European Technology and Innovation Platform "Smart Networks for Energy Transition"

ETN Global

ETIP SNET

Working Groups

- WG1 Reliable, economic and efficient smart grid system
- WG2 Storage technologies and sector interfaces
- WG3 Flexible Generation
- WG4 Digitisation of the electricity system and Customer participation
- WG5 Innovation implementation in the business environment
- NSCG NATIONAL STAKEHOLDERS COORDINATION GROUP

ETN representatives

Governing Board

- Rob Versteirt (ENGIE)

WG3 Flexible Generation

- Peter Breuhaus (IRIS)
- Peter Jansohn (PSI)
- Iarno Brunetti (ENEL)
- Olaf Bernstrauch (Siemens)

Activities

ETIP SNET Implementation Plan 2017-2020

- Topic 33 - Developing the next generation of flexible thermal power generation
- Topic 34 - Adaptation and improvement of technologies to novel Power-to-Gas and Power-to-Liquid concepts

ETIP SNET Vision

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ETIP SNET PLAN. INNOVATE. ENGAGE.

Specific Objectives of the Working Group

WG 3 addresses the business & technology trends considering

- **the contribution of flexible generation**
- **of all dispatchable generation sources**
- **for power, heat and cooling**
- **centralized and decentralized**
- **with or without embedded storage**

as needed for an integrated energy system.

WG 3 Working Process

Contributions to:

- Roadmap 2018-2027
- H2020 Working Programme 2018-2020
- Implementation Plan 2018-2020
- Vision 2050
- Mission 2030

May 16, 2018 5nd WG3 Workshop in Espoo

Next Step:

- Position Paper / White Paper:
  "Flexible Power Generation in a Decarbonizing Europe"

Structure of ETIP-SNET roadmap 2017 - 2026

WG 3 to review and extend structure of initial roadmap:

WG3 Topics in IP (1/7)

Coupling between flexible generation and storage:

Topic #	Topic description	Main FOs	Year	Target TRL
18	Integration of storage in existing thermal generation for increased flexibility	T22, D14	2018	4-7
19	Towards fully dispatchable RES: Variable RES with Storage	T10, D5	2019	4-7
*20**	*PV, CSP and storage (title might be reformulated)*	*tbc*	*tbc*	*tbc*

** Topic 20 is not available yet.*

Research challenges:

- *Hybrid solutions for optimal combination of RES with storage and manage RES uncertainty*
- *Thermal energy storage prototype and implementation in overall plant configuration*
- *CO2-cycling for synthetic fuel generation*
- *Integration of power-to-fuel technologies into power plant (generation and storage of renewable fuels*
- *Establish process chain using compressed air, batteries etc. to increase thermal plant flexibility*
- *Interlink fuel generation to other sectors*

Target TRL: ***4-7***

Estimated budget: ***Topic 18: 40 – 60 Million EUR (one big demo or multiple pilots)***
Topic 19: 30 Million EUR

WG3 Topics in IP (2/7)

Thermal generation:

Topic #	Topic description	Main FOs	Year	Target TRL
33	Developing the next generation of flexible thermal power plants	T22, D14	2018	3-7
34	Adaptation and improvement of technologies to novel Power-to-Gas and Power-to-Liquid concepts	T22, D14	2018	3-6

Research challenges:

- *Component improvements*
- *Improved operational flexibility*
- *Overall performance improvements (efficiency and emissions) at part load*
- *Enhanced thermal power plant robustness (reduce maintenance and repair costs)*
- *Enable multi fuel operation*
- *Novel monitoring and control*
- *Digitization*

Target TRL: ***3-7***

Estimated budget: ***65 Million EUR***

WG3 Topics in IP (3/7)

Thermal generation:

Topic #	Topic description	Main FOs	Year	Target TRL
33	Developing the next generation of flexible thermal power plants	T22, D14	2018	3-7
34	Adaptation and improvement of technologies to novel Power-to-Gas and Power-to-Liquid concepts	T22, D14	2018	3-6

