**ETIP SNET Virtual Workshop**

**R&I priorities strategy Agendas for a common path toward Energy Transition in 2050**

**on 18.06.2020**

ETIP SNET strongly believes that collaboration among all sectors of the energy system is crucial to meet the 2030 and 2050 targets set up by then European Commission toward the energy transition.

In order to strengthen the already existing collaboration and to create new links with other ETIPs and PPPs (and future Partnerships under Horizon Europe), ETIP SNET hosted a virtual workshop with: ETIP Wind, ETIP PV, ETIP RHC, ETIP BATTERIES, ETIP DEEP GEOTHERMAL, PPP SPIRE, EFFRA, EGVI, FUTURE INTERNET, CYBERSECURITY, CET, and European Associations ENTSO-E, E.DSO, FACTORY OF THE FUTURE, ERANET REGSYS, ESMIG, T&D EUROPE, EMIRI, EASE AND EERA.

As key industry-led communities along the innovation chain, each ETIP and PPP (and the future Partnerships) are contributing to identifying R&I priorities for medium- and long-term strategies.

In view of defining the specification for all R&I needs for the energy transition in Europe and for meeting the goals of the Green Deal, ETIP SNET strongly believes that this virtual workshop has been a great and unique occasion for ETIPs and PPPs to meet, present and match their own R&I priorities / Strategic Agendas

During the workshop **the priorities identified by ETIP SNET in the 10year Roadmap and Implementation Plan 2021-2024, and the R&I priorities of the invited ETIPs and PPPs and see how their priorities can connect with ETIP SNET priorities and support and collaborate toward the energy transition in 2030-2050 has been shared.**

ETIP SNET presented its R&I Roadmap 2020-2030 with identified R&I priorities and the range of impacts suited to achieve a specific purpose, called Functionalities, that have been used as basis for the ETIP SNET R&I Implementation Plan 2021-2024 published mid-May. Five Virtual Parallel sessions took place to discuss about common proprieties and way to collaborate and interact.

The outcome of this workshop is represented by this REPORT where you can find all the key points reached after each parallel session and gather together in the same document the points of view and feedback of several ETIPs, PPPs, European Associations and European Initiatives, to be presented to the European Commission.

**Key points from the 5 Parallel Sessions:**

**The general scope of the Workshop and of the 5 Parallel sessions is** to explore the potential synergies between the ETIP SNET priorities and the priorities identifies by other ETIPs as well as by relevant PPPs, European associations and other Initiatives. In particular, strengthening mutual cooperation, towards the common overarching goal of energy transition in 2030-2050.

**Parallel Session 1 – The Efficient and Flexible Organisation of Energy Systems**

**Moderator: Antonio Iliceto**

*Technical Advisor: Coralie Badajoz*

As base of this parallel session 1, there are three Functionalities related to the ”Efficient and Flexible Organisation of Energy Systems” - one of the ETIP SNET 2050 Vision building blocks>

1. F1 The Efficient and Flexible Organisation of Energy Systems,
2. F2 Cross-sector integration,
3. F3 Integrating the subsidiarity principle – The customer at the center, at the heart of the Integrated Energy System.

For each Functionality, the main achievements expected by 2030 according to the ETIP SNET Roadmap have been briefly summarized

The session had 3 rounds of discussion:

1. *Towards the development of Market Design and Governance for provision of Ancillary services, for storage owners, for large scale demand response, etc.*”.
2. “*Towards the development of Protocols, standardization and interoperability for Interfaces, Communication, etc* ”.
3. “*Towards an Integrated energy system architectures (design including new materials and hybrid AC/DC grids)*”.
4. ***Towards the development of Market Design and Governance for provision of Ancillary services, for storage owners, for large scale demand response, etc.*”.**

The main priorities of ETIP SNET 2021-2024 Implementation Plan are reminded below (non-exhaustive list):

* Market rules and coordination mechanisms for provision of ancillary services by aggregated storage and virtual power plants, comprising RES, flexible thermal generation (small and micro-CHP), heat-pumps, EVs, etc.
* Market design and data interchange management for the provision of ancillary services between DSOs and TSOs through coordinated communications, coordinated smart metering and platforms, and considering physical grid constraints.
* Market design for storage owners and operators, including of EV, pricing mechanisms, economic evaluation of different grid services provided, optimisation of utilisation of multi-stake services.
* Market design and market operator platforms for thermal storage in electricity and heating markets

**After this first discussion, priorities were drafted and validated with the audience (including representative from ETIP Battery WG6)**:

* Aggregate the storage behind or before the meter / the storage shall contribute to the overall system (EV, etc.)
* **Demand response**: need proper valorization for the systems and the users (need pricing, tariffs and how to measure it).
* Systems need to **be observable** based on well functional **models** operationally available representing the complex system operated;*for operators (D and T) to be able to do effective assets planning, operational planning through analyticaltools and controllers*
* Addresse t**echnical issues** to coordinate the systems (distributed vs centralised control, stochastical techniques of control, sensors, etc.)
* Thermal storage shall be considered within the domain of integrated sectors.

