Connecting R&I priorities of ETIPs and PPPs for a common path to achieve the Energy Transition by 2050

ETIP SNET Virtual Workshop on 18.06.2020

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Connecting R&I priorities of ETIPs and PPPs for a common path to achieve the Energy Transition by 2050

ETIP SNET Virtual Workshop

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1. INTRODUTION

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, EERA and Hydropower Europe.

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 moved forward the clear need for ETIPs and PPPs to further collaborate and match the various R&I priorities and Strategic Agendas.

In the workshop, the priorities identified by ETIP SNET in the 10year Roadmap 2020-2030 and Implementation Plan 2021-2024, and the R&I priorities of the invited ETIPs and PPPs have been shared. The goal has been to create progress in connecting the priorities of the invited ETIPs and PPPs with ETIP SNET priorities and support and collaborate towards achieving the energy transition in 2030-2050.

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. These principles have been used as basis for the ETIP SNET R&I Implementation Plan 2021-2024, published mid-May 2020. In the workshop, five Virtual Parallel sessions took place to discuss about common priorities and ways to collaborate and interact.

The outcome of this workshop is represented by this report which brings forward the key points reached during each parallel session. The report gathers the viewpoints and feedback of several ETIPs, PPPs, European Associations and European Initiatives.

1.1 AGENDA

The Virtual workshop was structured in two plenaries sessions and in five Parallel sessions to discuss several aspects and Functionalities identified in the ETIP SNET Vision 2050 and in the ETIP SNET 10 years Roadmap 2020-2030.

All the topics discussed during the Plenaries and the five Parallel sessions are described in the draft agenda below:

<table>
<tr><th colspan="5">VIRTUAL PLENARY SESSION</th></tr>
<tr><td>14h15 – 14h25</td><td colspan="4">Welcome of attendees, AGENDA and explanation of the Virtual workshop tool – Maria Laura Trifiletti (ETIP SNET Coordinator)</td></tr>
<tr><td>14h25 – 14h30</td><td colspan="4">Opening speech - Guido Guida (ETIP SNET Chair)</td></tr>
<tr><td>14h30 – 14h40</td><td colspan="4">Keynote speech - Mark Van Stiphout (Deputy Head of Unit - Research and Innovation at DG Energy C2)</td></tr>
<tr><td>14h40 – 15h00</td><td colspan="4">ETIP SNET presentation of 10 Years R&I Roadmap 2020-2030 - Michele De Nigris (Director Sustainable Development and Energy Sources - RSE SpA)</td></tr>
<tr><th colspan="5">Virtual Parallel sessions
15h00 – 16h00</th></tr>
<tr><td colspan="5">General introduction by the supporting Core team: Explain the different Functionalities</td></tr>
<tr><td>The Efficient and Flexible Organisation of Energy Systems
(F1 – Cooperation, F2 - Cross sector, F3 - Subsidiarity)</td><td>Markets as key enablers of the energy transition
(F4 -Wholesale, F5 - Retail)</td><td>Digitalisation enables new services for integrated energy systems
(F6 - Digitalisation)</td><td>Infrastructure for integrated energy systems as key enablers of the energy transition
(F7- Networks, F8 - Business, F9 - Simulation)</td><td>Efficient Energy use
(F10 - Flexibility, F11 - Heating and cooling, F12 - Transport)</td></tr>
<tr><td>Moderator:
 
Antonio Iliceto
International Relations
Terna Rete Italia</td><td>Moderator:
 
Natalie Samovich
Head of R&I
Enercoutim</td><td>Moderator:
 
Maher Chebbo
GM & Senior Executive Digital Officer
GE Digital</td><td>Moderator:
 
Norela Constantinescu
Manager Research & Innovation
ENTSO-E</td><td>Moderator:
 
Alexander Wiedermann
Senior Manager with MAN Energy Solutions (MES)</td></tr>
</table>

Core team support: Coralie Badajoz	**Core team Support:** Athanase Vafeas	**Core team support:** Rainer Bacher	**Core team support:** Michele De Nigris	**Core team support:** Antonio Negri
Validation of key points with participants (last 15 minutes)	**Validation of key points with participants (last 15 minutes)**	**Validation of key points with participants (last 15 minutes)**	**Validation of key points with participants (last 15 minutes)**	**Validation of key points with participants (last 15 minutes)**
VIRTUAL PLENARY SESSION				
16h00-16h25	Key points from Parallel sections about identified common and separate priorities (presented by moderators – **5 minutes each panel)**			
16h25-16h45	Q&A			
16h45-17h00	Conclusion remarks - DG ENER – Michela Marasco (DG ENER Policy Officer) - ETIP SNET Support Team (Nikos Hatziargyriou . ETIP SNET Vice-Chair)			
17h00	*End*			

The scope of this report is to summarise the discussions and conclusions points of the 5 Parallel sessions.