Research challenges:

- *Combustion systems for stable combustion of gas mixtures with hydrogen up to 100%*
- *Extension of low emission load range*
- *Improving flexible load operation*
- *Improved design of combustor liner to reduce surface exposure to hot gas and radiation*
- *Development of safe hydrogen starting methodology*

Target TRL: ***3-6***

Estimated budget: ***10 Million EUR***

WG3 Topics in IP (4/7)

Variable RES:

Topic #	Topic description	Main FOs	Year	Target TRL
35	Improved flexibility and service capabilities of RES to provide the necessary ancillary services in scenarios with very large penetration of renewables	T6, T13	2018	3-6
36	Enhanced smart RES flexible solutions and control strategies for Power Electronic Converter (PEC) dominated grids	T6	2018	7

Research challenges:

- *Improvement of renewables generators for better adaptation for provision of ancillary services*
- *New control strategies with support services like storage and manageable RES*
- *Instability mitigation of RES, new strategies to define stability criteria in future scenarios*
- *Investigate different energy mix configurations to ensure electrical system stability*
- *Communication protocols with storage systems with PEC*

Target TRL: ***3-6***

Estimated budget: ***25 - 30 Million EUR***

WG3 Topics in IP (5/7)

Variable RES:

Topic #	Topic description	Main FOs	Year	Target TRL
35	Improved flexibility and service capabilities of RES to provide the necessary ancillary services in scenarios with very large penetration of renewables	T6, T13	2018	3-6
36	Enhanced smart RES flexible solutions and control strategies for Power Electronic Converter (PEC) dominated grids	T6	2018	7

Research challenges:

- *Identify qualification and interaction of smart converters*
- *Identify and develop concept of Renewable Flexible Modules (RFM) including components*
- *Adaptation of current RFM's and explore additional functions of the future RFMs*
- *Integrate additional protection functions at RFM level*
- *Investigate role of storage systems and different energy mix configurations*

Target TRL: ***up to 7***

Estimated budget: ***40 - 45 Million EUR (4 – 6 projects)***

WG3 Topics in IP (6/7)

Hydropower:

Topic #	Topic description	Main FOs	Year	Target TRL
37	Refurbishment and upgrade of existing hydropower with the purpose of increased flexibility and expanded storage capacity	T9	2018	5-7
38	Environmental impact assessment of hydropower projects	T4	2018	5-7

Research challenges:

- *Medium and large-scale demonstration projects to focus on more flexible hydropower plants*
- *Medium and large-scale demonstrators incorporating technical improvements and planning tools*
- *Smarter compatibility with environmental restrictions*
- *Better utilization of hydro power in sensitive areas*

Target TRL: ***5 - 7***

Estimated budget: ***20 - 25 Million EUR (Topic 37), 2-3 Million EUR (Topic 38)***

WG3 Topics in IP (7/7)

Cross cutting issues:

Topic #	Topic description	Main FOs	Year	Target TRL
39	Digitalisation of flexible, dispatchable generation technologies	T7	2018	5-7

Research challenges:

- *Simulation of plant components and electromechanical system at development and design phase*
- *Predictive maintenance methods*
- *Plant operation optimization based on data analytics*
- *New operative process base on new algorithms and methods (big data; artificial intelligence)*

Target TRL: ***5 - 7***

Estimated budget: ***25 Million EUR (3-5 projects)***

Table of content

- ❑ Roadmap / Implementation Plan: 2019 activities
- ❑ Roadmap / IP : on-going process
- ❑ The next steps

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From Vision to Roadmap: on-going process

Reuse in RM: Key structures of ETIP SNET Vision 2050

- From the **ETIP SNET Vision 2050** : Five building blocks identified
  - Integration needs for **Physical infrastructures**
  - Integration needs for **Stakeholder organisations**
  - Integration needs for **Monitoring and Controls**
  - Integration needs for **Markets**
  - Digitalisation enables **Services for integrated energy systems**

