This project is funded by
the European Union

EU-INDIA
CLEAN ENERGY & CLIMATE PARTNERSHIP

A short desk study on the possible relevance of the Energy Efficiency First Principle for India

pwc

Authors:
PwC India – Rahul Bhalla, Anubha Ashtikar, Gopal Np, Rajeev Ralhan

Year: June 2023

Supported by: EU-India Clean Energy and Climate Partnership

Table of Contents

List of figures and tables

1. Introduction

1.1. Background

This study on the possible relevance of the Energy Efficiency First Principle for India, aims to understand the key elements of the Energy Efficiency First Principle applied in the EU, and to see to what extent it could be relevant in the Indian context. The study also aims to identify possible synergies with the existing energy efficiency policies in India, for integrating energy efficiency first principle in the potential sectors, which shall assist in meeting India's climate commitments.

As part of the European Green Deal, the commission presented an EU strategy for energy system integration on 8 July 2020. The energy system integration will be facilitated by the implementation of the eight legal acts of the 'clean energy for all Europeans" package adopted in 2018-2019. The strategy intends to design a more efficient and integrated system that links energy sources and infrastructure to support decarbonisation and build a climate neutral EU by 2050. This will be accomplished through three levels:

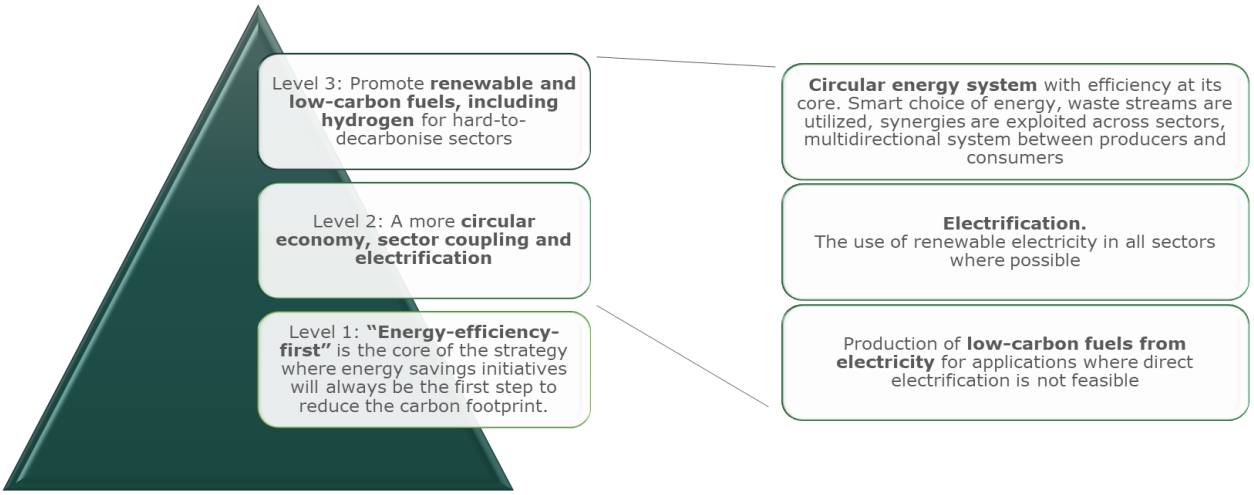

Figure 1: Levels of strategies. Sources: An EU Strategy for Energy System Integration, COM (2020) 299, The European Green Deal, COM (2019) 640

'Energy efficiency first' is at the core of the strategy, as mentioned in figure 1

Definition of the Energy Efficiency First Principle

The article 2(18) of the Regulation on the Governance of the Energy Union and Climate Action provided the following definition of the Energy Efficiency First Principle: [1] "energy efficiency first means taking utmost account in energy planning, and in policy and investment decisions, of alternative cost-efficient energy efficiency measures to make energy demand and energy supply more efficient, in particular by means of cost-effective end-use energy savings, demand response initiatives and more efficient conversion, transmission, and distribution of energy, whilst still achieving the objectives of those decisions."

The Energy Efficiency First Principle is a horizontal guiding principle of the EU's climate and energy governance that establishes that only the energy needed is produced and investments in stranded assets are to be avoided in the path of achieving climate goals.