In addition, an **on-line post event consultation** among all the registered and participants was carried out and left open for one month.

Several comments and statements from other ETIPs, PPs, and Associations have been received and they have been inserted in this Report in separate tables after each of the 5 parallel sessions.

These additional comments and statements are absolutely essential and useful as starting points for further discussions and next steps, with the **main aim to continue to pave the way toward common R&I priorities for the energy transition in Europe and for meeting the goals of the Green Deal.**

2. KEY POINTS FROM THE FIVE 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 identified by other ETIPs as well as by relevant PPPs, European associations and other Initiatives; in particular, strengthening mutual cooperation, towards the common overarching goals to achieve the energy transition in 2030-2050.

2.1 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” corresponding to one of the ETIP SNET 2050 Vision building blocks:

- F1 The Efficient and Flexible Organisation of Energy Systems,
- F2 Cross-sector integration,
- 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 architecture (design including new materials and hybrid AC/DC grids)*”.

1. 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 were discussed (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, and thermal storage.
- 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 in heating and cooling 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 analytical tools and controllers*
- Address **technical issues** to coordinate the systems (distributed vs centralised control, stochastical techniques of control, sensors, etc.)
- Thermal storage shall be considered e.g. within the domain of integrated sectors. It also provides significant potential when utilized for demand response and improvement of energy efficiency of buildings, especially with heat pumps.

2. "Towards the development of Protocols, standardization and interoperability for Interfaces, Communication, etc ".

The main priorities of ETIP SNET 2021-2024 Implementation Plan were discussed (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.).
- Friendly communication interfaces to the users and to the Renewable Energy Communities (RED-II Directive).

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 have been done till today.
- The regulations are needed and once developed, the market environment will be developed accordingly.
- Need to standardize interfaces and develop seamless platforms between storage owners, DSO and aggregators, between aggregators and the markets, and for the integration of demand-side assets into the electricity 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.)
- Bridge the main data models of the building/construction domain with their counterparts in the energy (networks) domain.
- Integrating active buildings into the energy system requires real-time bidirectional information exchange between energy system and building. Given the priorities of the Green Deal to push forward renovation activities, it is critical that such activities include the development and deployment of smart ICT infrastructure that enable these communications. Interoperability in this domain can be based on bridging popular data models from both sides (e.g. BIM/IFC from construction and CIM, EEBUS/SPINE, OpenADR, SAREF from the energy world indicatively). Such interoperability could become the foundation for the seamless integration of buildings (as producers and consumers of electricity/heat/gas) into the coupled energy networks.

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

The main priorities of ETIP SNET 2021-2024 Implementation Plan were discussed (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.
- Subsidiarity and hierarchical control of energy infrastructure need to be driven by coordinated market signals (e.g. coordinated TSO/DSO markets clearing and optimally scheduling assets at local/regional/national scale). Control dispatch and delivery of services from distributed resources (that are not fully controllable in a Direct Load Control paradigm) remains a critical challenge.

2.1.1 TABLE FOR COMMENTS/STATEMENTS AS REPLIES OF POST-EVENT CONSULTATION.[1]

International Hydropower Association (IHA), on behalf of ongoing 'XFLEX HYDRO' and 'Hydropower Europe' EU Horizon 2020 projects
Recognise the need in F1-F3 for market design and mechanisms for provision of ancillary services, particularly from hydropower plants, including large hydro storage projects.
Depsys
An additional point: Reflecting the distribution grid voltage and congestion limitations (in day-head and real-time) on energy prices of end-customers to enable an efficient demand response.
VUB/RENAISSANCE Project - Alex Felice
In order to fully exploit the flexibility from all energy carriers the sector-coupling should be taken in consideration from the design and planning phase and not only on the operational part as is done right now for the majority of the cases. We will need energy models that are able to handle this problem.
T&D Europe
The discussion focussed on functionalities required in future. This should be complemented by proposals how to ensure timely future-readiness of the grids with regard to these functionalities.
As many solutions are available already today and have been demonstrated in numerous pilot R&I projects, more focus should be given to deployment and barriers to it.

