** No need to have in SA2 – Since OAM can already support such.

**SA5:** See Q.1.5.

**Q.1.7: Renewable energy info**

(The question applies to all granularities above. Your answer needs to be provided for each granularity.)

**SA2:** Similar as the energy consumption as mentioned in Q.1.1-Q.1.6

**SA5:** Similar as the energy consumption as mentioned in Q.1.1-Q.1.6

**3 – VODAFONE Group Plc**

We need to be able to calculate RAN energy consumption per UE. TSG-RAN will decide on whether to do the standards work to enable this (e.g. reporting of number of resource blocks used by the UE) in September 2024 (but more support from other companies is needed, however).

TSG-RAN will not provide more granular information than per-UE in Rel 19, so there is little point in doing extra Rel 19 work for questions 1.1, 1.3, 1.4, 1.5, 1.6.

Gathering information on whether the gNB was using renewable energy or not may be useful.

**4 – Qualcomm Korea**

**Q 1.1: Average per UE,**

SA5, no need for SA2's work

**Q 1.2: per specific UE**

SA5, based on the discussion in the reflector, the formula relies on the UE data volume, the NF level data volume and the NF EC, OAM already gets the NF level data volume, NF EC, UE data volume in RAN side, CHF knows each PDU session data volume for the UE, OAM can do the calculation to combine the information in OAM and CHF. the new interaction between CHF and OAM need SA5's work.

**Q 1.3: per PDU session of UE**

SA5, similar as Q1.2, OAM can do the calculation with the input information from CHF, one general issue is about the PDU session data volume in RAN side, RAN can not provide the PDU session level data volume for a UE since RAN had no concept of PDU session, if we use the PDU session data volume collected in UPF to calculate the PDU session EC in RAN side, the result is not accuracy since most of RAN side impact (e.g., RAN protocol header, RAN side retransmission) are not be considered.

**Q 1.4: per QoS flow of UE**

SA5, similar as Q1.2 and 1.3, OAM can do the calculation with the assistance of CHF.

but similar as Q1.3, a general issue is that RAN can not provide a QoS flow data data volume, currently the data volume in MDT is per DRB level, if the QoS flow data volume in UPF is reused to calculate the QoS flow EC in RAN side, the accuracy of the result should be considered.

**Q 1.5: NF (only UPF and gNB)**

SA5, it is already supported in OAM, no further work in SA2.

**Q.1.6: Network slice:**

SA5, it is already supported in OAM, no further work in SA2.

**Q.1.7: Renewable energy info**

SA5, the renewable energy info for different granularities need further work in SA5.

## 5 – China Mobile Com. Corporation

### Q.1.1 Average per UE

It is not clear how to calculate the average per UE. For NG-RAN, this is per RAN node, for UPF, this is per NF node, maybe it is different UE number in the RAN node and UPF node. So it is not clear how the average per UE can be calculated.

### Q.1.2: Per specific UE

**SA2:** This is in the scope of SA2 work. 5GC NF can calculate the specific UE's energy consumption based on the (data volume of this UE in this node)/(node level data volume)\*(node level Energy consumption). And all the nodes this UE traffic related e.g. I-UPF, can be calculated. Even though the above calculation is not so precise, but this kind of information can reflect the UE/user energy consumption information/status, and expose this information can help to describe the UE/user's carbon footprint.

### Q.1.3: Per PDU session of the UE

**SA2:** this granularity is belong to SA2, since the concept of PDU session of specific UE is belong to SA2. But whether we need to support it in this release, we can wait to see the discussion.

### Q.1.4: Per QoS flow of the UE (including per application)

**SA2:** this per flow granularity is belong to SA2. But for the per AF, we think this per AF level calculation can be more easily than per flow, since the SDF in UPF can be used to calculate the per AF level energy consumption.

### Q.1.5: NF (only UPF and gNB)

No need to have in SA2, and should be in SA5.

### Q.1.6: Network slice:

No need to have in SA2, and should be in SA5.

### Q.1.7: Renewable energy info

(The question applies to all granularities above. Your answer needs to be provided for each granularity.)

We do support to consider the renewable energy information in this release. It is valuable to introduce the percentage of renewable information and show this to the UE/AF, when the UE/user communicate through the network. And this work should cooperate with SA5.

And the renewable energy info should be applicable to all the above supported granularities.

## 6 – DOCOMO Communications Lab.

### Q.1.1

#### SA2:

To our understanding, there is no need for this granularity in the key issues and/or solutions of SA2 FS\_EnergySys SID.

#### SA5:

If SA5 identifies some use-cases that need this level granularity, it can be considered in SA5.

### Q.1.2:

Our understanding of the explanation of the question is that this level of granularity is the TOTAL end-to-end energy consumed in 5G system (RAN and 5GC) to provide end-to-end services to the given UE specified by SUPI. Based on this understanding:

SA2:

New functionality is needed to **obtain** the energy consumed for the UE in each serving NF (gNB, UL-CL UPF, PSA UPF, ...) and then compute the total end-to-end UC.

To **obtain** the UC at each serving NF, different approaches are possible, e.g.:

- If the serving NF natively supports per specific UE energy consumption determination (e.g., if gNB can provide such information in future release), this capability can be used to get the EC per UE in the NF.
- Otherwise, it can be estimated/calculated e.g., "(x / y) \* z" where
  - "z" is the total EC of the serving NF obtained from OAM
  - "y" is the total load of the NF, the load can include different factors depending on the type of the NF, e.g., number of connected UEs, number PDU sessions, number of QoS Flows, total traffic volume, etc.
  - "x" is the load corresponding to the specific UE

All these parameters are dynamic (as a function of time) and the calculation is over a time period.

SA5:

1) Our understanding of the following text

”

*Energy consumption and energy efficiency can be addressed at different granularities, from coarsest grain to finest grain:*

[...]

5. Customer / Subscriber

6. UE (a customer may have multiple UEs)

[...]

*NOTE 2: Aforementioned items 5 to 6 are not in the scope of SA5, given that UE-level and Customer / Subscriber-level measurements cannot be provided by OAM.”*

in SP-231723 (S5-238353) is that currently SA5 cannot provide this granularity.

2) OAM provides the NF-level EC (which is currently supported by SA5 specifications) to the new functionality defined in SA2.

3) From our view, supporting this level of granularity by OAM incurs significant signalling overhead as all the specific UE level information should be exposed from the 5GC to OAM.

4) To our understanding, implementing this functionality in the CHF break the logic of the NF because computing the EC of specific UE needs mapping the UE to the serving NFs which is unknown to the CHF (in principle, CHF considers amount of data not the number and mapping of serving NFs).

**Q.1.3:**

Since a PDU session can be served by multiple UPFs (e.g., I-UPF, PSA UPF, etc.), to our understanding, this granularity is similar to Q.1.2 where the end-to-end EC should be computed. Accordingly:

SA2:

New functionality to obtain EC (using the alternative approaches explained in Q.1.2) of the given PDU session in the serving NFs and then calculate the total end-to-end EC of the PDU session.

SA5:

OAM provides NF EC (which is currently supported by SA5 specifications) to the new functionality in SA2.

OAM and CHF are not suitable options for this level of granularity as explained in Q.1.2.