The principle also puts forth the 'save before you build' philosophy by treating energy efficiency as the 'first fuel' in which both the public and the private sectors can invest ahead of more complex or costly energy sources. It envisages a shift from a traditional model of energy production and consumption to a more flexible system which incorporates renewable technologies and an actively engaged energy consumer base.

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021H1749&from=EN

The principle also adopts a comprehensive approach of promoting energy efficiency across the entire value chain (from energy production, network transport to final energy consumption) to promote climate neutrality so that efficiencies are achieved both in primary and final energy consumption.

The main objective of the principle is to consider actions in energy efficiency and energy demand management on par with alternative actions to a specific need or objective, particularly when energy supply or energy infrastructure investments are at stake.

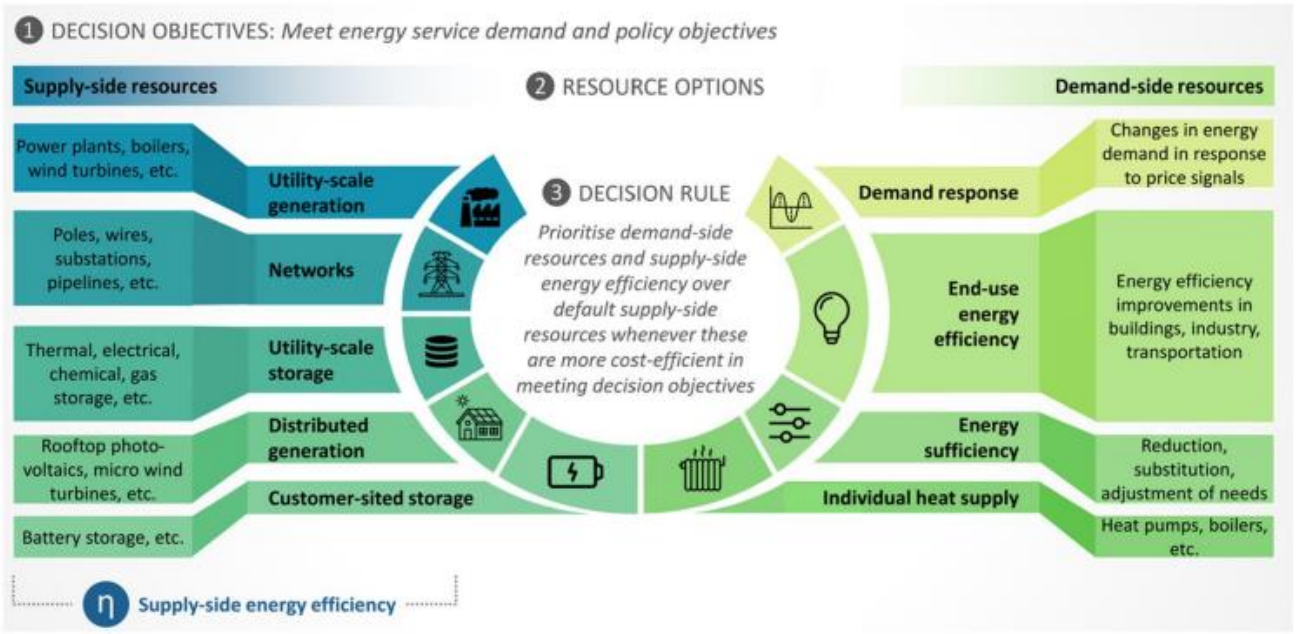

Figure 2: Conceptual framework of Energy Efficiency First principle[2]

Anchored in EU legislation

The Energy Efficiency First Principle is embedded in the Regulation on Governance of the Energy Union and Climate Action (2018/1999) and in the Energy Efficiency Directive (2018/2002).

The article 3 of the Commission's recast proposal[3] sets an obligation for EU countries to ensure that energy efficiency solutions are considered in energy system and non-energy sector's planning, policy, and investment decisions. This obligation is coupled with requirements for EU countries to:

- develop and ensure application of cost-benefit assessment methodologies that allow proper assessment of wider benefits of energy efficiency solutions from the societal perspective
- identify an entity responsible for monitoring of the application of the principle
- report to the Commission on how it is applied

The implementation of the Energy Efficiency First Principle is supported by the Commission Recommendation (EU) 2021/1749[4], which identifies specific actions to be taken by EU countries to ensure its proper application. It includes detailed guidelines, and provides further explanations, tools, and examples to help decision-makers understand and apply the principle in various contexts.