[1] Some of these points – if discussed during the sessions- have been included in the text.

The term Virtual Power Plant is not restricted to generation assets. This means aggregation of all types of distributed resources, as there are distributed generators (both variable renewables and flexible ones), storage and all types of demand respond mechanisms. Need to mention demand-side mechanisms in general (and not only selectively heat-pump and EVs).
Regarding priorities from the first discussion "*Systems need to be observable based on well functional models operationally available representing the complex system operated; […]*": the question needs to be why such solutions were not yet widely adopted on distribution level and what needs to be done to change this (regulatory side / Technology side).
Regarding standards within substations: With IEC 61850 a very comprehensive standard is available, which has proven in the past, that it can be extended in case this is required.
Hypertech SA
Validation of effectiveness and value of VPPs comprising demand-side assets (e.g. EVs, heat-pumps, building loads) and feedback mechanisms for the appropriate adaptation of market codes and ancillary service product requirements in order to optimally integrate demand side flexibility in terms of market/operational efficiency and citizen acceptance.
A market should be specifically designed for such assets. The main challenge is to design coordinated (or unified) markets for ancillary services for the TSO & DSO and specify the market rules and product definition in a manner that is technology-neutral so that any asset operator can participate and the market will decide the most cost-efficient solutions. Market rules (e.g. regarding minimum bid size) need to be revisited, especially in light of Local Flexibility Markets where large power capacities will not be available (nor useful) at the level of distribution network nodes.
Establishing appropriate Performance Measurement & Verification methodologies for demand response is tricky. Different demand response schemes (price-based/incentive-based) require different methodologies – the common major challenge being the establishment of the baseline compared to which the actual performance will be compared. For incentive-based DR largely depends on the valorisation channel (e.g. different market actors/operators) specify different ways to establish a baseline energy consumption/production and what constitutes delivery of "demand response". Once some consensus on this is achieved, monetization aspects can follow (depending on the remuneration of relevant services from system operators) as well as aspects related to automation to remove the burden from citizen's shoulders to adapt their consumption patterns according to grid or price signals.

E.DSO
Operation procedures are designed for generation units: There is a need to include technical particularities of batteries such as service duration, capacity limits and fast dynamic response into the market design.
Solar Heat Europe/ESTIF
Thermal storage can play a key role in sector integration
Energy Center – Politecnico di Torino
Building retrofit that creates building as renewable energy communities can be a game changer
Data must be made easily and quickly available to the users and to renewable energy communities (RED-II Directive)
The building retrofit, boosted by the strong fiscal support (110% of the entire investment) will boost the market in 2020-2021. This will lead to market-driven distributed storage capacity, including eCar charging stations

2.2 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 briefly summarised.
The session had four 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.

3. Towards a better understanding of the adaptation of the energy behaviour of the demand

The first Discussion Round was 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:

- Completeness of the topics presented in the Implementation Plan: The audience approved the new emerging feature for the market design for putting the consumer at the centre[2] - which was a core concern of ETIP SNET. Having a high priority for this

[2] while considering the criticality of infrastructures for market and system operations

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 been 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, especially when facilitated by a technical and market framework. Beside incentives, showing users/ prosumers tangible advantages and easy-to-use tools is also an effective way.
- On the question about how to motivate consumers to use less energy, it was observed that the motivation question should also include the choice of the green electricity and its visibility for consumers.
- Communication campaigns towards audiences are more sensitive to economic arguments than to 'green preference', and based upon measured benefits, focused on savings and living quality could also contribute to such motivation objective.
- A debate took place on the metrics for the incentives (what about an incentive giving economic advantages to the technologies with the largest Internal Rate of Return). 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.
- ***As additional comment received post event:*** But beyond the non-energy benefits that are of paramount importance to obtain acceptance during purchase act, automation is also expected to be a key enabler of change in residential energy demand patterns in order to operate residential loads according to the price or grid signals with the agreement of the user.

4. "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, CHP units of all types, Compressed air or Liquid-air Energy Storage). 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. Business models related to building retrofit and energy-driven urban renovation are expected to be key enablers since covering multiple components of the electricity

value chain (e.g. distributed storage capacity in the urban environment through electromobility infrastructures).

- 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?
- The above statement made for a particular technology raised the issue of the technology-dependence scheme for rewarding flexibility services: should the remuneration be irrespective of technology based on performance-based Service Level Agreements?
- Sector interfaces/integration and market adaptation of all components have to be considered as well as market coupling. On that specific topic, one warning was made on arbitrage opportunities and complex trading strategies opened by market coupling across energy vectors in the light of evolving costs of energy conversion technologies. 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).