#### **Q.1.4**

Similar to PDU session, a QoS flow can be served by multiple NFs. A new functionality is needed to obtain the total EC of the QoS flow.

SA2:

Similar to Q.1.3.

SA5:

Similar to Q.1.3

#### **Q.1.5:**

SA2:

No impact.

SA5:

Already supported by 3GPP SA5 specifications:

- 3GPP TS 28.552 clause 5.1.1.19.3 for physical network function (PNF)
- 3GPP TS 28.554 clause 6.7.3.1 for KPI on estimated NF Energy Consumption (EC), including virtualized network functions (VNF).
- However, additional measurements/KPI for virtualized environment are needed to consider the “actual” energy consumption, not estimated ones only.

#### **Q.1.6:**

SA2:

No impact.

SA5:

Already supported by OAM.

#### **Q.1.7:**

The same answers of EC, summarized as follows:

**Average per UE:** out of SA2 SID scope, can be considered by SA5 if needed



**Per specific UE, Per PDU session of the UE, Per QoS flow of the UE:** NF level information of renewable energy is provided by SA5 but a new functionality in SA2 is needed to obtain end-to-end renewable energy info considering the serving NFs,

**NF, Network Slice:** no impact on SA2, can be supported by OAM

## 7 – Motorola Mobile Com Technology

**Q.1.1:** Average per UE

There is no need or use case to justify.

**Q.1.2:** Per specific UE

In scope of SA2 considering per specific UE ID and 5G core related measurements, e.g., UPF, SMF.

**Q.1.3:** Per PDU session of the UE

In scope of SA2. It makes sense to consider a PDU per specific application.

**Q.1.4:** Per QoS flow of the UE

In scope of SA2. It makes sense to consider a QoS Flow per specific application.

**Q.1.5:** NF (only UPF and gNB)

SA5 already provide this, no need for SA2 to get involved.

**Q.1.6:** Network slice

SA5 already provide this, no need for SA2 to get involved.

**Q.1.7:** Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)

SA5 needs to initially work out and define the renewable energy performance measurements before we can comment on specific granularities. It is difficult currently to tell.

## 8 – Ericsson LM

**Q.1.1:** Average per UE

We see no need for this.

**Q.1.2:** Per specific UE

**SA2**

Nothing new needed

**SA5 (Lead Group)**

This can be calculated per UE based on the Energy consumed in UP by dividing total energy consumption over a period over affected UP nodes (gNBs and UPFs) used by the UEs in the period (based on existing SA5 OAM KPIs) by total data volume handled by these UP nodes and multiplied by the data volume of the PDU sessions for the UE in these nodes (based on existing SA5 OAM charging data collection) – this requires charging information and OAM information post processing – whether this is based on new agreed KPI definition is to be discussed in SA5, as well as any requirement of time alignment between energy information and charging data collection

**Q.1.3:** Per PDU session of the UE

**SA2**

**Nothing new**

**SA5 (Lead Group)**

Same as for Q.1.2. with the difference that the data volume is measured for a single PDU session.

**Q.1.4: Per QoS flow of the UE**

(Including per application)

**SA2**

**SA5(Lead Group)**

Same as for Q.1.2 but for the QoS flow.

**Q.1.5: NF (only UPF and gNB)**

**SA5**

(Existing capability)

**Q.1.6: Network slice**

**SA5**

(Existing capability)

**Q.1.7: Renewable energy info** (The question applies to all granularities above. Your answer needs to be provided for each granularity.)

**SA5**

It's possible to additionally consider the Renewable energy ratios per UP node (during the considered time period) used for the calculations for the energy consumption estimates to derive the renewable energy consumed in Q.1.2, Q.1.3, Q.1.4, Q.1.5, Q.1.6. This will however require the energy company to report renewable energy on a similar timescale as the OAM KPIs and will add another layer of complexity.

**9 – Guangdong OPPO Mobile Telecom.**

**Q.1.1: Average per UE**

No need. do not see meaningful use cases for Average per UE.

**Q.1.2: Per specific UE**

Pending to RAN decision. If RAN is not going to report EC related to per specific UE, then no need in this release.

**Q.1.3: Per PDU session of the UE**

Yes, prefer to have this in SA2 scope.

**Q.1.4: Per QoS flow of the UE**

Yes, prefer to have this in SA2 scope. Support to include both per QoS flow of the UE and per application granularities.

**Q.1.5: NF (only UPF and gNB)**

Yes, prefer to be in SA2 scope. Potentially with a new network functionality to collect proper metrics from OAM, and use that piece of information to calculate NF-level EC and EE.

**Q.1.6: Network slice**

Yes, prefer to be in SA2 scope. Potentially with a new network functionality to collect proper metrics from OAM, and use that piece of information to calculate Network Slice-level EC and EE.

**Q.1.7: Renewable energy info**

Yes, in SA2 scope, with NF-level Renewable energy info being in NF profile in NRF.

**10 – vivo Mobile Communication Co.**

**Q.1.1:**

No need, what 5G can do by using the average UE energy consumption is not clear.

**Q.1.2:**

SA2. If RAN side cannot provide energy consumption at per UE level, this information is only calculated by the data volume of UE, this is also a statistic, cannot accurately reflect the energy RAN used for specific UE. So, it is better to involve RAN in the whole estimation and calculation.

Also, SA5 measurement on CN/RAN has no information of UE, so let the SA5 can calculate UE energy consumption is not feasible, the system impact to enhance SA5 to perform UE level measurement is very huge.

**Q.1.3: Per PDU session of the UE**

Same as Q1.2

**Q.1.4: Per QoS flow of the UE**

Same as Q1.2

**Q.1.5: NF (only UPF and gNB)**

SA5 already has this kind of measurement data.

**Q.1.6: Network slice**

SA5 already has this kind of measurement data. But we need further confirm if RAN side and CN side can provided network slice level energy consumption as stated in the SA5 formula.

**Q.1.7: Renewable energy info**

SA5 related.

**11 – LG Electronics France**

**Q.1.1: Average per UE**

This information is considered NOT needed.

**Q.1.2: Per specific UE**

**SA2**

is proper to collect and calculate User Plane energy consumption per specific UE by taking data volume of UE into account.

We believe that it would be appropriate and future-proof for SA2 to lead this granularity considering the case that Control Plane is also considered in the future.

**Q.1.3: Per PDU session of the UE**

**SA2**

is proper to collect and calculate User Plane energy consumption per PDU session of the UE by taking data volume of PDU session of the UE into account.

We believe that it would be appropriate and future-proof for SA2 to lead this granularity considering the case that Control Plane is also considered in the future.

A PDU Session can represent specific service(s) because each PDU Session is associated with a combination of DNN and S-NSSAI. Therefore, to collect and calculate energy consumption per PDU session of the UE is useful when all services associated with the PDU Session are subject to energy related policy/control while taking the following SA1 requirement into account.

*”Subject to operator’s policy, the 5G system shall support a means to define subscription policies and means to enforce the policy that define a maximum energy consumption (i.e. quantity of energy for a specified period of time) for services without QoS criteria.*

*NOTE 3: The granularity of the subscription policies can either apply to the subscriber (all services), or to particular services.”*

**Q.1.4: Per QoS flow of the UE (including per application)**

**SA2**

is proper to collect and calculate User Plane energy consumption per QoS flow/application of the UE by taking data volume of QoS flow/application of the UE into account.