1. **“*Towards the development of Protocols, standardization and interoperability for Interfaces, Communication, etc* ”.**

The main priorities of ETIP SNET 2021-2024 Implementation Plan are reminded below (non-exhaustive list):

* Data exchange protocols / interfaces for a well-functioning market between all players. Protocols for stochastic model-based handling of market operations on different timescales. Common, standardised models for encrypted and authenticated market orders.
* Standardized communication protocols and ICT infrastructure between devices and networks and also between devices and remote management platforms to meet requirements of network operators, retailers and aggregators. Interoperability for devices and actors of the integrated energy system (e.g. prosumers, connected buildings, DSO, storage, RES, PV, EV) etc.
* Communication interfaces of smart substations, especially on LV secondary substation level (interfaces for internal substation components and between substation with upper level and information systems, like EMS, SCADAS, legacy systems, etc.).

**After this second discussion, priorities were drafted and validated with the audience (including representative from ETIP Battery WG6)**:

* From a distribution system point of view, regarding storage: a lot of pilots and demo projects, but no private investments on pure market basis => The regulation shall be developed and define what is the real market environment to foster the definition of business cases.
* Need to standardize interfaces and develop seamless platforms between storage owners, DSO and aggregators, between aggregators and the markets.
* **ETIP Battery (WG6)** 
  + Need demonstrations focusing on BESS interoperability leading to a marketplace for new services
  + Need Services around the battery (service stacking, more R&D efforts on EMS, etc)

1. “*Towards an Integrated energy system architectures (design including new materials and hybrid AC/DC grids)*”.

The main priorities of ETIP SNET 2021-2024 Implementation Plan are reminded below (non-exhaustive list):

* Model of the energy system including all major energy carriers, encompassing the whole energy chain from prosumers, energy communities, e-transportation, distribution and transmission grids (LV, MV, HV), national and regional electrical and gas exchange, with clear boundary interactions
* Proper balance between large interconnected grids and decentralised, modular control architectures for real-time voltage and frequency control (including AC, AC/DC hybrid and DC microgrids, local storage, smart transformers) utilizing flexibility from all energy carrier systems.

**After this third discussion, priorities were drafted and validated with the audience (including representative from ETIP Battery WG6)**:

* How DC can come back into buildings and energy community mini/micro grids
* AC/DC hybrid systems becoming more relevant
* Need to coordinate the control actions that can be done locally
* Basic rights of the consumers to belong or not to an energy community creating a local monopoly
* Keep the grid from technical point of view as a territorial monopoly independently-owned, to avoid duplication of assets

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**Parallel Session 2 - Markets as key enablers of the energy transition**

**Moderator: Natalie Samovich**

*Technical Advisor: Athanase Vafeas*

As base of this parallel session 2 there are two Roadmap Functionalities related to the **“Markets as key enablers of the energy transition”** - one of the ETIP SNET 2050 Vision building blocks:

* F4 Pan-European wholesale markets, and
* F5 Integrating local markets (enabling citizen involvement).

For each Functionality, the main achievements expected by 2030 according to the ETIP SNET Roadmap have been then briefly summarised.

The session had 4 rounds of discussion:

1. Towards a better understanding of the **adaptation** of the energy behaviour of the demand
2. Towards novel, multi-sided **Business models** dedicated to each stakeholder in the electricity value chain and beyond
3. Towards Cross-border, **Coordinated schemes** for **market design** at each level of relevance (pan-EU, dedicated markets)
4. Towards a secure and efficient **Data** management along the value chain
5. Towards a better understanding of the **adaptation** of the energy behaviour of the demand

The first Discussion Round, focusing on a better understanding of the adaptation of the energy behaviour of the demand, the priorities of ETIP SNET 2021-2024 Implementation Plan were introduced in the form of:

* Methods and tools to support consumer and prosumer energy behaviour adaptation: online measurements and behavioural studies to analyse non-energy benefits (comfort, security, etc.)
* Methods and tools, including campaigns to support the industry's consumption adaptation in order to support the system.

Additional questions were brought by the Moderator to fuel the discussion on incentives, active modes of participation or on the conditions upon which multi-sided markets could facilitate more engaged participation.

The following highlights emerged from the first discussion:

* A first discussion was centered around completeness of the topics presented in the Implementation Plan (are we missing anything?)
* The audience approved the new emerging feature for the market design for putting the consumer at the centre - which was a core concern of ETIP SNET. Having a high priority for this topic is very positive for the group. Indeed, clear progress emerges on how to involve small consumer and prosumers.
* Another positive reaction was on the increased priority given to behavioural questions: they have often be forgotten, and this is interesting to see them valorised.
* It was believed by the group that incentives for energy behaviour adaptation would favour this shift.
* On the question on how to motivate consumers to use less energy, it was observed that the motivation question should also include the choice of the green electricity, but such option is limited by its feasibility, visibility as to the source is not available and choices are limited.
* A debate took place on the metrics for the incentives (what about an incentive giving economic advantages to the technologies with the largest IRR. The rationale was based on the fact that as of today, we have only the price for selecting the type of energy/technology. Other types of indicators could then be foreseen to include environmental indicators to that choice. This question ended with the observation that the adaptation of the technology choice and of the modification of the investment activity is already assessed in considering economic advantages but also non-energy related benefits, spill over effects