5. 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 ETIP SNET R&I Implementation Plan 2021-2024 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 as well as 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.
- It is recommended giving additional focus on identifying the demand for solutions that might be hindered by today's market design.

- 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[3] are being already addressed by large projects, while for the 4th and 5th bullet point[4], it is observed that not so many projects[5] have been launched and that this should be a priority for the next future R&I agenda.

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

Priorities extracted from ETIP SNET R&I Implementation Plan 2021-2024 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 third 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 and data protection is of essence. One participant highlighted the importance of data model and relevant standards (CIM) in particular for distribution grids in order to improve data exchange between different stakeholders
- 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.

[3] respectively pan EU market design, market design for TSO with cross border coordination, coordination mechanisms for Ancillary Services
[4] design of local markets and retail P2P market for LEC, or market design for large scale demand response beyond electricity
[5] among them we could mention the H2020 RENAISSANCE project that explores the design of local market and P2P trading inside a LEC and the "gamification" of the demand-response schemes in two universities campus

2.2.1 TABLE FOR COMMENTS/STATEMENTS AS REPLIES OF POST-EVENT CONSULTATION [6]

VUB/RENAISSANCE project
Related to point 3) *Towards Cross-border, Coordinated schemes for market design at each level of relevance (pan-EU, dedicated markets)* in the context of RENAISSANCE project we are exploring the design of local market and P2P trading inside a LEC and also the "gamification" of the demand-response schemes in two universities campus (students can get discount on some universities' services by consuming less energy or consuming when local RES are available)
T&D Europe
We have the impression of an underlying assumption that today's market design is hindering solutions, which are assumed to be beneficial, but without validating this assumption.
We recommend giving additional focus on identifying the demand for solutions that are assumed to be hindered by today's market design.[7]
University of Vaasa · School of Technology and Innovations
"putting the consumer at the centre" – Let's make clear what this really means. – Sounds beautiful, but I do not want to give the management of the critical infrastructure (including related markets) into hands of amateurs. Moreover, a more distributed power system is more complex, not necessarily more reliable and cost effective[8].
E.DSO
• DSOs as neutral market facilitators can enable new services and empower established and emerging market parties and consumers to play an active role in the energy system by integrating prosumers' electricity into the grid. • DSOs can help to integrate smartly new technologies and services such as energy storage and electric vehicles into the network. • DSOs as digital players can make the energy transition feasible by data-handling grid and meter data in accordance with the highest network security and data protection standards. • Need of fair and proportionate rules in the Design of local markets and must be covered by appropriate regulation

[6] some of these points – if discussed during the sessions- have been included in the text.
[7] comment added in the highlights
[8] a footnote was added

Regarding the difficulty of providing grid services to geographic area

- For new significant grid users requiring connection to the electricity grid, a joint analysis should be carried out by the DSO and TSO to establish whether connection to the transmission or distribution grid is more appropriate.
- It is also possible to research Virtual Power grids to not only focus on a knowledge exchange relationship on grid connection and provided services for energy transmission
- With the decentralisation and increasing local production and consumption of energy large transmission to provide flexibility and network services is decreasing.

HYDROPOWER EUROPE

"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". To reach the free carbon economy in 2050, incentives have to include economic indicator of CO2 emission during the whole life cycle.

R&I project is required to assess "Merit order" for the different flexibility resources and products to allow system operators to predict the availability of resources for the different products and timeframes, as well as to estimate the related costs including externalities such as CO2 emissions or other environmental indicators in business models.

Hypertech SA

A key enabler of change in residential energy demand patterns will be automation. Non-energy benefits are very important in order to obtain acceptance of the solutions during the purchase. Sustained demand adaptation to the energy system requirements will not be achieved through behavioural change (perhaps energy efficiency can be partly achieved from purchase habits/priorities – e.g. for eco-appliances). Providing the demand flexibility necessary for the 2050 integrated system powered by RES will require automated technologies for HEMS/CEM/BEMS that take the burden from the hands of citizens and operate residential loads according to the price or grid signals – the user will always maintain the final word of course.[9]

[9] a bullet point added in the highlights.