We believe that it would be appropriate and future-proof for SA2 to lead this granularity considering the case that Control Plane is also considered in the future.

**Q.1.5: NF (only UPF and gNB)**

SA5

**Q.1.6: Network slice**

SA5

**Q.1.7: Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)**

Per specific UE: SA2

Per PDU session of the UE: SA2

Per QoS flow of the UE (including per application): SA2

## 12 – CATT

### Q.1.1: Average per UE

Either SA2 or SA5.

### Q.1.2: Per specific UE

SA2. SA2 has better knowledge of specific UE (SUPI) behavior.

### Q.1.3: Per PDU session of the UE

SA2. SA2 is more suitable for monitoring the performance of specific PDU Session and specific QoS flow.

### Q.1.4: Per QoS flow of the UE (including per application)

SA2. See above.

### Q.1.5: NF (only UPF and gNB)

SA5. Already defined in SA5

### Q.1.6: Network slice

SA5. Already defined in SA5

### Q.1.7: Renewable energy info

Same as the above

## 13 – Samsung R&D Institute UK

### Q.1.1

SA2: No need.

**SA5: This is scope of SA5 work.**

### Q.1.2

**SA2: This is scope of SA2 work.** 5GC NF can be enhanced to collect/calculate the energy consumption of a particular UE which is identified by UE identity. The result of collection/calculation will be used for enhanced procedures e.g. NF selection/re-selection, Network Slice selection/replacement, Policy adjustment as studied in SA2.

SA5: No need.

### Q.1.3

**SA2:** Along with Q.1.2, collection/calculation of energy consumption **'per PDU session of a particular UE' is scope of SA2.** This will assist the 5GC NF to determine whether all or some of PDU sessions of the UE needs to be applied for energy saving operations.

**SA5:** SA5: Along with Q.1.1, **'Average per PDU Session for all UEs' is scope of SA5.**

### Q.1.4

**SA2:** Similar with Q.1.3, **'Per application of a particular UE' is scope of SA2.** It is not clear to us yet, whether 'Per QoS Flow of a particular UE' is a suitable granularity while not being supported by RAN WGs. We can clarify QoS Flow case by using e.g. SDF, App ID, etc. that can be mapped to 'application'.

**SA5:** Similar with Q.1.3, **'Average per QoS flow for all UEs' is scope of SA5.**

### Q.1.5

**SA2: 'Per NF(UPF)' and 'Per NF for a particular UE' need to be supported in SA2 scope as well (per gNB is not needed).**

- Similar with what SA2/SA5 defined in NWDAF case, SA2 can define collection/calculation of energy consumption per UPF in control purpose (e.g. NF selection/re-selection) which is distinguished with using MDAS defined by SA5 in management purpose. We think using OAM may not be sufficient to fulfill the energy consumption data collection/calculation requirements for the 5GC NFs, e.g. the period of collection, the subjects of calculation, the exception conditions, etc.

- Considering what SA2 intended in the study, to be aware of energy consumed by a particular UE overall, energy consumption of all UPFs that are serving for an UE should be collected and calculated accordingly. For example, when the UE is using multiple network slices or when the UE is using a PDU session with I-UPFs and PSA UPF. Those should be supported for NF selection/re-selection or other procedures. 'Per NF for a particular UE' cannot be supported in SA5, and it is scope of SA2.

**SA5: EC measurement per ManagedFunction is scope of SA5.**

### Q.1.6

**SA2: Similar with Q.1.5, both 'Per Network Slice' and 'Per Network Slice for a particular UE' should be supported in SA2.**

- For 'Per Network Slice', using OAM may not be sufficient to fulfill the energy consumption data collection/calculation requirements for the 5GC NFs.

- For 'Per Network Slice for a particular UE' cannot be supported in SA5, and it is needed at 5GC NFs when it determine in NF selection/re-selection, Network slice selection/replacement or other procedures.

**SA5: EC measurement per Network Slice is scope of SA5.**

### Q.1.7

SA2: No need.

**SA5: Defining the renewable energy information and related managements can be further work in SA5.**

## 14 – Nubia Technology Co.

ZTE Answer:

### Q.1.1 Average per UE

Does not see the use case.

### Q.1.2 Per specific UE

SA2: It is the scope of the SA2 WG. The new NF (e.g. EECF) can collect the energy related information (from SA2 NF and OAM) and calculate the energy consumption of the UE. (It is FFS how to calculate the per UE EC, e.g.

per UE EC = The sum of ECs of all PDU sessions of the UE, or

per UE EC = energy consumed for the UE in each serving u-plane NF, e.g. gNB and UPF)

SA5: OAM can provides the NF level Energy consumption and data volume in a certain time period to the new NF. So the new NF can use this information to calculate the per UE EC.

**Q.1.3:** Per PDU session of the UE

It is the scope of SA2. see answer to Q.1.2

**Q.1.4:** Per QoS flow of the UE (including per application)

It is the scope of SA2. see answer to Q.1.2

**Q.1.5:** NF (only UPF and gNB)

There is nothing needed for SA2

SA5 has support this granularity

**Q.1.6:** Network slice

There is nothing needed for SA2

SA5 has support this granularity

**Q.1.7:** Renewable energy info

Similar answer to Q.1.1~Q.1.6

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**15 – SK Telecom**

Q.1.1

SA2: NO

SA5: YES

Q.1.2

SA2: YES

We need support from the SA2 to track the usage of specific devices (or a group of UEs) by considering detailed filters such as specific periods, procedures, slices, and DNN, etc.

SA5: NO

Q.1.3

SA2: YES

Since the PDU session is closely related to the service, we need support from the SA2 to track the usage of specific sessions (or a PDU set) by considering detailed filters such as specific periods, procedures, slices, and DNN, etc.

SA5: YES

Q.1.5

SA2: YES. Per gNB is not needed.

SA5: YES

Q.1.6

SA2: YES

SA5: YES

**16 – SK Telecom**

Q.1.4

SA2: YES

Consideration at the SDF level is need too.

Q.1.7

SA2: NO

**17 – MediaTek Inc.**

1.1 SA2

1.2 SA2

1.3 SA2

1.4 SA2

1.5 SA5

1.6SA5

1.7

it should have same granularities as the above bullets and according to different granularities, it will be collected by SA2 or SA5 as mentioned and similar to the above bullets

**18 – Intel Deutschland GmbH**

Q 1.1: Average per UE

SA5.

Q 1.2: per specific UE

SA2.

Q 1.3: per PDU session of UE

Not needed in this release.

Q 1.4: per QoS flow of UE

Not needed in this release.



Q 1.5: NF (only UPF and gNB)

SA5.

Q.1.6: Network slice

SA5.

Q.1.7: Renewable energy info

Not needed in this release.

## 19 – ETRI

### Q.1.1: Average per UE

Not needed: RAN and UPF operate on different nodes, so the number of UEs handled by each node can vary. This makes calculating average energy per UE challenging.

### Q.1.2: Per specific UE

**SA2:** Utilizing ULI information and policy control, as well as the granularity of calculations involving I-UPF and PSA UPF, etc., SA2 could be effectively integrate with NWDAF to provide detailed energy consumption data for specific UEs.