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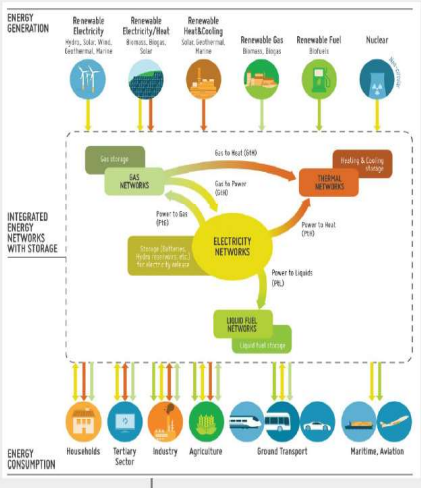
Reuse: Physical Infrastructures of the ETIP SNET Vision 2050



The RD&I Value Cycle: Vision – Roadmap – Implementation Plan – Project Monitoring

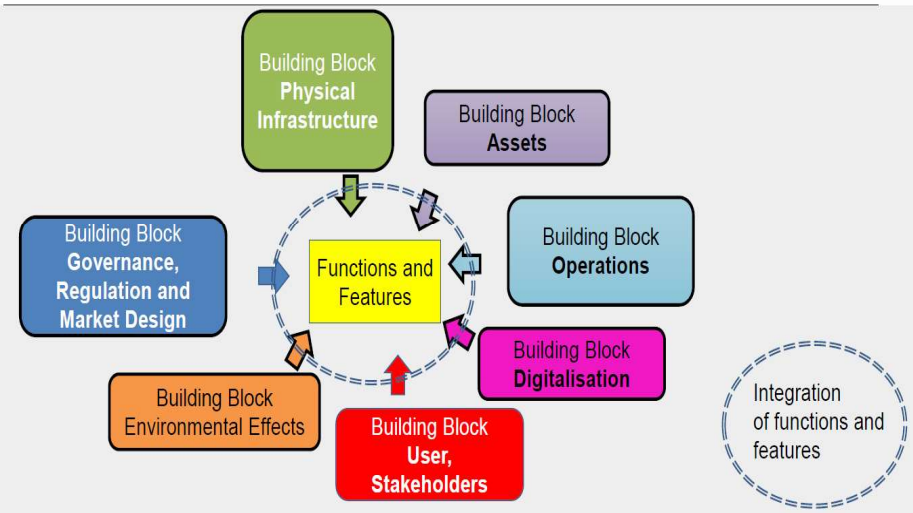
ETIP SNET Vision 2050: Building Blocks

ETIP SNET Roadmap 2020-2030: Seven Building Blocks, each with Features and Functions, to be integrated

ETIP SNET Implementation Plans 2020-2023, 2022-2025, 2024-2027, 2026-2030: Projects with defined priority (time-line), stakeholders (actors) for integrating Features and Functions with measurable, scalable, replicatable results

ETIP SNET Project Monitoring 2019, 20xx: Project evaluation for coverage of integration related to features and functions based on measurable outputs from RD&I Projects

ETIP SNET Roadmap 2020-2030: Seven Building Blocks.



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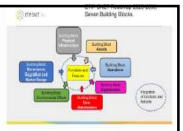

ETIP SNET Roadmap 2020-2030: The (PHYS) physical energy system infrastructures - with their ASSETs being planned, built and maintained - are (OPER) operated supported by monitoring, controlling functions and market interaction relying on (DIGIT) digital technology functions for any USERs according to an overarching (GOV) Governance, regulation and market design with minimal adverse effects on the (ENV) environment.