1. "Towards novel, multi-sided Business models dedicated to each stakeholder in the electricity value chain and beyond”

topics were introduced by the Moderator on the need to have Business models adapted for each type of stakeholder (including prosumers providing Ancillary Services, retailers & aggregators, data analysis service providers, storage in electrical transportation networks, gas-fired or biomass-fired CHP units). Additional questions were proposed to the audience, such as the smart sector integration and about the best way to manage the interface/interaction of potential overlaps (e.g. industry side also matters with green energy markets).

About the novel, multi-sided dedicated Business models, the main highlights that emerged include:

* Multi-sided business models and multi-sided flexibility are expected to be a central topic.
* The integration of the multi-sided features in a bigger market is expected to be a topic of the future linked with sector integration.
* For Hydropower sector, there is a strong need to work on business models for a black start, balancing the grid and reserve capacity. Is hydropower sufficiently compensated for providing flexibility?
* Sector interfaces/integration and market adaptation of all components have to be considered as well as market coupling.
* Last question related to the conditions to monitor and get more significant insights as to adaptation of the energy behaviour of the demand side (consumer/prosumer; industry)

1. Towards Cross-border, **Coordinated schemes** for **market design** at each level of relevance (pan-EU, dedicated markets)

It was first reminded that these levels include the pan-EU level and the levels of dedicated markets. Then the priorities from the Implementation Plan were presented to initiate the debate with a generic question on the priority from the point of view of each participant:

* Pan-EU market design to foster the integration of large-scale RES, storage, Demand Response, Electric Vehicles (EV) in coordination with network operations
* Market design for TSO with cross-border coordination and involving multiple DSO, aggregators, and multi-operation zones
* Market rules and coordination mechanisms for providing Ancillary Services by aggregated storage and Virtual Power Plants (comprising RES, flexible thermal generation, heat pumps, EVs,..)
* Design of local markets and retail P2P markets for Local Energy Communities with power balancing and coordinated LV/MV technical grid control
* Market design for large scale demand response beyond electricity
* Market design for storage owners and operators.

As a result of the discussion, the key highlights were addressed:

* Market rules and coordination mechanisms providing Ancillary Services encompass a generic dimension and a local dimension.
* For the coordinated schemes, there are several nice EU projects that explore reserves, and it is well proven that they are able to lower the costs for neighbouring TSOs, and TSO/DSO collaboration.
* If TSO/DSO are involved, it appears however difficult to see how a local DSO could provide this to other DSO in a different geographic area or a member state.
* Interfaces are clearly needed with communication systems and protocols between grid operators and services providers.
* A priority ranking was then proposed to conclude based on the coverage of these issues by current EU funded projects. The 1st 2nd and 3rd bullet points above mentioned[[1]](#footnote-1) are being already addressed by large projects, while for the 4th and 5th bullet point[[2]](#footnote-2), it is observed that not so many projects have been launched and that this should be a priority for the next future R&I agenda.

1. Towards a secure and efficient **Data** management along the value chain

Priorities extracted from Implementation Plan deal with

* Data exchange protocols/interfaces for a well-functioning market between all players (stochastic model-based for handling market operations on different time scales; common, standardised models for encrypted and authenticated market orders)
* Methods for data protection for management of DER
* Risks of using public ICT and wireless infrastructures for smart grid functionalities (e.g. smart meters, energy boxes).

The audience took the chance to propose some priorities: All three priorities were identified as relevant to participants, while the 3rd one -risks of using public ICT and wireless infrastructures for smart grids functionalities - remains a central topic, at least for Germany (concerning the roll-up of smart meters).

Main highlights were formulated on important issues that could be kept in mind for the preparation of the next calls.

* How to compare these risks in a benchmark across different Member States?
* Presence of the two interconnected networks: digital and interconnected network. Both are to stay Data value chains; data protection is of essence.
* Other key topics include data access and the impact of large-scale analytics and Artificial Intelligence enablement across data value chains.
* Data analytics should deserve much attention. Forecasting is important but not only on the generation side but also on the demand side (for DSM), needs for risk management procedures, probabilistic approach.

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**Parallel Session 3 - “Digitalisation enables services for the integrated energy systems”**

Moderator: Maher Chebbo, Chair ETIP SNET WG4;

Technical Support: Rainer Bacher

As base of this parallel session 3 there is one Functionality F6 which links to the ETIP SNET 2050 Vision building block BB3 “Digitalisation enables services for the integrated energy systems”, being the focus of this session, with one single associated FUNCTIONALITY **F6: Integrating digitalisation services (including data privacy, cybersecurity).**

The distinction between the Research Areas (each with associated research sub-areas / TOPICS and tasks) and the Functionalities:Functionalities are representing “range of impacts suited to achieve a specific purpose”; here for contributing to realise the “Building Block 3”. On the other side a research area with its Research Sub-areas (identical to Topics as called in the ETIP SNET implementation plan) describe “The research activities to be conducted in the reference period are organised in this roadmap”. I.e. FUNCTIONALITIES are there to describe the effects of the activities in the research areas in order to realise the integrated energy system of the year 2030 and later.