### Q.1.3: Per PDU session of the UE

**SA2:** Each PDU session represents specific services, associated with a combination of DNN (Data Network Name) and S-NSSAI (Single Network Slice Selection Assistance Information). Therefore, calculating and collecting energy consumption per PDU session is useful for applying energy-related policies and controls.

Challenges:

RAN data limitations: RAN cannot provide detailed data for PDU sessions and QoS flows, which can reduce the accuracy of energy consumption calculations.

UPF data limitations: Using data collected from UPF to calculate RAN side energy consumption is limited because it does not reflect RAN-specific elements.

### Q.1.4: Per QoS flow of the UE

**SA2:** Supports detailed monitoring of energy consumption per QoS flow and application.

Challenges:

Similar to Q.1.3, RAN data limitations and UPF data limitations reduce calculation accuracy.

### Q.1.5: NF (only UPF and gNB)

**SA5:**

Managed with existing capabilities.

### Q.1.6: Network slice

**SA5:**

Managed with existing capabilities.

**Q.1.7: Renewable energy info**

**SA2 & SA5:**

Incorporating renewable energy information at all granularity levels is crucial for enhancing network energy efficiency and improving user experience. Collaboration between SA2 and SA5 is essential to achieve this.

**20 – NEC Europe Ltd**

Q1.1 - not applicable (no requirement)

Q1.2 - SA2 (new EENF)

Q1.3 - SA2

Q1.4 - SA2

Q1.5 - pass

Q1.6 - SA2

Q1.7 - pass

**21 – Verizon Spain**

**Q.1.1:** Average per UE

**Neither SA2 nor SA5; not needed**

**Q.1.2:** Per specific UE

**Both SA2 and SA5 work dependent on RAN for Rel-19**

**Q.1.3:** Per PDU session of the UE

**Both SA2 and SA5 work dependent on RAN for Rel-19**

**Q.1.4:** Per QoS flow of the UE (including per application)

**Both SA2 and SA5 work dependent on RAN for Rel-19**

**Q.1.5:** NF (only UPF and gNB)

**SA5; already in SA5**

**Q.1.6:** Network slice

**SA5; already in SA5**

**Q.1.7:** Renewable energy info

**SA5-led**

## 2.2 Exposure of energy-related information

**Question 2:** Which of the following granularities should be supported for exposure of energy consumption to 5GC NF?(Companies should indicate in their replies the responsibility for exposure per working group. Companies may also include more information in their response on what they think the suggested WG should address in the corresponding work, to help others understand the proposal.)

**Table 2: Exposure of energy-related information to 5GC NF**

Granularity of exposure	SA2	SA5
<b>Q.2.1:</b> Average per UE		
<b>Q.2.2:</b> Per specific UE		
<b>Q.2.3:</b> Per PDU session of the UE		
<b>Q.2.4:</b> Per QoS flow of the UE (including per application)		
<b>Q.2.5:</b> NF (only UPF and gNB)		
<b>Q.2.6:</b> Network slice		
<b>Q.2.7:</b> Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)		

### Feedback Form 2:

**1 – Nokia UK**

**Granularity of exposure**

**Q.2.1:** Average per UE

Not needed

**Q.2.2:** Per specific UE

**SA5** (new CHF Service)

**Q.2.3:** Per PDU session of the UE

**SA5** (new CHF Service)

**Q.2.4:** Per QoS flow of the UE

(including per application)

**SA5**(new CHF Service)

**Q.2.5: NF (only UPF and gNB)**

**SA5** (Existing, Exposed by SBMA)

**Q.2.6: Network slice**

**SA5** (Existing, Exposed by SBMA)

**Q.2.7: Renewable energy info** (The question applies to all granularities above. Your answer needs to be provided for each granularity.)

**SA5** (associated to same information granularity as above in this column, exposed by SBMA service or CHF service as per above)

## **2 – HuaWei Technologies Co.**

**Q.2.1: Average per UE**

**SA2:** There is no need in SA2 to support such functions as the answer to Q.1.1.

**SA5:** OAM can support such functionalities, see the answer to Q.1.1.

**Q.2.2: Per specific UE**

**SA2:** Considering answer Q1.2, the result of calculation by 5GC NF in SA2 can be provided to e.g., PCF, NEF, NWDAF, ...

**SA5:** There is no need in SA5 to support such functions as the answer to Q.1.2.

**Q2.3: Per PDU session of the UE**

**SA2:** We don't see this is an urgent demand of supporting such, but if supported, same "per-specific-UE" as in Q.2.2.

**SA5:** No need.

**Q.2.4: Per QoS flow of the UE**

**SA2:** Same as "per-specific-UE" as in Q.2.2.

**SA5:** No need.

**Q.2.5: NF (only UPF and gNB)**

**SA2:** Not needed to be provided to other NFs since only used for calculation and not for other purposes

**SA5:** measurement and evaluation is performed by OAM and passed to 5GC functionalities (e.g., EECF/SM-F/NWDAF).

**Q.2.6: Network slice:**

**SA2:** Same as the answer to Q.2.5.

**SA5:** Same as the answer to Q.2.5.

**Q.2.7: Renewable energy info**

**SA2:** Similar as the energy consumption as mentioned in Q.2.1-Q.2.6

**SA5:** Similar as the energy consumption as mentioned in Q.2.1-Q.2.6

**3 – Qualcomm Korea**

**Q.2.1: Average per UE**

SA5

**Q.2.2: Per specific UE**

SA5, new service maybe needed, and should be decided by SA5

**Q.2.3: Per PDU session of the UE**

SA5, new service maybe needed, and should be decided by SA5

**Q.2.4: Per QoS flow of the UE**

(including per application)

SA5, new service maybe needed, and should be decided by SA5

**Q.2.5: NF (only UPF and gNB)**

SA5, already supported by SBMA

**Q.2.6: Network slice**

SA5, already supported by SBMA

**Q.2.7: Renewable energy info** (The question applies to all granularities above. Your answer needs to be provided for each granularity.)

SA5, new service maybe needed, and should be decided by SA5

**4 – China Mobile Com. Corporation**

**Q.2.1: Average per UE**

**Not clear how to calculate.**

**Q.2.2: Per specific UE**

**SA2:** Belong to SA2. This energy consumption information per specific UE can be exposed to PCF to adjust some policy e.g. URSP, BDT, traffic steering. We think it should not be used to do QoS upgrade and downgrade.

There is no need of SA5 to support this. What's more, the CHF should not be involved to calculate the per specific UE energy consumption since the energy information do not impact the charging system. What's more, not clear how the OAM can expose the per specific UE energy consumption information.

**Q2.3: Per PDU session of the UE**

**SA2:** if we support, belong to SA2. In our idea, the scenario is per PDU session level energy information may expose to NWDAF to help estimate the future energy consumption information.

**SA5:** No need.

**Q.2.4: Per QoS flow of the UE**

**SA2:** if we support, belong to SA2. In our idea, the scenario is per QoS flow level energy information may expose to NWDAF to help estimate the future energy consumption information.