[2] https://link.springer.com/content/pdf/10.1007/s12053-022-10053-w.pdf
[3] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en
[4] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021H1749

EU-level targets

The European Commission has stepped up Europe's 2030 climate ambition by putting forward the 2030 Climate Target Plan, with a target to reduce European Union's greenhouse gas emissions by 55% (compared to 1990) by 2030 in a responsible way.

With the ongoing revision of the directive on energy efficiency proposed in the European Green Deal package in July 2021, the Commission intends to provide a stronger and wider legal basis for the application of the principle.[5]

Figure 3: Possible benefits of energy efficiency[6]

[5] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en#key-steps
[6] https://cordis.europa.eu/project/id/696077

2. Regulatory framework for Energy Efficiency First Principle – Key highlights from EU

This chapter focuses on methods of integrating the Energy Efficiency First Principle with the regulatory and policy framework, identifying the barriers, linkages with public sector, and supporting the implementation of the principle through various fiscal mechanisms. This chapter discusses the policy approaches undertaken by the EU Member States for implementing the Energy Efficiency First Principle, a mapping of the main EU legislations, and key provisions for considering the Energy Efficiency First Principle for different sectors i.e., building sector, power sector, district heating, and end-use energy efficiency. The examples of the EU Member States which have implemented the principle are illustrated in this section, including their learning experiences of the implementation, challenges and barriers, overview of the role of policies and regulatory frameworks, and the possible next steps which can be used to further enhance the application of the principle in the future. The chapter also covers a comprehensive impact assessment study that highlights the benefits and cost components for the assessment of energy-efficient measures.

The implementation of the Energy Efficiency First Principle includes the following steps:

- **Setting the right rules and legislation**
  - An enabling legal framework is required to implement the Energy Efficiency First Principle and energy-efficient measures. The legislation should identify energy efficiency as a possible solution, aid its implementation, ensure the proper follow up, and address the barriers to energy-efficient solutions.
  - An initial screening should be performed to assess if the Energy Efficiency First Principle could be applicable to a specific policy initiative, regulation, or project. The first screening should aim to identify if energy efficiency falls within the scope of a forthcoming initiative or a project. The second screening would help to clarify if energy efficiency can be applied in practice, and the third screening would help to determine if energy efficiency can be properly implemented.
  - A key aspect linked to rules and legislation is raising awareness about possible energy efficiency measures, their costs, benefits, and ways of their optimal implementation. Barriers to the Energy Efficiency First Principle and specific energy efficiency solutions should be identified and addressed through legal provisions.

- **Identifying barriers to the Energy Efficiency First Principle**
  - The identification and sub-sequent selection of energy-efficient solutions in line with the Energy Efficiency First Principle face various barriers. The ENEFIRST[7] project, in one of its work strands, identifies and divides these potential barriers into the following categories:
    - Political barriers – It is linked to a bias towards certain solutions.
    - Regulatory barriers – when regulation in place impedes the choice of energy-efficient solutions.
    - Policy interaction barriers (e.g., conflicting objectives or priorities) – It is linked to the fact that decision makers tend to look at their specific policy areas.
    - Financial barriers – It is linked with the insufficient funds or financial aid to energy-efficient solutions
    - Technical barriers – It is linked with the energy-efficient solution being technically more difficult to assess.
    - Information barriers – It is linked with the lack of information and data available to properly identify and estimate benefits of energy-efficient solutions.
    - Cultural and behavioural barriers – It is linked with the behaviour and habits limiting the scope of options considered.

[7] https://www.bpie.eu/publication/report-barriers-to-implementing-e1st-in-the-eu-28/

        - Communication/awareness barriers – It is linked with the lack of awareness about energy efficiency options.
        - Lack of expertise – It is linked with the insufficient knowledge on implementation of energy-efficient solutions or technologies.
        - Bias towards the supply-side stakeholders in policy or decision making.
        - Supply chain barriers – It is linked with the concept that the energy markets are designed from a supply-side point of view, so energy efficiency could be disruptive to the existing system.
    - The policy makers should build the necessary administrative capacity and expertise in energy efficiency, ensure that sufficient financial resources are available to public bodies for assisting market entities and consumers in the implementation of energy-efficient solutions, and monitor the policy impacts.