In the introduction of this session 3, for each of the 12 Functionalities, the main purposes expected by 2030 according to the ETIP SNET Roadmap have been then briefly summarized.

This session 3 is about achieving the Functionality F6 and the Building Block 3 by 2030. All Research areas with their 24 Research Subareas / TOPICS with the in total 120 task contribute to this functionalities F6, Details are given in the most recent ETIP SNET Implementation plan 2021-2024[[3]](#footnote-3).

The moderator introduced the purposes of FUNCTIOALITY F6, being among other “Digitalisation enables new services: Transition via 2030 towards 2050” with shared platforms, aggregation, decentralised control techniques, services, real-time balancing and resilience at various time-frames and regional aggregations. These services must bone fully respecting “Rights for privacy”. Also, integrated energy systems must not be vulnerable to any kinds of cyberattacks, understanding already now that the massive application of technologies such as IoT will increase the challenges dramatically.

2 rounds of discussion took place:

1. **Priorities “Digital Technologies”**
2. **Priorities “Digital Use Cases”**
3. Priorities “Digital Technologies”.
   1. Making **communication standardised and interoperable**
   2. Providing **data protocols for data exchange**
   3. Monitoring and control of **distributed generation**
   4. Integrating **digital twins** for system control (platforms)
      * Data predictions to be made
   5. Providing **decision making tools for TSO and DSO**
   6. Providing **Cybersecurity protection** of grid infrastructures
   7. Handling **Smart Meter Data** and **Big Data**
   8. Adapting and using **IoT technologies**
   9. **Data Storage** architectural schemes
   10. Managing legacy **SCADA**

A lively discussion was started by the representative of the EC who mentioned the urgent need to make links between the various ETIPs and PPPs and that isolation of R&I must be avoided in all circumstances. The ETIP SNET contributions are important for the EC also to increase knowledge on evidence about what types of policies are needed.

Gareth Bissell (ENEL) discussed point 1 of the above priority list “Communication to be standardised and interoperable”. This point is important, however, perhaps even more important is the fact that “Smart Applications must be more standardised and interoperable”. He specifically referred to applications for trading, markets, operations: for these applications, application interoperability is key. It is recommended to ETIP SNET to highlight this aspect of “application standardisation needs” even more. The SGAM is a “Smart Grids applications model” with application layers, physical layers, etc and should serve as excellent example. At the bottom of the SGAM, there are the “devices”. But the fact that standardisation is not only about devices (Hardware) should be made clear in the presented list of priorities 1 – 10.

This was confirmed by the session 3 moderator: Accelerating digitalisation needs standardisation and interoperability. Smart Grids need a “reference architecture on Smart Grids”. IT/OT also needs standards for real-time systems. Digital twins need to be made in such a way to enable easy exchange of data with other digital twins. The moderator also mentioned CEN/CENELEC standards such as M144/490 for Smart Metering and Grids and that exchange with US-Groups on Smart Grids is ongoing. In addition, IEC – CIM efforts for Business to Business applications must be integrated and are urgently needs to achieve full digitalisation. Clearly, technologies must be integrated in such a way that doing changes becomes economic and costs less money. This can only be achieved if standards are available.

The representative of BAAM-Consulting asked if the work towards achieving the “digitalisation functionality” also includes the corresponding legislation work. For example, the TSO-DSO interface needs to be fully digitalised, but to succeed this need supporting legislation.

The moderator mentioned that technologies are realised by being embedded in “social innovation”. This can lead to new policies. The work for this, however, is in the other Research areas (other WGs of ETIP SNET) all contributing together to achieving the five ETIP SNET Building blocks with their 12 FUNCTIONALITIES. Privacy, Security, Cybersecurity (which were a key topic in the early “Smart Meters” discussion) have all already influenced policies at EC level. Currently, the work of the ETIP SNET WG4 towards achieving Functionality F6 and Building Block 3 discussed in this session is not focusing on policies.

The representative of Siemens – being a major equipment manufacturer for integrated energy systems including the monitoring and control systems – mentioned the issue of “Making Hardware and Software cleaner”, meaning: increasing performance, making them less failure prone, etc. He asks if this important issue is included in the priority list 1-10 related to digitalisation, i.e. is this issue a task of Research Area 3? Or is it a task the research areas related to “control of distributed systems”? He also mentioned that handling “old systems” in parallel to modern, digitalised system parts should be another priority which should be put as separate bullet on the list. Also, more emphasis could also be put on “Digitalisation around the hardware, e.g. for increasing wind turbine blade efficiency with thousands of sensors in such units and where the goal is e.g. to decrease failure rates in the future.

The moderator mentioned that R&I is needed for collection of massive data with follow-up data analysis and learning from “big data”.