2.3 PARALLEL SESSION 3 - "DIGITALISATION ENABLES SERVICES FOR THE INTEGRATED ENERGY SYSTEMS"

Moderator: Maher Chebbo
Technical Advisor: Rainer Bacher

As base of this parallel session 3 there is one Functionality **F6: Integrating digitalisation services (including data privacy, cybersecurity)** 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.

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 R&I Implementation plan 2021-2024) describe "The research activities to be conducted in the reference period". 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 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[10].
The moderator introduced the purposes of FUNCTIONALITY 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 fully respect "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.

[10] https://www.etip-snet.eu/wp-content/uploads/2020/05/Implementation-Plan-2021-2024_WEB_Single-Page2.pdf

2 rounds of discussion took place:

1. **Priorities "Digital Technologies"**
2. **Priorities "Digital Use Cases"**

1. 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 monitoring and control (platforms)
    - Data predictions to be made
5. Providing **decision making tools for TSO and DSO**
6. Providing **Cybersecurity protection** of grid infrastructures and all involved market participants
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 needs 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 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 further below in this section of the 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 insights on Use cases and also the latest ETIP SNET R&I Implementation plan (IP) 2021-

2024[11] which gives more information 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, operation, maintenance planning and optimisation, 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 one; 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 Cases" 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.

[11] https://www.etip-snet.eu/wp-content/uploads/2020/05/Implementation-Plan-2021-2024_WEB_Single-Page2.pdf

2. Priorities "Digital Use Cases".

1. Digitalising **smart appliances**: making demand and generation flexible considering also people's willingness to access own appliances without interfering with privacy issues.
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 considering also Renewable Energy and Citizen Energy Communities s
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 predict and detect component failures;
7. Digitalising **buildings, living quarters (islands)** for stand-alone operation considering people's willingness to have their appliances monitored and being part of the cloud without interfering with privacy issues
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 TSO's interaction with local markets;
    - for enabling DSO's 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.

2.3.1 TABLE FOR COMMENTS/STATEMENTS AS REPLIES OF POST-EVENT CONSULTATION.[12]

UNIVERSITY OF VAASA · SCHOOL OF TECHNOLOGY AND INNOVATIONS
Digitalising smart appliances – I really hope this does not mean that this is a very high priority issue. As verified in an EU funded project, digitalising appliances such as dishwasher - is tinkering (and may even be hazardous). Instead, focus should be on relevant issues, e.g. heating and cooling (ca. 50% of total end use of energy).
Solar Heat Europe/ESTIF
R&I should also foster the use of digitalisation for SMEs (for which the shift will be more difficult)
AI and digital twins will be key to integrate RES-HC in EU industrial process and speed up the decarbonisation of this sector
HYDROPOWER EUROPE
In the list of priorities “Digital Use Cases”. Case 6 : “Developing models and digitalisation to detect component failures “ should include “assessment of cost of flexibility”
Digitalization, through use cases 4 and 6, is the key to assess the cost of flexibility for different technologies and select the best solutions

[12] Some of these points – if discussed during the sessions- have been included in the text.

Hypertech SA - Antonis Papanikolaou

There is an overlap – in my opinion – between bullets 1, 3 and 7. The energy system is likely to see the building (the metering point to be exact) as the main agent/actor. Behind-the-meter, the building performance encapsulates the impact of the smart appliances, human behaviour, energy management, etc.

This digitalised energy system element can then take part in ICT-supported use cases (such as ancillary service provisions, islanding/micro-grid mode, etc.). [13]

[13] This is the list of the ETIP SNET IP 2021-2024. Revisions will be made in the next IP 2023-2027.

2.4 PARALLEL SESSION 4: "INFRASTRUCTURE FOR INTEGRATED ENERGY SYSTEMS AS KEY ENABLERS OF THE ENERGY TRANSITION"

Moderator: Norela Constantinescu
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)
- RA2: system economics (F8)
- RA3: 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.