**SA5:** No need.

**Q.2.5: NF (only UPF and gNB)**

SA2 Not needed to support this, it is OAM(SA5) to expose the Node level energy consumption information to 5GC NFs e.g. NWDAF.

**Q.2.6: Network slice:**

No need.

**Q.2.7: Renewable energy info**

**SA2:** We do support to consider the renewable energy information in this release. It is valuable to introduce the percentage of renewable information and show this to the 5GC NFs. And this work should cooperate with SA5.

**5 – DOCOMO Communications Lab.**

**Q.2.1:**

SA2:

Not needed in SA2 FS\_EnergSys KIs

SA5:

Can be considered if there is a valid UC

**Q.2.2:**

Per specific UE energy-related information can be used in the solutions of KI#2 and KI#3; so, to our understanding, the capability to expose the information to 5GC NFs is needed.

SA2:

The new functionality can provide services to expose this information to other 5GC using SBA interfaces.

SA5:

No impact.

**Q.2.3:**

To our understanding, per PDU session EC is needed for the principles concluded for KI#3, i.e., "UP path of PDU session may be adjusted".

SA2:

The new functionality can provide services to expose this information to other 5GC using SBA interfaces.

SA5:

No impact.

**Q.2.4:**

SA2:

The new functionality can provide services to expose this information to other 5GC using SBA interfaces.

SA5:

No impact.

**Q.2.5:**

SA2:

No impact

SA5:

Already supported by OAM

**Q.2.6:**

SA2:

No impact

SA5:

Already supported by OAM

**Q.2.7**

The same answer of Q.2.1-Q.2.6.

**6 – Motorola Mobile Com Technology**

**Q.2.1:** Average per UE

Not needed.

**Q.2.2:** Per specific UE

In scope of SA2, can be exposed to, e.g., PCF.

**Q.2.3:** Per PDU session of the UE

In scope of SA2, can be used for path adjustments.

**Q.2.4:** Per QoS flow of the UE

In scope of SA2, but there is no clear usage.

**Q.2.5:** NF (only UPF and gNB)

SA5 already provide this, no need for SA2 to get involved.

**Q.2.6:** Network slice

SA5 already provide this, no need for SA2 to get involved.

**Q.2.7:** Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)

SA5 needs to initially work out and define the renewable energy performance measurements before we can comment on specific granularities. It is difficult currently to tell.

**7 – Ericsson LM**

**Q.2.1:** Average per UE

Not needed

**Q.2.2:** Per specific UE

SA5, New CHF Service and/or extension of spending limit control

**Q.2.3:** Per PDU session of the UE

SA5 Same as Q.2.2

**Q.2.4:** Per QoS flow of the UE

Including per application

SA5 Same as Q.2.2

**Q.2.5:** NF (only UPF and gNB)

SA5 Existing service

**Q.2.6:** Network slice

SA5 Existing service

**Q.2.7:** Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)

SA5 associated to same information granularity as above in this column, exposed by existing service or new CHF service as per above.

**8 – Guangdong OPPO Mobile Telecom.**

**Q.2.1:** Average per UE

no need

**Q.2.2:** Per specific UE

pending to RAN

**Q.2.3:** Per PDU session of the UE

yes, prefer to be in SA2 scope.

**Q.2.4:** Per QoS flow of the UE

**(Including per application)**

yes, prefer to be in SA2 scope with both Per QoS flow of the UE and per application granularities.

**Q.2.5:** NF (only UPF and gNB)



yes, prefer to be in SA2 scope.

**Q.2.6: Network slice**

yes, prefer to be in SA2 scope.

**Q.2.7: Renewable energy info**

With NF-level renewable energy information in NF profile in NRF. Also support to expose renewable energy information at per specific UE and per network slice granularities.

**9 – vivo Mobile Communication Co.**

**Q.2.1:**

No need  same as Q1.1

**Q.2.2:**

Yes. Interaction with SA5 CHF to do the credit limit control. RAN side need to be involved to provide the UE energy consumption.

**Q.2.3:**

Depends on the use case, how to UE the PDU session level Energy Consumption and for what purpose.

**Q.2.4:**

Same as Q2.4

**Q.2.5:**

SA5 provide to SA2.

**Q.2.6:**

SA5 provided to SA2, but for external exposure, SA5 now has no extra interface with external e.g. AF.

**Q.2.7:**

Depends on SA5

**10 – LG Electronics France**

**Q.2.1: Average per UE**

Not needed

**Q.2.2: Per specific UE**

SA2

**Q.2.3: Per PDU session of the UE**

SA2

**Q.2.4: Per QoS flow of the UE (including per application)**

SA2

**Q.2.5: NF (only UPF and gNB)**

SA5

**Q.2.6: Network slice**

SA5

**Q.2.7: Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)**

Per specific UE: SA2

Per PDU session of the UE: SA2

Per QoS flow of the UE (including per application): SA2

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## 11 – CATT

**Q.2.1: Average per UE**

SA2 or SA5

**Q.2.2: Per specific UE**

SA2

**Q.2.3: Per PDU session of the UE**

SA2

**Q.2.4: Per QoS flow of the UE (including per application)**

SA2

**Q.2.5: NF (only UPF and gNB)**

SA5

**Q.2.6: Network slice**

SA5

**Q.2.7: Renewable energy info**

Same as the above.

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## 12 – Samsung R&D Institute UK

**Q.2.1**

SA2: No need.

**SA5: This is scope of SA5 work.**

**Q.2.2**

**SA2: This is scope of SA2 work. 'Per specific UE' exposure can only be specified by SA2.**

SA5: No need.

### **Q.2.3**

**SA2: Along with Q.2.2, 'Per PDU session of a particular UE' exposure is scope of SA2.**

**SA5: Along with Q.2.1, 'Average per PDU Session for all UEs' exposure is scope of SA5.**

### **Q.2.4**

SA2: Similar with Q.2.3, 'Per application of a particular UE' exposure is scope of SA2.

SA5: Similar with Q.2.3, 'Average per QoS flow for all UEs' exposure is scope of SA5.

### **Q.2.5**

**SA2: Along with Q.1.5, the result of collection/calculation per NF(UPF), the energy related information based on the collected/calculated result, and/or the configured energy related information can be provided to the other 5GC NFs (e.g. AMF, SMF, NWDAF, EECF, ...). Those should be supported for the NF selection/re-selection, or other procedures and it is scope of SA2. Also, 'Per NF for a particular UE' exposure can only be specified by SA2.**

**SA5: Along with Q.1.5, the use of EC measurement per ManagedFunction is scope of SA5.**

### **Q.2.6**

**SA2: Similar with Q.2.5, this should be supported for the NF selection/re-selection, Network slice selection/replacement, or other procedures and it is scope of SA2. Also, 'Per Network Slice for a particular UE' exposure is scope of SA2.**

**SA5: Along with Q.1.6, the usage of EC measurement per Network Slice is scope of SA5.**

### **Q.2.7**

SA2: No need.

**SA5: it can be worked further in SA5.**

## **13 – Nubia Technology Co.**

ZTE Answer:

### **Q.2.1 Average per UE**

Not needed. Does not see the use case.

### **Q.2.2 Per specific UE**

SA2: It is SA2 scope, the new NF can expose the per UE EC to 5G NF.

There is no need for SA5 to expose these information.