This question introduces the part B of this session 3, which concentrates on the aspect of “use cases” (see below in this report)

A question was asked how the efforts of ETIP SNET on digitalisation connect to other big initiatives such as “Gaia-X” and the fact that there are many ongoing similar initiatives: How will the connection be done?

The moderator referred to the Use case on “sector coupling” of ETIP SNET WG1 which clearly intends to link and connect to these corresponding other initiatives. Also the recent “Big idea” efforts of ETIP SNET WG4 is about linking with other initiatives: Innovation linking with e.g. the EV automotive sectors. Digitalisation - unlike Hardware - cannot be done in vertical silos. Digitalisation is about connecting and integrating across the whole energy system. I.e. value creation in digitalisation occurs by going cross sectors, e.g. by linking electricity with buildings, linking heating/cooling and gas, linking electricity systems and mobility, etc.

The discussion then came back to part A “Digital technologies”. The moderator highlighted the need to present more details and mentioned the white papers of the ETIP SNET WG4 with more details on Use cases and also the latest ETIP SNET Implementation plan (IP) 2021-2024[[4]](#footnote-4) which gives more details on challenges, scopes, tasks that need to be investigated in R&I projects. The IP also includes expected impacts, the expected outcomes of R&I projects working on each of 24 TOPICs related to knowledge; algorithms, software, models and tools; and demonstration-related outcomes.

Gareth Bissel (ENEL) emphasised that the aspect of “digital twin” may need more clarification, and that this is not only about simulation. He emphasised that this should also include aspects of “Hardware in the loop (HIL)”. Examples of HIL applications are for HVDC links, power electronics for control. Simulation and HIL must go together to be impactful and robust.

The moderator clarified that according the ETIP SNET, the term “Digital Twin” does not only stand for simulation and software; Digital twin also refers to Hardware which needs to be part of a digital twin. All kinds of digital twins are needed: Digital twins of wind turbines, of the networks (electricity and other energy carriers), of sub-stations, of transformers, of Smart meters and in general, of the overall value chain. Digital twin approaches must be developed to cover the overall life-cycle from design side, from operation, from de-commissioning. R&I must be enhanced so that the data of digital twins can be updated easily and efficiently. Indeed, the list of Use cases could be enhanced by one focusing on “Advanced HIL capabilities”.

Stephan Wilker (TU Wien) mentioned that the role of the “Emerging Energy communities” may need to be enhanced in relation to digitalisation and compared to the presented current priority list B. How can customer participation become an active part of the market? Communication must be standardised and be supportive for customers moving from location to the next oney; solutions are needed so that previously owned and used (energy) assets and digitalisation environments can be moved from one living place to the next one even with a different grid operator and different energy suppliers, new energy community environments, etc.

The moderator agreed on the importance of energy communities and mentioned that in the priority list B, stakeholders are meant to refer to all kinds of customers: they can be energy communities which are connected or not to the grid. Open, scalable and standardised, interoperable IT platform solutions are needed to enable communities in their efforts to become autonomous, fully democratised as also worked out by the task force on energy communities of the EC.

ETIP Batteries commented that they are also working on many of the ETIP SNET topics related to storage.

The moderator agreed that digitalisation of batteries must be strengthened. ETIP SNET WG4 works on “Digital battery Use Case” such as Digital passport for batteries including a carbon foot print; Battery manufacturing; Properly recycling batteries; battery maintenance; battery life-cycle; batteries to be integrated into energy system including battery flexibility service needs.

1. Priorities “Digital Use Cases”.
   1. Digitalising **smart appliances**: making demand and generation flexible
   2. Digitalisation to **enable flexibility**: in grid technologies; by Load Shedding; in secondary substations;
   3. Digitalisation to **enable the provision of ancillary services** by prosumers
   4. Developing **State of Health (SoH)** estimates of transmission system components;
   5. Digitalisation to enable **condition-based planning LV/MV based maintenance**;
   6. Developing **models and digitalisation** to detect component failures;
   7. Digitalising **buildings, living quarters (islands)** for stand-alone operation
   8. Developing processes for **intentional islanding**;
   9. Providing RES and Hydropower **forecasting**;
   10. Digitalisation to enable self-healing electricity / energy systems
   11. Digitalisation to enable **Wide Area Monitoring and Control Architecture** for **Transmission** Systems;
   12. Developing **Energy Management platforms**
       * for TSOs interaction with local markets;
       * for enabling DSOs active participation of customers in energy market interoperability;
   13. Developing **control center architectures for distributed network control**;
   14. Developing **training simulators** for DSOs and TSOs using Digital Twins;
       * Advanced MMI (Man-Machine-Interface);

Gareth Bissell (ENEL) asked if this list of Use cases is clear enough to show the depth of necessary R&I. He mentioned that “More formalisation is needed for Use cases”. R&I must be made aware that IEC has already created formal approaches for use cases so that Use cases can be enduring, can be shared, can be in repositories, can be applied for any kind of digitalisation. Any kinds of use cases can be created by applying the already existing formalisations. It is indeed important that Smart appliances on the level of devices are made flexible and interoperable. But is even more important that the application level is formalised and standardised so that applications such as asset management and condition monitoring can be done efficiently, realised quickly by scalable and replicable applications. For this to happen, it is strongly recommended to apply the SGAM (Smart Grids Application Model) with its reference layer approach supporting applications, interoperability on different layers.

