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3. IMPLEMENTATION OF THE EE1ST PRINCIPLE IN SPECIFIC POLICY AREAS

3.1. Energy markets

Participation of demand response and other demand-side resources can reduce the need for expanding generation, transmission and distribution capacities. Thus, the application of the EE1st principle implies that all regulatory barriers to enable market access of demand-side resources are removed (for electricity markets this implies proper implementation of Electricity Directive and Regulation). Moreover, it is necessary that demand response can compete on an equal footing with generation and is further promoted by setting the right incentives or requirements in power markets.

Areas to be looked at:

1) Encouraging demand response to allow consumer load participating alongside supply within the wholesale, balancing and ancillary services markets;
2) TSOs and DSOs must treat demand response providers, including aggregators, in a non-discriminatory manner and on the basis of their technical capabilities;
3) National regulatory authorities should define technical modalities for the participation in these markets based on participants' capabilities and market requirements.[1]

Examples of measures:

- Time-of-Use tariffs - enable demand response by incentivising customers to shift their electricity use from high- to low-demand periods:
  - Critical peak pricing (CPP) is designed to capture the short-term costs of periods, which are critical for the power system. It is triggered by system criteria (e.g. unavailability of reserves, extreme weather conditions that cause unexpected variations in demand, etc.).
  - Real-time pricing (RTP) - a pricing scheme in which the energy price is updated at a very short notice, typically hourly.
- Direct load control programmes - engage a large number of small consumers by directly controlling a specific type of their appliances.
- Curtailable load programs - engage medium and large consumers who receive incentives to turn off specific loads
- Capacity market programs - commit customers to providing pre-specified load reductions and receive guaranteed payments. When system contingencies arise, they are subject to penalties if they do not curtail when directed.
- Demand-side bidding programs - provide consumers the opportunity to participate in the electricity market by submitting load reduction offers. Large customers may

[1] See: JRC (2016) Demand Response status in EU Member States, JRC Science for Policy Report https://publications.jrc.ec.europa.eu/repository/bitstream/JRC101191/ldna27998enn.pdf

participate in the market directly, while small consumers can participate indirectly through third-party aggregators or load serving entities (LSEs).[2]

- Decoupling utility sales and revenues: break the link between the utility's revenue and the amount of energy it sells or transmits in order to ensure that the utility recovers its capital expenditures and operating expenses plus an authorised return on investment, no less and no more.
- Integration of increasing amounts of distributed energy resources into the electric power system by utilities, independent power producers and energy consumers.
- New regulatory incentives to research and invest into energy efficiency solutions, e.g. a bonus factor to be granted to TSOs and DSOs in network development (if TSO is hugely engaged in finding implementing (costly) energy efficiency solutions, National Regulatory Authorities could provide a bonus factor in tariffs approval/price cap).

3.2. Energy supply and distribution

Application of the EE1st principle refers to prioritising energy efficiency over investments in energy infrastructures. It can be achieved by consideration or analysis of demand-side resources or energy efficient technologies as alternatives, in particular in planning generation, storage, transmission and distribution network infrastructure. In addition, if a supply side decision is necessary, EE1st should be applied in order to choose the most efficient alternative. It is in line with the energy system integration strategy, which requires to properly factoring energy efficiency on supply side. Decisions to save, switch or share energy should properly reflect the life cycle energy use of the different energy carriers, including extraction, production and reuse or recycling of raw materials, conversion, transformation, transportation and storage of energy, and the growing share of renewables in electricity supply.

Areas to be looked at:

- Consideration of demand-side resources when evaluating investment needs for generation capacity for cost-effectiveness at the system level;
- Requirement to use cost-benefit analysis in the planning of regional district heating networks to identify the most cost-effective heat supply options and to assess these against reducing heat demand through energy efficiency in buildings and processes;
- Providing cost-optimal deployment of hydrogen infrastructures and alternative end-use efficiency measures through market design and regulation;
- Evaluating the trade-off between utility-scale and behind-the-meter energy storage facilities vs. adoption of energy-efficient appliances/equipment and demand response schemes.

Examples of measures:

- Bids to be organised to replace peak fossil fuel plants with clean generation and demand-side resources.
- Integrated distribution system planning to maximise the use of distributed energy resources, including energy efficiency and demand response, and anticipation of impact of these resources on grid needs.