- **Integrating the principle in the policy and legal framework**
    - Energy efficiency policy defines specific measures and objectives for energy efficiency as well as its supporting and enabling conditions. The Energy Efficiency First Principle evaluates and enables application of energy-efficient alternatives for decisions affecting energy consumption, energy supply, and implementation of energy-efficient solutions.
    - The form of actions required for the implementation of energy-efficient solutions are defined in energy efficiency policy measures. The legal form of these actions forms a part of energy policy development. For example, to encourage energy efficiency and overcome barriers indicated above, encouragement for energy efficiency solutions could take form of specific energy efficiency targets. Another way is to set mandatory energy savings obligations on energy providers requiring them to reduce their customers' energy use.[8]
    - Objectives of the Energy Efficiency First Principle can be achieved by any binding target and prescriptive requirement to use energy-efficient solutions. However, the form of such requirements, their stringency and obligation they impose, are issues to be considered as part of energy-related policy.

- **Incentivising Energy Efficiency First Principle**
    - Energy efficiency might not be preferred by utilities as when consumers save energy, the sale of the utilities is less. Therefore, it is important to change the energy business models to the kind that favour higher energy sales to business models that reward energy services or a certain level of comfort. For example, the model of 'energy efficiency as a service'.
    - Another disincentive is the fact that the purchase of energy-efficient equipment or building renovations require relatively high upfront costs while the payback periods can be long.
    - For the above reasons, enabling energy efficiency is often not sufficient and direct or indirect incentives are needed, so that wider benefits of energy efficiency measures for society are considered in decision making. The incentives should influence the choice of individuals so that they are beneficial for the system.

- **Funding and financial support**
    - Supporting implementation of a dedicated vehicle for energy efficiency
        - Dedicated funding should be aimed to support and promote energy efficiency projects and provide clarity to the investors on the availability of financial support. There are currently limited public funding schemes ring-fenced to energy efficiency projects, although energy efficiency is eligible under various funding programmes.
        - Stronger incentives for energy efficiency investments can be provided by setting up a dedicated energy efficiency fund or scheme. Such a fund would help to create an exemplary framework under which the Energy Efficiency First Principle is applied. Typically, package solutions combining funding support with advisory services have a higher absorption rate and it benefits from higher leverage[9].
    - Applying the Energy Efficiency First Principle to all relevant areas of EU funding instruments
        - Energy efficient projects should be prioritised by defining eligibility criteria for financial support by setting energy efficiency targets and benchmarks. Whenever possible, EU funds may establish (sector or technology-specific) energy consumption or efficiency improvement thresholds based on best available technologies.

[8] https://www.sciencedirect.com/science/article/pii/S0301421514002705#bib7
[9] https://onlinelibrary.wiley.com/doi/full/10.1002/wene.384

        - Managing authorities should consider energy efficiency while setting selection criteria for measures in those sectors where the Energy Efficiency First Principle could be implemented so that projects applying the principle could be prioritised.
    - Providing technical assistance to help fund managers and project promoters applying the Energy Efficiency First Principle
        - The European Commission can offer advisory services to the managing authorities to help them to operationalise the Energy Efficiency First Principle in their programmes, notably through the Technical Support Instrument.[10]
        - Technical assistance will help managing authorities, financial institutions, and project promoters to use adequate indicators and methodologies measuring energy savings, and it may cover a part of the monitoring requirements such as energy audits for the considered assets.
    - Reflecting the Energy Efficiency First Principle in State aid guidelines
        - Energy and Environmental State aid guidelines and General block exemption Regulation, both of which are currently under revision, address energy efficiency[11]. This is relevant for OPs which, being under shared management, are not exempted from the state aid by default. This may also apply to projects funded under the Recovery and Resilience Facility.

- **Providing information**
    - Some of the barriers to applying the Energy Efficiency First Principle are the lack of awareness about energy saving potentials, its possible benefits, and ways to assess it.
    - It is important to raise awareness and knowledge about potentials and wider impacts of energy efficiency in different sectors and associate energy efficiency with the increase of comfort, performance, and quality.
    - Awareness to choose to invest in energy efficiency should be provided to the citizens along with information that dilutes the negative influence of cognitive biases such as by providing information on future cost savings, environmental, and social benefits.[12] Thus, effective information campaigns need to address background knowledge, preferences, and cognitive biases influencing energy-related decisions.[13]
    - Capacity building of the relevant stakeholders has to be ensured to analyse the information and data available.
    - In the context of the Energy Efficiency First Principle, it is also important to ensure that information on energy efficiency options and their potential benefits should be provided to authorities and market entities to facilitate them with their planning or investment decisions. The information provided should present expected energy savings of a given action, technology, or solution and should get implemented.
    - One important tool to be considered is the De-risking Energy Efficiency Platform (DEEP) database[14] with energy and financial performance data from energy efficiency projects supported by EU, national, and local public funding.