The moderator agreed and mentioned that the association ESMIG has recently defined 17 Use cases just for Smart Metering, such as for the “Capability to make pre-payment”, for “Customer-related demand response management”. All key processes must be defined by a formalised approach. This must include: Who are the stakeholders involved? What are the benefits? Referring to the priority list shown above, this links to points 4: Asset health, 5: Maintenance (condition based planning and maintenance), 7: Sector coupling with transformations towards smart building. All must be formalised as Use cases. Also, many use cases will be needed for demand flexibility involving residential and commercial customers. The SGAM reference layer approach is very important and more related R&I work must be done. Other examples of key priority efforts are mentioned in the list shown before. More Lighthouse projects must be undertaken and funded with the goal to link parts of systems together. R&I must contribute to knowledge about what systems and pieces of systems need to be connected. The goal must be to make deployment and use as easy as possible for customers e.g. by enabling easy access to platforms. Such platform must become one-stop shops. ETIP SNET WG4 will continue to work out guidelines and principles related to these issues. Engagement in ETIP SNET WG4 is strongly encouraged.

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**PARALLEL SESSION 4 :“*Infrastructure for integrated energy systems as key enablers of the energy transition”***

**Moderator: Norela Constantinescu, Co- Chair ETIP SNET Working Group 4;**

**Technical Support: Michele De Nigris**

The Session 4 has been focused on the infrastructures for energy transition towards 2050, and it deals mainly with 3 Functionalities of the ETIP SNET Roadmap (RM) 2020-2030.

* **F7** (Electricity Systems and Networks): the **“Upgraded electricity networks, integrated components and systems” functionality** is important in relation to the growing electrification and the more decentralized deployment of renewable power generation, that will require reinforced and smarter electricity networks, able to accommodate both centralized and decentralized elements and to make the best of RES allocation over the European territory. Pervasive network digitalisation, supported by high-capacity cyber-secure communication networks, will ensure decentralized monitoring and control. Not only density of the network, but also interconnection capacities –with harmonized security, planning and operation standards- will be needed to match growing RES supply and electricity demand over larger areas, as well as transparency to market participants all over Europe.
* **F8** (Business): the **“Energy System Business (includes models, regulatory)” functionality** is a direct consequence of the functionality F7, which requires new forms of business models, of regulatory rules. Business models are constantly to be adapted in real-world business. F8 includes Business models, market design, regulatory rules, market governance, business models adapted to energy and computer- ICT- and monitoring and control system architectures, managing grid-connected flexibilities and their optimal aggregation.
* **F9** (Simulation tools): the **“Simulation tools for electricity and energy systems (Software)”** functionality is (besides F8) a direct consequence of the F7, which requires new simulation tools and simulation results of electricity but also energy system beyond electricity. F9 includes Short-term market-related simulations including for handling security issues of all kinds, long- and medium-term integrated energy-system (heating and cooling, gas) and electricity system planning related models and simulations, electricity system congestion and stability-handling tools for all time intervals from seconds to hours; electricity system analysis, observation and optimisation tools and software; system-control-related model-predictive simulations and optimisations of the electricity system and life-cycle related ageing simulations.

These 3 Functionalities (F7, F8 and F9) are related with several **specific Research Areas** (RAs) and Research Sub Areas (RSAs) of the RM they contribute to. In particular they deal with:

* RA1. consumer, prosumer and citizen energy community (F7, F8)
* RA 2. system economics (F8)
* RA 3. digitalization (F7)
* RA4: planning - holistic architectures and assets (F7, F9)
* RA5: flexibility enablers and system flexibility (F7, F9)
* RA6. system operation (F7, F9).

The picture here below has been presented, in order to efficiently illustrate all the RSAs contributing to the discussed Functionalities.



The discussion has been guided based on 3 Topics (related to the mentioned Functionalities), in order to understand:

* how the participating stakeholders (ETIPs, PPPs…) could contribute to ETIP SNET priorities and
* how the ETIP SNET priorities could fit to their (ETIPs, PPPs…) agenda:

The 3 Topics have been structured as following, accordingly with the Functionalities around 3 discussion rounds:

1. architectures and assets;
2. business models, regulation and legislation;
3. control and operation.
   1. **DISCUSSION A: ETIP SNET priorities on architectures and assets:**

The discussion on this topic has been developed touching some key points related with the importance of planning and siting network flexibility sources streamlined permitting. The analysis of the aspects related to RES (and conventional) generation flexibility (forecasting, integration and operation, synthetic inertia) has been considered. The importance of the innovative components (functions HVDC meshed systems, sustainability, circularity, reliability under extreme conditions, remote monitoring) has been highlighted, as well as of the advanced asset management (sensors, degradation models, risk assessment, end of life).