[2] Analysis to support the implementation…op. cit

- Appropriate methodologies development for evaluating distributed energy resources like solar photovoltaics, energy storage, energy efficiency and demand response.
- Energy efficiency test for all energy infrastructure projects - cost-effective demand-side resources to be evaluated alongside supply-side resources in energy needs.
- Methodologies setting-up for an energy system-wide cost-benefit analysis taking into account demand-side resources alongside supply in determining investment needs.

3.3. Energy demand

While promotion of demand side solutions is at the heart of the EE1st principle, the application of the principle is also possible in energy using sectors, in particular households, services, industry, and transportation, by evaluating technology trade-offs and energy performance of different solutions. The prinicple should lead to promotion of energy efficient products and technologies.

Areas to be looked at:

- Public procurement rules should require or encourage the procurement of energy-efficient goods and services in the public sector, based on integrated cost-benefit assessments.
- Strengthen material efficiency and energy-efficient technologies as counterparts to the production of materials and energy supply.
- Reuse of waste heat.

Examples of measures:

- Linking permitting of localisation of industrial facilities generating waste heat to the possibility of connecting to local heat networks.
- Considering waste heat reuse when granting permits to installations generating large amounts of waste heat.
- Introducing requirements for purchasing top energy performance class products.

3.4. Buildings

40% of energy in the EU is consumed in buildings. As compared to other sectors, it is relatively easy and cost effective to reduce a substantial amount of the consumption by energy efficient renovation of the buildings. Large scale buildings renovations can replace the need for expansion of energy production, transmission and distribution capacities.

It is therefore crucial that buildings renovation programmes are taken into account in policies and investment decision that aim at supply adequacy and the stability of distribution networks. Moreover, buildings can actively participate in demand response scheme in their capacity of heat and cold storage and time deferred use of certain appliances. Finally, buildings are well disposed for decentralised renewable energy production and storage.

Areas to be looked at:

- Access of buildings renovation programmes to finance that was so far reserved to generation, transmission, distribution and storage capacity. Public procurement rules should require the purchase, construction and rental procurement of energy-efficient buildings, goods and services in the public sector, based on integrated cost-benefit assessments.
- Integration of energy efficiency elements into local special planning and urbanistic permitting.
- Strengthening material efficiency and energy-efficient technologies in buildings as counterparts to the production of materials and energy supply.
- Building standards, modernisation and renovation of building stock.

Examples of measures:

- Including buildings renovation in auctioning of renewable energy sources.
- Including buildings renovation in infrastructure financing.
- Access of buildings and aggregators to the capacity mechanism market and to the supply adequacy market.
- Modulation of electricity price, distribution price and other charges to stimulate demand response and electricity storage (including in form of heat) in buildings.
- Linking permitting of localisation of buildings to renewable energy potential (orientation for solar energy, space for geothermal and heat pumps, proximity of local RES communities and renewable energy production).
- Requiring a certain energy performance level or improving first the performance of the building envelope before replacements of heating systems.

3.5. Transport

Sustainable transport is at the core of the recently adopted by the Commission “Sustainable and Smart Mobility Strategy”.[3] The strategy also puts a lot of emphasis on efficiency of transport, which could be achieved via fuel switch, modal shift or transport system improvements. While reduction of energy consumption is directly linked to the

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0789&from=EN

decarbonisation objective, it is also important that energy consumption be explicitly considered in transport planning and management.

Electrification of vehicle fleets is to be accompanied by deployment of renewables, but energy efficiency is a vital component to help ensure stabilisation of the grids that are to serve electrified mobility. Application of the EE1st principle should ensure that while focussing on the fuel switch possible energy savings are not ignored.

Areas to be looked at:

- Ensuring that vehicles are designed and used in a way that is as energy efficient as possible, meaning that minimal energy is used in any particular journey;
- Assessment of the energy efficiency of different modes of transport, digital technologies, joint undertakings, and sustainable urban mobility plans (SUMPSs) but also energy- and cost-optimised national road and rail network planning and operation in the planning and management of urban and long-range mobility;
- Encouraging use of transport means based on efficiency and emission reduction potential/options for the transport of goods as well as cost-effectiveness.