Research Area contributing to F7	Research Area contributing to F8	Research Area contributing to F9
RA1. CONSUMER, PROSUMER and CITIZEN ENERGY COMMUNITY: • RSA 1.1 (Social campaign and social studies) • RSA 1.2 (Adaptive consumer / user behaviour incl. energy communities) **RA 3. DIGITALIZATION** • RSA 3.1 (Protocols, standardisation and interoperability) **RA4. PLANNING - HOLISTIC ARCHITECTURES and ASSETS** • RSA 4.1 (Integrated Energy system Architecture) • RSA 4.2 (long term planning) • RSA 4.3 (Asset Management and maintenance) • RSA 4.4 (System Stability analysis). **RA5: FLEXIBILITY ENABLERS and SYSTEM FLEXIBILITY** • RSA 5.2 (Generation flexibility) **RA6. SYSTEM OPERATION** • RSA 6.1 (State estimation and state supervision), • RSA 6.3 (medium- and longer term control), • RSA 6.4 (preventive control/restoration) • RSA 6.5 (Control center technologies	RA**1. CONSUMER, PROSUMER and CITIZEN ENERGY COMMUNITY:** • RSA 1.1 (Social campaign and social studies) • RSA 1.2 (Adaptive consumer / user behaviour incl. energy communities) **RA 2. SYSTEM ECONOMICS** • RSA 2.1 (Business models) • RSA 2.2 (Market design) • RSA 2.3 (Market governance).	**RA4. PLANNING - HOLISTIC ARCHITECTURES and ASSETS** • RSA 4.1 (Integrated Energy system Architecture) • RSA 4.2 (long term planning) • RSA 4.3 (Asset Management and maintenance) • RSA 4.4 (System Stability analysis). **RA5: FLEXIBILITY ENABLERS and SYSTEM FLEXIBILITY** • RSA 5.3 (Storage flexibility and energy conversion flexibility). **RA6. SYSTEM OPERATION** • RSA 6.1 (State estimation and state supervision), • RSA 6.3 (medium- and longer term control), • RSA 6.4 (preventive control/restoration) • RSA 6.5 (Control center technologies

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 streamlining their permitting processes. 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 enabled by 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 energy system, including in coordination, planning of the electric grid and other networks (e.g. gas grid, to enable sector coupling), it has been clarified that from the ETIP SNET point of view , the coordinated **planning of electricity networks together with other energy vectors networks that can best fit (either locally or at a larger scale) the opportunities for flexibility (e.g. gas, district heating and cooling, water, etc.) will gain importance in the frame of the progressive decarbonisation of the energy sector.**

Assets:

Concerning the assets, the preference of using and leveraging the potential of the existing assets has been mentioned (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 the normal 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.
The adoption 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.

2. DISCUSSION B> 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. The centralised and decentralised integration of RES and its impacts on planning, operational planning (resilience) and operation have been touched. 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»). It stated that hydro power generation 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 for generation** was discussed. About the business models, **regulation and legislation to remunerate flexibility** is also important to foster investments towards flexible technologies, taking into consideration the necessity to locate the flexibility means and tools in the most appropriate geographical and network locations. Business models are important for aggregated PV generators. Regulation and legislation is needed for flexibility services remuneration: this will help the development of the RES technologies.

3. 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 been pointed 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 (DT)** to simulate user behavior and needs of flexibilities: DT can be used for the simulation of the integration of flexibility services by different customers and distributed resources.

2.4.1 TABLE FOR COMMENTS/STATEMENTS AS REPLIES OF POST-EVENT CONSULTATION.[14]

International Hydropower Association (IHA), on behalf of ongoing 'XFLEX HYDRO' and 'Hydropower Europe' EU Horizon 2020 projects
Just to underline the notes and comments already said in functionality F8: on the need for supportive regulations and market design (a) to modernise and enhance hydro flexibility, and (b) to properly reward hydropower's flexible and ancillary services delivered to support network operations, not just its generation.
Depsys
In line with RA6, another topic can be state estimation of multi-energy systems based on the sensors and monitoring of electrical distribution grid
T&D Europe
Timing of standards has been addressed as a challenge. An important consequence is to distinguish between enabling functionalities, which are requiring standardisation and a certain stability, and such, which are using these enabling ones and may evolve without standardisation.

[14] Some of these points – if discussed during the sessions- have been included in the text.

E.DSO
Discussion B: Increased visibility over the necessary infrastructure needs with digitalisation along with cost-efficient development in physical networks regarding capacity.
Solar Heat Europe/ESTIF
It's key to have a renewable-based electrification and not an increase in fossil powered electricity
HYDROPOWER EUROPE
Concerning discussion about 2. ETIP SNET priorities on business models, regulation and legislation, we must add that some national regulations require operators of storage facilities, including active consumers, to pay network charges or energy taxes and other levies twice. It is clear that the abolishment of this burden would lead to more energy storage projects being deployed.
We call to abolish any kind of double taxation by developing efficient taxation schemes and redesigning charges related to energy storage in a way that the societal benefit from storage is reflected and barriers for storage projects to access the market are removed.[15]

[15] A very strong and unsolved debate exists nowadays many European countries on the ways to adequately compensate system management costs.