***Main contributions to the discussion A (Q&A):***

The contributions received can be grouped following 3 main topics: planning, assets and standards:

**Planning:**

Considering the architectures and protocols for the planning of systems of the future, the **interoperability issues** have been mentioned and discussed. As main output/need, the identification and application of specific standards and protocols have to be managed for enabling the different needed functionalities (i.e. connecting the different types of devices) as for examples DER, DR etc., using combinations of centralised and decentralised control. Addressing communication channels is also a tool to reach this goal.

About the control and flexibility to deliver services to TSOs, the lack of regulation legislation on this topic is a key issue. As an example, the contribution of the PARITY PROJECT has been provided: there is a need **of concrete rules to monitor the real services delivered.**

About the integrated planning of the integrated energy system, including in coordination, planning of the electric grid and other networks (e.g. gas grid, to enable to sector coupling), it has been clarified that from the ETIP SNET point of view, **planning in parallel transmission of electricity and transmission of gas** **will evolve in a more interlinking the models and including other sectors**

**Assets:**

Concerning the assets, it has been mentioned the preference of using the existing assets (they could be enhanced by a process of digitalisation). New developments (e.g. offshore developments) and new technologies (e.g. new technologies for electricity transmission (e.g. HVDC, HTS)) are needed.. Concerning the **AC/DC systems and hybrid systems** – and in specific the interaction of AC and DC systems – the need of control and protection systems have been stated. Specific mention has been given to the role of **circularity** of new equipment and materials.

**Standards:**

From the discussion, a key point was that the time period of standardisation is often too long with respect to the pace of development and application of digital technologies (e.g. digital twins). Often technologies and solutions are developed and applied before the related standard even exists.

The **importance of development of standards** has been discussed. In particular with reference to thenormal standardization development track this lasts normally 36 months (i.e. in fact not too long with regards to the development paths of industrial products), a solution could be found in improving the process, through a more active participation of the most interested stakeholders in the process.

**The solution could be to focus on really extremely important and sector widespread standards first, such as 61850 – CIM etc.**

Theadoption and fostering of the **USE CASE approach** could be promoted:addressing use cases similarities will foster the development of new applications and functionalities, shortening the time to market.

* 1. **ETIP SNET priorities on business models, regulation and legislation:**

The discussion on this topic, was aimed to analyze the possible need of upgrading the regulatory and legislative framework for infrastructure. It has been touched the centralised and decentralised integration of RES and its impacts on planning, operational planning (resilience) an operation. Then the business models for data analysis service providers to energy using large scale data bases and advanced data mining techniques has been mentioned.

***Main contributions to the discussion B(Q&A):***

# The feedbacks received on regulation & business models brought a contribution from the International hydropower association (Projects «Hydropower europe and X-flexhydro»), stated that hydro can ensure generation flexibility fit for network requirement, but regulation is needed for upgrading and modernising hydro plants turbine and generation (pumped storage).

Moving to the **market design** aspects,the need of **rewarding flexibility services not only generation** was discussed. About the business models, the importance of **regulation and legislation to remunerate flexibility** also important to foster investments towards flexible technologies. Business models are important for aggregated PV generators, needed regulation and legislation – flexibility services remuneration will help the developments in the RES technologies.

## DISCUSSION C: ETIP SNET priorities on control and operation

The discussion has been guided through several aspects, including; advanced system observability, monitoring and control (PMUs, protections) standards and interoperability, monitoring and simulation (digital twins), integrated control centres (cybersecurity), advanced controllability and stability assessment (e.g. inertia management, system estimation, power flow tools) and resilience toolbox (threats, vulnerability, contingencies, risks, restoration).

***Main contributions to the discussion C (Q&A):***

Synthetic inertia will be required to integrate DER and RES in the LV grid: this is important for integration of RES (which is interfaced to the system through power electronics). In the frame of this aspect, the discussion analyzed the opportunity to **design power electronics for synthetic inertia,** even if **costs will be higher.** An **adequate remuneration is needed.**

Deepening the RA related to the **remuneration of the delivery of synthetic inertia services,** some aspects have beenpointed out, i.e.: secure interfaces for controllable loads are required to ensure consumer side flexibility; higher costs of intelligent load control devices are again related to the question of remuneration of the services.

A further point about the use of **Digital twins** to simulate user behaviour and needs of flexibilities: DT can be used for the simulation of the integration of flexibility services by different customers and distributed resources.

**TABLE FOR COMMENTS/STATEMENTs**

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**Parallel Session 5 - Efficient Energy Use**

**Moderator: Alexander Wiedermann**

**Technical Support: Antonio Negri**

As base of the parallel session 5 there are three Functionalities related to the ”Efficient Energy Use”, one of the ETIP SNET 2050 Vision building blocks, being the focus of the Session:

* F10 Integrating flexibility in generation, demand, conversion and storage technologies,
* F11 Efficient heating and cooling for buildings and industries in view of system integration of flexibilities,
* F12 Efficient carbon-neutral liquid fuels & electricity for transport in view of system integration of flexibilities.