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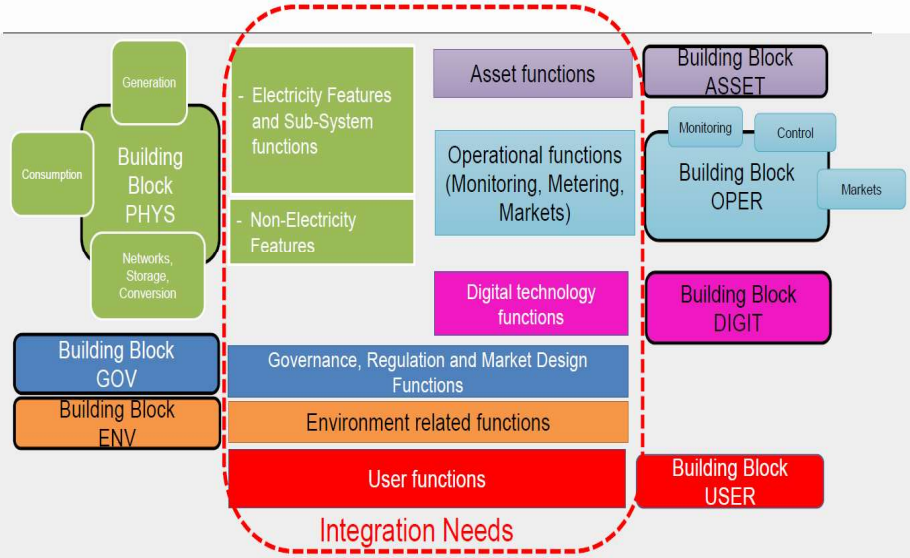
ETIP SNET Roadmap 2020-2030:
Integration Needs for seven Building Blocks and functions



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ETIP SNET Roadmap 2020-2030: Building Blocks each features and functions, to be integrated

The ETIP SNET Roadmap defines **integration needs for features and functions of each Vision 2050 Building Block**

- with Status Quo and remaining Challenges,
- High-level objectives,
- Scope,
- Tasks,
- Outcomes,
- Impacts,
- Contributors,
- Budgets,
- Timeline

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Roadmap: on-going process

Links between Building blocks and 36 Functional Objectives of the RM 17-26

Example for the **PHYS-GEN** Building Sub-Block

Features Generation: (PHYS-GEN)	Renewable Electricity features and their integration	Renewable Electricity/Heat features and their integration	Renewable Heating & Cooling features and their integration	Renewable Gas features and their integration	Renewable Fuel features and their integration
Integration Functions	T22, D14, D3, D4				

T22: Flexible (large) thermal power generation
D14: Decentralised thermal power generation
D3: Small size DER
D4: Medium size DER

All 36 TSO/DSO functional objectives are carefully reviewed, placed into new RM functions (of Building blocks). Where useful, they are merged; Separation T and D only where absolutely necessary.

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ETIP SNET Implementation Plan 2020-2023 (IP): RD&I projects integrate - in a measurable way - RD&I features[1] and functions defined in the RM.

The Implementation Plan defines RD&I Projects with

- Time-line for realisation (time-line, priority)
- What Building blocks defined in ETIP SNET RM are to be considered
- What functions and features defined in ETIP SNET RM are to be integrated with
  - details of needed functions and features
  - details for measurable results (with TRL and measure for scalability, replicability)
- What stakeholders/actors are to be involved?
- What are the expected project costs and what amount is expected to be funded ?

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Implementation Plan: on-going process

Proposed Timelines for RD&I projects (ETIP SNET Implementation Plan)

- When are what types of RD&I results (Key exploitable results) and deployment needs to be achieved at what TRL level?

- Proposal to use **five time-line categories** for each project in the ETIP SNET Implementation plans:
  - Category "**Deployment**": wide-spread application of products and services at commercial scale.
  - Category "**High**": urgent implementation and demonstration needs.
  - Category "**Medium 2030**": research, demonstrated by 2030.
  - Category "**Medium 2040**": research, demonstrated by 2040.
  - Category "**Low**": research, demonstration between 2040 and 2050.

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Examples of work to do by kernel team, WGs by March 10: Review paper, edit mapping, propose new functions

TO DO: For each of the seven building blocks PHYS, ASSET, OPER, DIGIT, USER, ENV, GOV + sub-building blocks, review the proposed FO from the previous RM and make new proposals for functions

Review functional objective of previous RM and new Functions	New RM 2020-2030: (DIGIT) Digital Technologies - related Integration functions
T7	Grid-related expert systems and tools
New DIGIT 1	??
New DIGIT 2	??
New DIGIT 3	??
New DIGIT 4	??