Examples of measures:

- Incorporating energy consumption planning in SUMPs;
- Providing incentives for purchase and use of low energy consuming vehicles and promotion of light personal vehicles;
- Taking energy efficiency into consideration when designing traffic security rules and infrastructure objects;
- Taking into account societal benefits from energy efficiency when designing transport infrastructure (e.g. when levelling rough topography, building bridges and tunnels).

3.6. Water

Energy and water correlate closely in economic life and at many levels (‘*water-energy* nexus’). Water is needed for energy purposes, e.g. for cooling, storage, biofuels or hydropower. Energy is needed for water purposes, e.g. to pump, treat and desalinate.[4] Applying the energy efficiency first principle in the water sector means to assess solutions to break the link between energy consumption and consumption of water.

Solutions to decrease the energy demand in the water sector should apply to all types of projects, at all stages, along the whole supply chain, and when setting the (multi-) annual financial frameworks on regional and local level.

Energy efficiency first in the water sector should also be considered when assessing how municipalities’ budgets could be relieved. Especially when municipalities own the water utility, the electricity consumption of (waste) water plants might represent a significant share of their electricity bills. As, for example, the awareness, experience, capacities can vary largely from one municipality to the other, regional or national actions via Article 7 of the Energy Efficiency Directive could facilitate the investments in the water sector.

[4] Cf. Magagna D., Hidalgo González I., et al. (2019) Water – Energy Nexus in Europe, Publications Office of the European Union, Luxembourg.

Areas to be looked at:

- Reducing the amount of energy used to produce and treat different types of water;
- Reducing water demand and network losses, which translates into lower energy requirements for pumping and treatment;
- Using smart technologies and processes.

In the areas listed above following solutions could be considered:

- Energy efficient production of drinking water along the whole supply chain (distribution, use and wastewater treatment);
- Assessment of the potential of the construction of two-tier system necessary for separate treatment of storm water and sanitary wastewater (this could avoid the need for additional water treatment capacities which might result in increased energy consumption);
- Replacement of non-renewable heat generators in hot water production, e.g. production of hot water by solar collectors;
- Installation of more efficient pumps;
- Water piping infrastructures geared to current use;
- Distribution systems;
- Variable speed drives;
- Better process control and more efficient compressors and demand oriented pumps.

Examples of measures:

- Consideration of drinking and waste water infrastructure to mitigate peak loads in the electricity grid, for example by pumping drinking water when electricity demand is low;
- Use of biogas generated on site for generation of combined heat and power, feeding self-generated electricity and heat to the nearby electricity and district heating grids, when available;
- Implementation of green infrastructure practices, such as green roofs, which can retain large amount of rainwater and consequently reduce the storm water volume rate of run off entering the drainage system.

3.7. ICT

While digitalisation is typically considered as a means for managing and reducing energy demand, the rapid growth in ICT equipment and services results in higher energy consumption of the sector itself. In particular, construction of new data centres is expected to drive energy consumption up. Applying the EE1st principle refers in this case to selecting and implementing a portfolio of resources that can deliver the increasingly critical energy service of data transfer at the lowest possible cost from a societal perspective. In addition, the design and location of ICT infrastructure should be subject to assessment on energy consumption.

Similarly, the deployment of 5G networks is expected to allow for a significant increase in the capacity of wireless communications and enable technologies like the connected and autonomous mobility. Although 5G is a natively greener technology, a lot depends on the exact design and deployment of the network. Applying EE1st principle in this case refers to an approach that looks at the whole system and tackles at the same time the architecture of the network, the energy efficiency of the equipment and the software as well as the operation of the network.

Areas to be considered:

- Promoting diffusion of energy-efficient data centre facilities, waste heat reuse, and adoption of self-use renewable generation systems;
- Evaluating the efficiency of the 5G network during its design, construction and utilisation and improving it based on available technologies.

Examples of measures:

- Encouraging localisation of data centres close to heat networks;
- Setting ICT system energy performance standards and requirements;
- Promoting the use of behind-the-meter battery storage for demand response in 5G macro sites allowing for charge when the demand for internet connection service is low and discharges when it is high;
- Enabling activation of more advanced and energy-efficient Sleep Modes.