### **Q.2.3: Per PDU session of the UE**

It is the scope of SA2. see answer to Q.2.2

**Q.2.4:** Per QoS flow of the UE (including per application)

It is the scope of SA2. see answer to Q.2.2

**Q.2.5:** NF (only UPF and gNB)

SA5 has support this granularity. The new NF can obtain this granularity EC information from OAM

**Q.2.6:** Network slice

SA5 has support this granularity. The new NF can obtain this granularity EC information from OAM

**Q.2.7:** Renewable energy info

Similar answer to Q.2.1~Q.2.6

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#### 14 – SK Telecom

Q.2.1

SA2: NO

SA5: YES

Q.2.2

SA2: YES

SA5: NO

Q.2.3

SA2: YES

SA5: YES

Q.2.4

SA2: YES

Q.2.5

SA2: YES. Per gNB is not needed.

SA5: YES

Q.2.6

SA2: YES

SA5: YES

Q.2.7

SA2: NO

**15 – TOYOTA MOTOR CORPORATION**

**Q.2.1:** Average per UE

No need.

**Q.2.2:** Per specific UE

SA2

**Q.2.3:** Per PDU session of the UE

SA2, if needed.

**Q.2.4:** Per QoS flow of the UE

SA2, if needed.

**Q.2.5:** NF (only UPF and gNB)

SA5

**Q.2.6:** Network slice

No need.

**Q.2.7:** Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)

SA2

**16 – MediaTek Inc.**

2.1

not needed

2.2

SA2

2.3

SA2

2.4

SA2

2.5

SA5

2.6

SA5

2.7

same answer as 1.7

**17 – Intel Deutschland GmbH**

Q 2.1: Average per UE

SA5.

Q 2.2: per specific UE

SA2.

Q 2.3: per PDU session of UE

Not needed in this release.

Q 2.4: per QoS flow of UE

Not needed in this release.

Q 2.5: NF (only UPF and gNB)

SA5.

Q.2.6: Network slice

SA5.

Q.2.7: Renewable energy info

Not needed in this release.

**18 – ETRI**

**Q.2.1: Average per UE**

**Not needed:** Similar to Q.1.1, the calculation methods are unclear and it is not necessary.

**Q.2.2: Per specific UE**

**SA2:** Manages specific UE energy consumption information, which can be used for policy adjustments and network optimization. Integration with NWDAF can also be considered.

**Q.2.3: Per PDU session of the UE**

**SA2:** Exposing PDU session-level energy information to NWDAF helps in estimating future energy consumption.

**Q.2.4: Per QoS flow of the UE**

<p><b>SA2:</b> Exposing QoS flow-level energy information to NWDAF aids in estimating future energy consumption.</p> <p><b>Q.2.5: NF (only UPF and gNB)</b> SA5: Supported by OAM</p> <p><b>Q.2.6: Network slice</b> SA5: Supported by OAM</p> <p><b>Q.2.7: Renewable energy info</b> Similar answer to Q.2.1~Q.2.6</p>
<p><b>19 – NEC Europe Ltd</b></p> <p><b>Q.2.1: Average per UE</b> - not applicable (no requirement for it)</p> <p><b>Q.2.2: Per specific UE</b> - SA2 (new EENF)</p> <p><b>Q.2.3: Per PDU session of the UE</b> - SA2</p> <p><b>Q.2.4: Per QoS flow of the UE</b> - not needed</p> <p><b>Q.2.5: NF (only UPF and gNB)</b> - pass</p> <p><b>Q.2.6: Network slice</b> - SA2</p> <p><b>Q.2.7: Renewable energy info</b> - pass</p>

**Question 3:** Which of the following granularities should be supported for exposure of energy consumption to Application Function?

*\* Note: The Application Function is an entity outside the 5GC for this question.*

(Companies should indicate in their replies the responsibility for exposure per WG. Companies may also include more information in their response on what they think the suggested WG should address in the corresponding work, to help others understand the proposal.)

**Table 3: Exposure of energy-related information to Application Function**

Granularity of exposure	SA2	SA5
Q.3.1: Average per UE		
Q.3.2: Per specific UE		
Q.3.3: Per PDU session of a UE		
Q.3.4: Per Application of a UE		

<b>Q.3.5:</b> Network slice		
<b>Q.3.6:</b> Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)		

**Feedback Form 3:**

**1 – Nokia UK**

**Q.3.1:** Average per UE

Not needed

**Q.3.2:** Per specific UE

**SA2** (NEF retrieves per UE information from CHF)

**Q.3.3:** Per PDU session of the UE

**SA2** (NEF retrieves per PDU session information from CHF. Needed to expose energy consumed per NPN, achieved by aggregating at NEF the consumed energy per DNN by UEs using the DNN of NPN for their PDU sessions)

**Q.3.4: Per Application of a UE**

**SA2**

(NEF retrieves per QoS flow energy information from CHF)

**Q.3.5:** Network slice

**SA5** (existing. Exposed by SBMA)

**Q.3.6:** Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)

**SA2** (if associated to information granularity as above in Q.3.2, Q.3.3, Q.3.4, calculated as detailed in corresponding Q.1.x replies and exposed to NEF as per corresponding Q.2.x replies)

**SA5** (if associated to same information granularity as above in Q.3.5, determined as detailed in corresponding Q.1.5 and Exposed by SBMA)

**2 – HuaWei Technologies Co.**

**Q.3.1: Average per UE**

**SA2:** There is no need in SA2 to support such functions as the answer to Q.2.1.

**SA5:** Technically can be supported with controllable enhancement in SA5.



**Q.3.2: Per specific UE**

**SA2:** Considering answer Q1.2, yes, we see the necessity to provide such info to AF.

**SA5:** not applicable

**Q.3.3: Per PDU session of a UE**

**SA2:** We don't see the scenario, but technically it is feasible.

**SA5:** not applicable

**Q.3.4: Per Application of a UE**

**SA2:** yes, we see the necessity to provide such info to AF.

**SA5:** not applicable

**Q.3.5: Network slice**

**SA2:** No need.

**SA5:** Technically can be supported with controllable enhancement in SA5. Scenario to be discussed.

**Q.3.6: Renewable energy info**

**SA2:** Similar as the energy consumption as mentioned in Q.3.1-Q.3.1

**SA5:** Similar as the energy consumption as mentioned in Q.3.1-Q.3.1

---

**3 – Qualcomm Korea**

**Q.2.1: Average per UE**

**SA5,** how do expose the info to AF should be decided by SA5.

**Q.2.2: Per specific UE**

**SA5,** how do expose the info to AF should be decided by SA5.

**Q.2.3: Per PDU session of the UE**

**SA5,** how do expose the info to AF should be decided by SA5.

**Q.2.4: Per QoS flow of the UE**

(including per application)

**SA5,** how do expose the info to AF should be decided by SA5.

**Q.2.5: NF (only UPF and gNB)**

**SA5,** how do expose the info to AF should be decided by SA5.

**Q.2.6: Network slice**

SA5, how do expose the info to AF should be decided by SA5.

**Q.2.7:** Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)

SA5, how do expose the info to AF should be decided by SA5.