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Position Paper / White Paper

Title as agreed in the Helsinki F2F, 16 May 2018:

"Flexible Power Generation in a Decarbonizing Europe"

Position Paper / White Paper
"Flexible Power Generation in a Decarbonizing Europe"

Who is the audience?

Politicians, EU and national Decision Makers, ETIP-SNET members, lobbyists, advisors, plant operators, users of flexible generation, regulatory authorities, NGO's, investors, funding agencies

Position Paper / White Paper
"Flexible Power Generation in a Decarbonizing Europe"

What do we want to achieve?

- understanding the existing energy system in EU (demand & supply)
- providing a forecast on how we see the European energy generation landscape in 2050
- understanding of «flexible generation» (what does it mean?) and its necessity for Europe, its technologies, challenges and future R&D needs (targets)
- explaining definitions and boundaries
- detailing the deliverables of flexible generation
- explaining the economics
- outlining the sector integration
- explaining the contribution of flexible generation to the generation transition and CO2 reduction

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Position Paper / White Paper
"Flexible Power Generation in a Decarbonizing Europe"

What is the structure of the paper?

Executive Summary
1. Today' situation in the power generation sector in Europe
2. European targets with regard to flexible generation
3. Energy sources (Coal, Gas, Liquid Fuel, Nuclear, wind, sun, wave, biomass, geothermal, water .....)
4. Technologies today (GT, ST, Hydro, Wind, PV, CSP, Gas Engines .....)
5. Challenges
6. Technologies tomorrow (Fusion, Fuel Cells, Nano-Generators, Digitization, Retrofitability incl. fuel switch, short term storage, seasonal storage, ...)
7. Outlook for a generation in a decarbonizing Europe
   - decisions needed by legislation
   - funding requests (R&D and deployment)
   - road map
   - grid prerequisites
   - infrastructure needs
   - economical consequences
8. Summary

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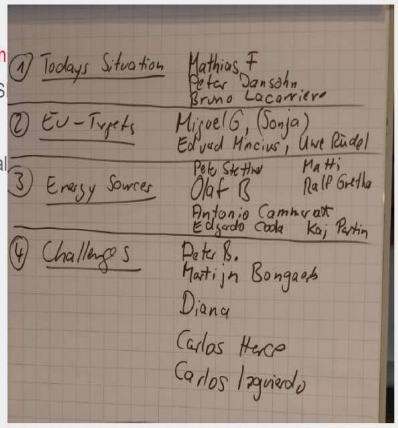
WG3 White Paper
"Flexible Power Generation in a Decarbonizing Europe"

What is the structure?

1. Today's situation in the power generation sector in Europe
2. European targets with regard to flexible generation
3. Energy sources (Coal, Gas, Liquid fuel, Nuclead, Wind, wave, sun
4. Technologies today (GT, ST- SteamTurbine, Hydro, Wind, PV, CS
5. Challenges
6. Technology tomorrow (Fusion, Fuel cells, Nano-generators, Digital storage, seasonal storage)
7. Outlook Generation in a Decarbonizing Europe.
   - Decision needed by legislation
   - Funding requests (R&D and deployment)
   - Roadmap
   - Grid prerequisites
   - Infrastructure needs
   - Economical consequences



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WG3 White Paper
"Flexible Power Generation in a Decarbonizing Europe"

The new timeline for the creation?

Editor Team to deliver guidance by March 15, 2019

Input to the missing chapters by end March 2019

Editor Team to propose a 1st draft mid April 2019

F2F Meeting in Switzerland between Monday, 22. April, and Friday, 17. May

- Finalization of Draft White Paper
- Update of Roadmap & Implementation Plan (Deadline to comment Version "0.x" is Thursday, 23. Mai)