For each Functionality, the main achievements expected by 2030 according to the ETIP SNET Roadmap have been then briefly summarized

Three rounds of discussion took place:

1. Generation Flexibility”,
2. “Heating and Cooling”.
3. “Role of Cities in the energy systems integration”.
4. “Generation Flexibility”, illustrating the priorities of ETIP SNET 2021-2024 Implementation Plan as follows:
   * to define the rules of a “market for flexibility”, that supports the economic based management of all the kinds of flexibility resources
   * to increase the flexibility of Thermal Power Plants (operation, shift toward *green* fuels)
   * to develop suitable PtG, PtH, PtX technologies
   * to ensure adequate RES flexibility.
   * to ensure sufficient dispatchable power
   * to increase the role of Storage and develop a suitable market for storage services remuneration
   * to support de-carbonization of energy intensive industries.
5. The second Discussion Round, focusing on the big issue of “Heating and Cooling”. The ETIP SNET priorities for this theme have been summarized as follows:

* Flexibility potential from aggregated heating (and cooling) storage at household and building to provide system services
* Near-zero energy building (NZEB) shall be the standard for new constructions; these NZEB shall demonstrate a high degree of flexibility
* Household heating and cooling, due to its high share of total EU energy consumption, shall be a primary target for both RES and district heating and cooling (DHC) grids
* Integration of energy storage systems with conventional power generators (cogeneration, hydropower, thermal plants) to increase their flexibility and improve operation
* Increased exploitation of waste heat resources.

A discussion took place with contribution from some members of the ETIP Renewable Heating and Cooling (RHC) Platform. First of all the issue of “Cooling” has been raised by Prof. Fikiin from the Sofia University, suggesting that more attention and emphasis should be given to the integration of the issue into the energy system, making the best use of potential synergies with other energy generation technologies and demand pattern.

Marco Calderoni and Wim van Elden, both from ETIP RHC, confirmed the importance of Household Heating and Cooling, due to its high share of total EU energy consumption, and stressed the need for growing penetration of both renewable energy systems and District Heating and Cooling (DHC) grids. The importance of Heat Storage for the RES-based Heating & Cooling technologies has been stressed, being a key issue to comply with the demand pattern and, at the same time, contributing to the flexibility and stability of the network. DHC network and Electricity network shall be connected, in view of an effective energy system integration: Power-to-Heat technologies and Seasonal Storage can be key issues for that.

1. “Role of Cities in the energy systems integration”. The ETIP SNET priorities have been summarized by the Moderator as follows:

* to develop and demonstrate stand-alone (islands) buildings and living quarters, supplied by renewable generation, sector-coupling and storage components (e.g. P2hydrogen, P2G, P2H, P2fuels ….),
* centralized and distributed algorithms for efficient management of EV charging, supporting business-to-customers and business-to-business relationships and ensuring easy and secure payments for customers,
* energy management in transport electricity networks to provide ancillary services to DSOs via storage facilities in the substations of the PCC (point of common coupling),
* flexibility services offered by transport electrification (Grid to Vehicle GtV and Vehicle to Grid VtG) to distribution grid operation.

To conclude the Session, the Moderator showed some bullet points summarizing the priorities of ETIP SNET Implementation Plan with the comments and suggestion received from the audience as follows:

1. Flexibility is an issue of paramount importance both for fossil fired generation plants and for RES-based plants.
2. Fossil fired plants are (and will be) still necessary toward an effective energy transition. Fuel and operation flexibility, together with green gases availability, are key elements for such plants.
3. Storage and highly performing forecasts systems are the key elements to achieve RES-based plants flexibility.
4. Household heating and cooling, due to its high share of total EU energy consumption, shall be a primary target for both renewable energy systems and for district heating and cooling (DHC) grids.
5. Heat storage is necessary to the RES-based H&C technologies and will contribute to the flexibility and stability of the network
6. DHC network and Electricity network connection is needed; Power-to-Heat , Seasonal storage can be key issues for that.
7. Cooling issue in the energy system integration shall deserve more attention
8. Renewables self-consumption and renewable energy communities are key issues to reach EU de-carbonization goals.
9. Transport sector could give substantial contribution to the energy transition. Growing energy sectors integration will contribute to the switch toward low- and zero-carbon electricity and net-zero-carbon fuels.
10. The deployment of “smart” advanced publicly accessible and private recharging points for electric vehicles will ensure the efficient integration of vehicle charging into the energy system.

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1. respectively pan EU market design, market design for TSO with cross border coordination, coordination mechanisms for Ancillary Services [↑](#footnote-ref-1)
2. design of local markets and retail P2P market for LEC, or market design for large scale demand response beyond electricity [↑](#footnote-ref-2)
3. <https://www.etip-snet.eu/wp-content/uploads/2020/05/Implementation-Plan-2021-2024_WEB_Single-Page2.pdf> [↑](#footnote-ref-3)
4. <https://www.etip-snet.eu/wp-content/uploads/2020/05/Implementation-Plan-2021-2024_WEB_Single-Page2.pdf> [↑](#footnote-ref-4)