- **Leading role of public sector**
    - Prioritisation of energy efficiency puts a responsibility on public authorities to lead by example. Even if the overall impact might not be significant in absolute terms, public bodies have an important role in promoting energy-efficient behaviour, products, and services. It is also vital that prioritisation of energy efficiency in the public sector is presented as an example of sustainable and sound management of public funds. Public sector can set example in various ways, for instance by:
        - Setting specific objectives for public buildings in terms of energy performance or renovation rates.
        - Strengthening the procurement of energy-efficient products and services.
        - Using energy services and energy performance contracting,[15]undertaking energy audits, and implementing energy management systems.

[10] https://eur-lex.europa.eu/EN/legal-content/summary/eu-technical-support-instrument-2021-2027.html.
[11] https://ec.europa.eu/competition-policy/public-consultations/2021-ceeag_en
[12] https://publications.jrc.ec.europa.eu/repository/handle/JRC124667
[13] http://publications.europa.eu/resource/cellar/05ffd175-f97e-4237-9061-8f9689298dff.0001.03/DOC_1#page=18&zoom=100,92,96
[14] https://deep.eefig.eu/
[15] https://publications.jrc.ec.europa.eu/repository/handle/JRC123985.

The regulation of Energy Efficiency First Principle is dependent on the policy framework. Defining policy targets requires to set objectives based on results and desired impact. The policy should define indicators and methodology for monitoring targets, including monitoring and evaluation protocols to monitor the impacts of energy consumption of the actions taken. The regulatory framework for the Energy Efficiency First Principle can be formulated with the above-mentioned steps to achieve desired energy efficiency targets.

Policy approaches in the EU Member States for implementing the Energy Efficiency First Principle for different sectors:[16]

The following section provides key provisions for consideration of EE1st principle for each of the main EU legislation for sectors such as buildings, power, district heating, end-use energy efficiency followed by the possible tools and methodologies to conduct a detailed Cost Benefit Analysis (CBA) as a part of the detailed impact assessment as undertaken by the EU. The section also highlights a some examples of EU member states which have implemented the EE1st principle.

- **Building sector:** The table gives a mapping of the main EU legislations for the building sector and key provisions for considering the Energy Efficiency First Principle. A detailed description of the relevant articles is given below.

Table 1 Detailed description of the relevant articles for building sector

Main EU Legislation for the building sector	Key provisions for considering the Energy Efficiency First Principle	Summary
Energy Performance of Buildings Directive (2010/31/EU; (EU)2018/844)[17]	• Long-term renovation strategies (EPBD, Article 2a) • Energy Performance Certificates informing citizens and businesses (EPBD, Article 11) • Minimum energy performance standards and calculating energy performance of buildings (EPBD, Articles 4 and 5, and Annex III) • Nearly zero-energy buildings: definition and timing of implementation (EPBD, Article 9) • Building modernisation and technical building systems (EPBD, Article 8) and inspections (EPBD, Article 14- 16) • Energy performance contracting (EPBD, Article 18)	The Energy Performance of Buildings Directive (EPBD) legislation has an overall goal of getting the Energy Efficiency First to be in alignment with the objectives set in the Paris Agreement, but it lags in its similar application in all articles as well as differences in implementation by the EU Member States
Renewable Energy Directive ((EU) 2018/2001)	• Implementing EE1st in renewable energy policy measures related to the buildings (RED, Article 15) • Article 23 on heating and cooling in buildings	The Renewable Energy Directive sets a binding target of 32% for overall share of energy from renewable sources in the EU by 2030.[18] It also established sustainability and GHG emissions saving criteria for biofuels, bioliquids, and biomass fuels.