2.5 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".

1. "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, PtHtP, 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.

2. 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 thermal 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. Kostadin Fikiin from the Technical University of Sofia, suggesting that more attention and emphasis should be given to the integration of the cooling and refrigeration sector into the energy system, making the best use of synergies with other energy conversion technologies and demand pattern. He also pointed out that refrigeration and cryogenic energy technologies need to be addressed in a much more specialized and thorough way, instead of just mentioning of 'cooling' *pro-forma,* along with its heating counterpart. In this context, Kostadin Fikiin provided a detailed list of suggestions (see further below).

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 the need for growing penetration of both renewable energy systems and District Heating and Cooling (DHC) grids. In most cases, RES-based Heating & Cooling technologies are coupled with Heat Storage to comply with the demand pattern. This is a strong asset that will additionally contribute to the flexibility and stability of the electricity network, provided that a suitable local control system is in place. DHC network and Electricity network shall furthermore be connected, in view of an effective energy system integration: Power-to-Heat technologies and Seasonal Storage can be key issues for that.

3. "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 in loco by renewable generation (e.g. solar heat, solar PV, bioenergy, …), by renewable generation, sector-coupling and storage components (e.g. P2hydrogen, P2G, P2H, P2fuels ….),
- ccentralised 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 summarized 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. This should be a transitional measure towards a switch to carbon free solutions
3) Storage and highly performing forecasts systems are the key elements to achieve RES-based plants flexibility.
4) Renewable heating and cooling in households and industries 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) Thermal storage is necessary to the RES H&C technologies and will contribute to the flexibility and stability of the overall network
6) DHC network and Electricity network must be based on RES and their connection is needed; Power-to-Heat, Seasonal storage (both electric and thermal) can be key issues for that.
7) The renewable 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. this should include both H&C and the power sector.
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.

2.4.1 TABLE FOR COMMENTS/STATEMENTS AS REPLIES OF POST-EVENT CONSULTATION.[16]

International Hydropower Association (IHA), on behalf of ongoing 'XFLEX HYDRO' and 'Hydropower Europe' EU Horizon 2020 projects
Importance of hydropower as a flexible form of renewable generation and storage to be recognised in functionality F10. A need to invest in new pumped storage projects (PSP) as well as retrofits and upgrades to existing plants, to improve efficiency and flexible performance.
T&D Europe
We would like to understand better, why today's markets for balancing energy and control power are considered to be insufficient to stimulate flexibility offerings. (At least this is what we conclude from the prominent request to create flexibility markets.)
E.DSO
• Developing planning capacities within this future integrated energy system will be pivotal as well for the demand and supply to match as much as possible. • Implement circular economy principles in a grid updating wave • Enable rights for consumer to be actively and intelligent supported in their choices
Solar Heat Europe/ESTIF
Heating and Cooling must be renewable and coming from local sources
RES-HC has a role to play not only for households and districts decarbonisation but as well in the industrial sector
Thermal energy storage can be a key enabler in a smart sector integration
Power-to-Heat-to-Power solutions should also be considered, namely combining thermal solutions with ORC.
F11 should comprise "Efficient and renewable heating and cooling for buildings and industries in view of system integration of flexibilities

[16] Some of these points – if discussed during the sessions- have been included in the text.

Hypertech SA
Given the electrification of heating and cooling mega-trend, the main challenge is to leverage the P2H units (of different sizes, from split units to MW-level heat pumps to heat/cool water for DHC) and the thermal inertia/capacity of buildings and liquids for use cases either at the plant-level (e.g. large HP & RES for self-consumption leveraging thermal capacity of water tanks) or energy system level (e.g. aggregated heat pumps offering services to the grid).
Integrate water/waste management as a complimentary system that can offer energy flexibility, especially at the neighbourhood/district level
Polytechnic of Turin
Concerning the District Heating and Cooling (DHC) grids, If a building becomes a prosumer, a self-consumer and the heating/cooling is electrified the need for district heating is lower. Renewable and Citizen Energy Communities can be a game changer.
Concerning the 10th Point of the conclusions "*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*. - Economically feasible if the charging stations are embedded into the building retrofit.
HYDROPOWER EUROPE
Concerning discussion about 2. ETIP SNET priorities on business models, regulation and legislation, we must add that some national regulations require operators of storage facilities, including active consumers, to pay network charges or energy taxes and other levies twice. It is clear that the abolishment of this burden would lead to more energy storage projects being deployed
We call to abolish any kind of double taxation by developing efficient taxation schemes and redesigning charges related to energy storage in a way that the societal benefit from storage is reflected and barriers for storage projects to access the market are removed[17]

[17] This statement needs to be intended as not discussed and agreed during the session. A very strong and unsolved debate exists nowadays in Italy on this aspect and will not be solved by simply removing a "tax" (intended as compensation for system management costs).