#### **4 – China Mobile Com. Corporation**

##### **Q.3.1: Average per UE**

Not clear how to calculate and expose

##### **Q.3.2: Per specific UE**

**SA2:** Belong to SA2. We think it is valuable to calculate the specific UE energy consumption in 5GC and expose it to AF. Even the calculation is not so precise, but this specific UE energy consumption in network, can contribute to describe the carbon footprint of specific UE/user in the society.

**SA5:** not applicable

##### **Q.3.3: Per PDU session of a UE**

**SA2:** maybe not need to expose this granularity to AF.

**SA5:** not applicable

##### **Q.3.4: Per Application of a UE**

**SA2:** based on SA1 requirement, it should be supported to expose per UE per AF energy consumption information to AF.

**SA5:** not applicable

##### **Q.3.5: Network slice**

**SA2:** No need.

**SA5**□ based on SA5 discussion.

##### **Q.3.6: Renewable energy info**

**SA2:**We suggest the customer in our network can have an idea of renewable energy information they use when they communicate through the network, e.g.to show the percentage of renewable energy consumption information to AF.

**SA5:** not applicable.

#### **5 – DOCOMO Communications Lab.**

##### **Q.3.1:**

SA2:

Not needed in SA2 FS\_EnergSys KIs

SA5:

Can be considered if there is a valid UC

**Q.3.2:**

SA2:

The new functionality can provide expose this information to AF (via NEF in the case of untrusted AF).

SA5:

No impact.

**Q.3.3:**

SA2:

Technically it is feasible (similar to Q.3.2) but the use-case and requirement is not clear to us.

SA5:

No impact.

**Q.3.4:**

To address the SA1 requirements, the AF providing a service to a UE may need to know the consumed energy for the service.

SA2:

The new functionality can provide expose this information to AF (via NEF in the case of untrusted AF).

SA5:

No impact.

**Q.3.5:**

SA2:

In the case of untrusted AF, NEF needs to get this information from OAM and expose it to the AF.

SA5:

In the case of trusted AF, it can get the information via SBMA from the OAM.

**Q.3.6:**

The same answers of Q.3.1-Q.3.5.

---

**6 – Ericsson LM**

**Q.3.1:** Average per UE

Not needed

**Q.3.2:** Per specific UE

How to expose externally depends on the how the customer of the information wants to receive it. If it's not easily consumed by an appropriate function, it will not be used. The NEF can re-expose information from the CHF to an AF. The CHF can also expose the information via the billing system and the existing SA5 exposure services could be extended. We may decide to only support a subset of these possibilities.

**SA2** NEF retrieves information from CHF and re-expose to AF.

**Q.3.3:** Per PDU session of the UE

Same answers as Q.3.2

**Q.3.4:** Per Application of a UE

**SA2**

Same answers as Q.3.2

**Q.3.5:** Network slice

**SA5** Ongoing work to extend existing exposure services.

**Q.3.6:** Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)

**SA2** if associated to information granularity as above in Q.3.2, Q.3.3, Q.3.4, calculated as detailed in corresponding Q.1.x replies and exposed to NEF as per corresponding Q.2.x replies.

**SA5** if associated to same information granularity as above in Q.3.5, determined as detailed in corresponding Q.1.5 and exposed by SA5 SBMA.

#### **7 – Motorola Mobile Com Technology**

**Q.3.1:** Average per UE

Not needed

**Q.3.2:** Per specific UE

In scope of SA2, can be exposed to authorized AF.

**Q.3.3:** Per PDU session of the UE

In scope of SA2, can be used only per application per PDU session.

**Q.3.4:** Per Application of a UE

In scope of SA2, shall be supported.

**Q.3.5:** Network slice

SA5 already provide this, no need for SA2 to get involved.

**Q.3.6:** Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)

SA5 needs to initially work out and define the renewable energy performance measurements before we can comment on specific granularities. It is difficult currently to tell.

#### **8 – Guangdong OPPO Mobile Telecom.**

**Q.3.1:** Average per UE

No need.

**Q.3.2:** Per specific UE

pending to RAN

**Q.3.3:** Per PDU session of a UE

No need to expose this to AF. Internal exposure expected to be used to obtain Q.3.4 to be exposed to AF.

**Q.3.4:** Per Application of a UE

Yes, prefer to be in the scope of SA2.

**Q.3.5: Network slice**

Yes, prefer to be in the scope of SA2.

**Q.3.6: Renewable energy info**

Assuming renewable energy information is included in NF profile in NRF, SA2 is supposed to develop mechanisms to expose renewable energy information to AF, e.g. at per network slice, per application, and per specific UE granularities.

**9 – LG Electronics France**

**Q.3.1: Average per UE**

Not needed.

**Q.3.2: Per specific UE**

SA2

**Q.3.3: Per PDU session of a UE**

SA2

If all services/applications of a PDU Session are relevant/dedicated with an AF, exposing energy-related information per PDU Session of a UE to AF is useful.

**Q.3.4: Per Application of a UE**

SA2

**Q.3.5: Network slice**

SA5

**Q.3.6: Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)**

Per specific UE: SA2

Per PDU session of a UE: SA2

Per Application a UE: SA2

**10 – vivo Mobile Communication Co.**

**Q.3.1:**

No

**Q.3.2:**

Yes, and RAN side needs to be enhanced.

**Q.3.3:**

**No**

**Q.3.4:**

**Yes, Same as Q3.2**

**Q.3.5: Network slice**

Yes, SA5 scope.

**Q.3.6: Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)**

First, depend on how to introduce renewable energy info in SA5. And further discussion is needed.

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**11 – CATT**

**Q.3.1:** Average per UE

SA2 or SA5

**Q.3.2:** Per specific UE

SA2

**Q.3.3:** Per PDU session of the UE

No need.

**Q.3.4:** Per Application of a UE

SA2

**Q.3.5:** Network slice

SA5

**Q.3.6:** Renewable energy info

Same as the above

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**12 – Samsung R&D Institute UK**

**Q.3.1**

SA2: No need.

**SA5: This is scope of SA5 work.**

**Q.3.2**

**SA2: This is scope of SA2 work. 'Per specific UE' exposure can only be specified by SA2.**

SA5: No need.

**Q.3.3**

**SA2: Along with Q.3.2, 'Per PDU session of a particular UE' exposure is scope of SA2.**

**SA5: Along with Q.3.1, 'Average per PDU Session for all UEs' exposure is scope of SA5.**

**Q.3.4**

**SA2: Similar with Q.3.3, 'Per application of a particular UE' exposure is scope of SA2.**

SA5: No need.

**Q.3.5**

**SA2: SA2: Similar with Q.2.6, It is scope of SA2. Especially, 'Per Network Slice for a particular UE' exposure can only be specified by SA2.**

**SA5: Along with Q.1.6, the usage of EC measurement per Network Slice is scope of SA5.**

**Q.3.6**

SA2: No need.

**SA5: it can be worked further in SA5.**

**13 – Nubia Technology Co.**

ZTE Answer:

**Q.3.1 Average per UE**

Not needed. Does not see the use case.

**Q.3.2 Per specific UE**

SA2: It is SA2 scope, the new NF can expose the per UE EC to AF via NEF

There is no need for SA5 to expose these information.