[16] https://enefirst.eu/wp-content/uploads/D4.1_Priority-areas-for-implementing-Efficiency-First.pdf
[17] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0844&from=IT
[18] https://euagenda.eu/upload/publications/eprs-bri2021662619-en.pdf

Governance Regulation (EU) 2018/1999	• Article 3 on NECPs (National Energy and Climate plans)	The National Energy and Climate Plans (NECPs) provide a framework to implement the energy policies of EU Member States and they can play a pivotal role in the long term if they are applied in a systematic way by assessing both demand and supply options.
Energy Efficiency Directive (2012/27/EU ; (EU) 2018/2002)	• Renovation obligation for central government buildings, and an exemplary role of the public sector (EED, Article 5)	The practise of increasing the renovation wave by putting first the demand-side options in public buildings can serve as a good practice.

- **Long-term renovation strategies (Article 2a):** This article states that each EU Member State shall establish a long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private, into a highly energy efficient and decarbonised building stock by 2050, facilitating the cost-effective transformation of existing buildings into nearly zero-energy buildings. It also states that each Member State must prepare a comprehensive long-term renovation strategy (LTRS) in the framework of its NECP, following the former Article 4 of the EED now transferred to the EPBD (new Article 2a). The provisions in Article 2a states that each member state needs to show how they support actors and prioritise interventions and their investments to achieve the overall objective (highly energy-efficient and decarbonised building stock by 2050), and hence the approach of the LTRS corresponds to the Energy Efficiency First Principle.

- **Energy Performance Certificates informing citizens and businesses (EPBD, Article 11):** The Energy Performance Certificates (EPCs) must be issued by the independent energy advisors as they are a useful tool for citizens, markets, and policy makers. An EPC includes the current energy performance of buildings and the minimum energy performance requirements. It can be used to compare and assess the building's energy performance. It can be used as a demand-side resource energy planning for buildings as well.

- **Minimum energy performance standards and calculating energy performance of buildings (EPBD, Articles 4 and 5, and annex III):** The Energy Performance of Buildings Directive (EPBD) sets out the methodology to assess the minimum requirements for setting the energy performance requirement in buildings. The EU Member States are free to adopt and implement more ambitious prerequisites based on their requirements. The methodology specifies that the energy needs "shall be calculated in order to optimize health, indoor air quality and comfort levels."

- **Nearly zero-energy buildings: definition and timing of implementation (EPBD, Article 9):** 'Nearly zero-energy building' (NZEB) describes that a building with very high energy performance and the energy requirement (nearly zero or very low amount) should be covered from renewable energy sources to a very significant extent. The EPBD mandates that all buildings built from the end of 2020 should adhere and built according to the NZEB standards. NZEB sets the energy requirements in terms of primary energy use.

- **Building modernisation and technical building systems (EPBD, Article 8) and inspections (EPBD, Article 14-16):** The Energy Performance of Buildings Directive (Article 2(3)) defines the term TBS (technical building systems) as "the technical equipment for space heating, space cooling, ventilation, domestic hot water, built-in lighting, building automation and control, onsite electricity generation or a combination thereof, including those systems using energy from renewable sources, of a building or building unit." Smart technologies in buildings such as digitalisation and building automation and integrating components such as electric vehicles charging infrastructure can help accelerate decarbonisation in buildings.

- **Energy performance contracting (EPBD, Article 18):** The Energy Performance Contracts are a contractual agreement between the Energy service companies (ESCOs) and the end user to finance energy efficiency projects with an agreed financing term and a repayment agreement. The EPCs can be an effective tool to

implement the Energy Efficiency First Principle as it helps in the aggregation of energy efficiency projects into investment pools, and this can help investors who invest above a certain size.

- **Implementing Energy Efficiency First Principle in the renewable energy policy measures related to buildings (RED, Article 15)**[19]**:** The integration of renewable energy sources (RES) in buildings by using solar water heaters or heat pumps or district cooling and heating is best done when complemented by building renovations. The Article 15 of the RED requires the EU Member States to ensure that national goals set for renewable energy sources contribute to the implementation of the Energy Efficiency First Principle.

- **Article 23 on heating and cooling in buildings:** This article requires the EU Member States to gradually increase the share of renewables in heating and cooling by 1.3% per year between 2020 and 2030. This can be achieved by either increasing the share of renewables in heating and cooling or reducing the final consumption in heating and cooling applications.

- **Renovation obligation for central government buildings, and exemplary role of the public sector (EED, Article 5)**[20]**:** The Article 5 of the Energy Efficiency Directive mandates that 3% of the total floor area of heated and/or cooled public buildings (those occupied by the central government) is renovated every year to meet the minimum energy performance requirements set in the Energy Performance of Buildings Directive (EPBD).