3. ADDITIONAL INFORMATION RECEIVED DURING THE ON-LINE CONSULTATION

Technical University of Sofia endorsed by International Institute of Refrigeration

Kostadin Fikiin has provided the following information in order to enhance the cooling-related aspects of the ETIP SNET documents by elaborating them with the necessary details, as a main focus or center of gravity of energy topics and projects.

In fact, artificial cooling (called also 'refrigeration') is a giant multibranch sector. It comprises: cold chain for refrigerated processing, storage, transport, distribution, retail and household handling of chilled and frozen foods, vaccines, medicines and pharmaceuticals; blood and tissue banks; gene banks; keeping in-vitro materials and embryos; cryosurgery; cryotherapy; cold spray anesthetics; cooling of medical diagnostic equipment; liquefaction and separation of gases (including liquid hydrogen for H2-based energy generation and LNG businesses); superconductivity; ice rinks, artificial ski runs, bobsleigh, luge and skeleton tracks, snowmaking machines; ice generators; cryogenics for powerful particle accelerators and thermonuclear reactors; cryogenic energy storage; cryorecycling; process cooling in brewery, chemical and metallurgical industries; cooling of electronic equipment and data centers, etc. Nearly 5 billion refrigeration, air-conditioning and heat pump systems are in operation worldwide. Global annual sales of such equipment amount to over 450 billion EUR. All refrigerated foodstuffs around the world cost over 2.7 trillion EUR (which exceeds several times the US military budget). Over 15 million people worldwide are employed in the refrigeration sector which is responsible for about 20% of the global electricity usage. Predictive studies reveal that, by 2050-2060, the amount of energy used worldwide for cooling should overtake that used for heating (and will even prevail by some 60% by the end of the Century).

The United Nations (UN) Secretary-General António Guterres called recently the governments and authorities around the world to develop National Cooling Action Plans to deliver efficient and sustainable cooling, where the energy sustainability and carbon neutrality must play a major role. As usual, EU should be a global leader in these endeavors.

The following list of ideas for energy topics and projects focusing on human-made cooling (refrigeration), has therefore been suggested to outline R&D&I priorities within the scope of ETIP SNET and their synergy with RHC-ETIP:

- Up to 100% renewable carbon-neutral cooling for industrial and building applications (e.g. solar and geothermal refrigeration).
- Intelligent heat pump technologies for a cleaner energy system.
- Smart, energy-efficient and renewable air-conditioning technologies.
- Combined cooling, heat and power (CCHP) generation.
- Sustainability and efficiency enhancement of low-temperature processes and technologies.
- Energy-efficient operations and logistics along the cold supply chain.

- Heat transfer modelling and optimisation of energy-intensive low-temperature processes and systems.
- Digitalisation (e.g. via IoT) of cooling, low-temperature energy storage and cold chain.
- Energy mapping of industrial refrigeration capacities and associated power expenditure across EU.
- Smart interoperability between power grids and cooling networks for a flexible and low-carbon energy system.
- Reversible heating and cooling networks for buildings or districts.
- Virtual grid-balancing batteries by passive or active energy storage in large refrigerated facilities.
- Cold supply chain for perishable commodities or LNG as an energy distributing network.
- Energy storage and cold-to-power solutions along the LNG or liquid H_2 supply networks.
- Cryotechnologies for liquid hydrogen production, distribution networks and H_2 energy applications.
- Thermal energy storage and grid balancing through phase-change materials and slurries for industrial cooling or air conditioning of buildings.
- Innovative concepts for cryogenic carbon capture, storage and use.
- Cryogenic recycling of waste for circular energy technologies.
- Novel energy-efficient technologies for cooling of data centres.
- Unconventional zero-direct-emission solid-state refrigeration principles (thermoelectric, magnetocaloric, electrocaloric, elastomeric or barocaloric).

4. ANNEX 1 – ATTENDEES LIST TO THE ETIP SNET VIRTUAL WORKSHOP

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