**Q.3.3: Per PDU session of the UE**

It is the scope of SA2. see answer to Q.3.2

**Q.3.4: Per QoS flow of the UE (including per application)**

It is the scope of SA2. see answer to Q.3.2

**Q.3.5: NF (only UPF and gNB)**

Why the 3rd party AF needs to know the EC of 5G NF (i.e. UPF and gNB). What is the use case/scenario.

**Q.3.6: Network slice**

SA5 can support this granularity.

**Q.3.7: Renewable energy info**

Similar answer to Q.3.1~Q.3.6

**14 – SK Telecom**

Q.3.1

SA2: NO

SA5: YES

Q.3.2

SA2: YES

SA5: NO

Q.3.3

SA2: YES

SA5: YES

Q.3.4

SA2: YES

SA5: NO

Q.3.5

SA2: YES

SA5: YES

Q.3.6

SA2: NO

**15 – TOYOTA MOTOR CORPORATION**

**Q.3.1: Average per UE**

No need.

**Q.3.2: Per specific UE**

SA2

**Q.3.3: Per PDU session of a UE**

SA2, if needed.

**Q.3.4: Per Application of a UE**

SA2, if needed.

**Q.3.5: Network slice**



No need.

**Q.3.6: Renewable energy info**

SA2

**16 – MediaTek Inc.**

3.1

no needed

3.2

SA2

3.3

SA2

3.4

SA2

3.5

SA5

3.6

SA2 or SA5 based on which granularity is used

**17 – Intel Deutschland GmbH**

Q.3.1: Average per UE

SA5.

Q.3.2: Per specific UE

SA2.

Q.3.3: Per PDU session of the UE

Not needed in this release.

Q.3.4: Per Application of a UE

SA2.

Q.3.5: Network slice

SA5.

Q.3.6: Renewable energy info

Not needed in this release.

## **18 – ETRI**

### **Q.3.1: Average per UE**

SA5 can technically support average energy consumption per UE with controllable enhancements.

### **Q.3.2: Per specific UE**

SA2 believes it is important to manage and provide specific UE energy consumption information to AF. This information can be exposed to AF via NEF for untrusted AF.

### **Q.3.3: Per PDU session of the UE**

SA2, if needed.

### **Q.3.4: Per Application of a UE**

SA2, if needed.

### **Q.3.5: Network slice**

SA5

### **Q.3.6: Renewable energy info**

SA2

## **19 – NEC Europe Ltd**

**Q.3.1: Average per UE** - not applicable (no requirement)

**Q.3.2: Per specific UE** - SA2

**Q.3.3: Per PDU session of a UE** - SA2

**Q.3.4: Per Application of a UE** - SA2

**Q.3.5: Network slice** - SA2.

**Q.3.6: Renewable energy info** pass

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## **3 Summary**

This clause provides a summary of the discussion.

### **3.1 Companies inputs on Question #1**

- **Total 20 responses collected**

**Table 4: (Summary of inputs) Q1. Collection and calculation of User Plane energy consumption**

<b>Energy consumption granularity</b>	<b>SA2</b>	<b>SA5</b>	<b>Not Needed</b>
<b>Q.1.1:</b> Average per UE	2	6	<b>13</b>
<b>Q.1.2:</b> Per specific UE	<b>16</b>	4	0
<b>Q.1.3:</b> Per PDU session of the UE	<b>14</b>	5	3
<b>Q.1.4:</b> Per QoS flow of the UE (including per application)	<b>15</b>	4	2
<b>Q.1.5:</b> NF (only UPF and gNB)	3	<b>17</b>	1
<b>Q.1.6:</b> Network slice	4	<b>17</b>	1
<b>Q.1.7:</b> Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)	<b>10 (4+6**)</b>	<b>12 (6+6**)</b>	1

\*\* : the same work split for (Q.1.1~Q.1.6) can be applied for the collection of renewable energy info.

- It is observed that the majority of companies do not see the need for collecting 'average per UE' energy consumption information.
- For the UE related granularities (Q.1.2/Q.1.3/Q.1.4), the majority preferred to work on the issue in SA2.
- For the 'per NF' and 'per network slice' granularities, SA5 is preferred to take the responsibility.
- For the collection of renewable energy information, companies proposed to split the work between SA2 and SA5 applying the same decision as for the collection of the normal energy consumption information.

### 3.2 Companies inputs on Question #2

- **Total 19 responses collected**

**Table 5: (Summary of inputs) Q2. Exposure of energy-related information to 5GC NF**

<b>Granularity of exposure</b>	<b>SA2</b>	<b>SA5</b>	<b>Not Needed</b>
<b>Q.2.1:</b> Average per UE	1	7	<b>12</b>
<b>Q.2.2:</b> Per specific UE	<b>15</b>	3	0
<b>Q.2.3:</b> Per PDU session of the UE	<b>13</b>	4	1
<b>Q.2.4:</b> Per QoS flow of the UE (including per application)	<b>13</b>	3	2
<b>Q.2.5:</b> NF (only UPF and gNB)	3	<b>17</b>	0
<b>Q.2.6:</b> Network slice	4	<b>15</b>	2
<b>Q.2.7:</b> Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)	<b>9 (3+6**)</b>	<b>11 (5+6**)</b>	1

**\*\* :** *the same work split for (Q.1.1~Q.1.6) can be applied for the collection of renewable energy info.*

- It is observed that the majority of companies do not see the need for exposing 'average per UE' energy consumption information to 5GC NFs.
- For the UE related granularities (Q.2.2/Q.2.3/Q.2.4), the majority preferred to work on the issue in SA2.
- For the 'per NF' and 'per network slice' granularities, SA5 is preferred to take the responsibility.
- For supporting the exposure of renewable energy information, companies proposed to split the work between SA2 and SA5 applying the same decision as for the case of the normal energy consumption information.

### 3.3 Companies inputs on Question #2

- **Total 19 responses collected**

**Table 6: (Summary of inputs) Q3. Exposure of energy-related information to Application Function**

<b>Granularity of exposure</b>	<b>SA2</b>	<b>SA5</b>	<b>Not Needed</b>
<b>Q.3.1:</b> Average per UE	1	<b>8</b>	<b>11</b>
<b>Q.3.2:</b> Per specific UE	<b>17</b>	1	0
<b>Q.3.3:</b> Per PDU session of a UE	<b>14</b>	2	4
<b>Q.3.4:</b> Per Application of a UE	<b>18</b>	1	0
<b>Q.3.5:</b> Network slice	5	<b>16</b>	1
<b>Q.3.6:</b> Renewable energy info (The question applies to all granularities above. Your answer needs to be provided for each granularity.)	<b>11 (4+7**)</b>	<b>10 (3+7**)</b>	1

**\*\* :** *the same work split for (Q.1.1~Q.1.6) can be applied for the collection of renewable energy info.*

- It is observed that the majority of companies preferred to either work in SA5 or not proceed to support exposing 'average per UE' energy consumption information to an AF outside of 5GC.
- For the UE related granularities (Q.1.2/Q.1.3/Q.1.4), the majority preferred to work on the issue in SA2.
- For the 'per network slice' granularity, SA5 is preferred to take the responsibility.
- For supporting the exposure of renewable energy information, companies proposed to split the work between SA2 and SA5 applying the same decision as for the case of the normal energy consumption information.