- **Power sector:** The table gives a mapping of the main EU legislations for the power sector and key provisions for considering the Energy Efficiency First Principle. A detailed description of the relevant articles is given below.

Table 2 Detailed description of the relevant articles for power sector

Main EU Legislation for the Power Sector	Key provisions for considering the Energy Efficiency First Principle	Summary
Directive (EU, 2019/944) on common rules for the internal market for electricity[21]	• Article 11 on entitlement to dynamic tariff • Article 13 on entitlement to aggregator contract • Article 17 on the market access of aggregators • Article 21 on entitlement to smart meter • Article 32 on DSO (Distribution system operator) planning and operation • Article 40 on TSO (Transmission system operator) operation • Article 51 on TSO planning • Article 59 on smart grid reporting by national regulatory authorities	The Directive establishes common rules for the generation, transmission, distribution, energy storage, and supply of electricity. The Directive aims to ensure affordable, transparent energy prices and costs for consumers, a high degree of security of supply, and a smooth transition towards a sustainable low-carbon energy system. It defines the required principles at the EU level and leaves the scope or opportunity for member states for their own national interpretation.
Regulation (EU, 2019/943) on the internal market for electricity[22]	• Article 3 on the principles of market operation • Article 12 on non-discriminatory DR dispatch	This regulation aims to set the basis for an efficient achievement of the objectives of the Energy Union, and in particular the climate and energy framework by for

[19] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018L2001
[20] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0027&from=EN
[21] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2019.158.01.0125.01.ENG&toc=OJ:L:2019:158:TOC
[22] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2019.158.01.0054.01.ENG&toc=OJ:L:2019:158:TOC

	• Article 18 on network tariff design and on DSO incentives • Article 20 on market reform plans • Article 22 on capacity market design	2030. Many elements of this directly applicable legislation are essential to set the status of demand-side resources.
Commission proposal (COM (2020) 824 final) for the revised Regulation (EU, 347/2013) on guidelines for trans-European energy infrastructure[23]	• Article 12 on scenario assumptions • Article 13 on non-wire solutions • Annex V on the integration of E1st in cost-benefit analysis	This COM (Commission Proposal) furthers the proposal of using the Energy Efficiency First Principle in project assessments and the need for considering other alternatives to the infrastructure investments.

- **Article 11 on entitlement to dynamic tariff/ electricity price contract:** The article states that Member States states must ensure that their national regulatory frameworks enable suppliers to offer dynamic electricity pricing contracts. Member States shall ensure that final customers who have a smart meter installed can request to conclude a dynamic electricity price contract.

- **Article 13 on entitlement to aggregator contract:** The article states that EU Member States shall ensure that all customers are free to purchase and sell electricity services, including aggregation, other than supply, independently from their electricity supply contract and from an electricity undertaking of their choice.

- **Article 17 on the market access of aggregators:** Member States shall allow and foster participation of demand response through aggregation. Member States shall allow final customers, including those offering demand response through aggregation, to participate alongside producers in a non-discriminatory manner in all electricity markets.

- **Article 21 on entitlement to smart meter:** This article states that each member state shall ensure that every final customer is entitled on request, while bearing the associated costs, to have installed or where applicable have upgraded under fair, reasonable, and cost-effective conditions, a smart meter.

- **Article 32 on DSO planning and operation:** Member States shall provide the necessary regulatory framework to allow and provide incentives to distribution system operators to procure flexibility services, including congestion management in their areas, to improve efficiencies in the operation and development of the distribution system. In particular, the regulatory framework shall ensure that distribution system operators are able to procure such services from providers of distributed generation, demand response or energy storage. It shall also promote the uptake of energy efficiency measures, where such services cost effectively alleviate the need to upgrade or replace electricity capacity and support the efficient and secure operation of the distribution system.

- **Article 40 on TSO operation:** The article states that each transmission system operator shall be responsible for ensuring the long-term ability of the system to meet the reasonable demands for transmission of electricity, operating, maintenance, and developing reliable and efficient transmission system.

- **Article 51 on TSO planning:** The article states that at least every two years the transmission system operators shall submit to the regulatory authority a ten-year network development plan based on existing and forecast supply and demand after having consulted all the relevant stakeholders.

- **Article 59 on smart grid reporting by national regulatory authorities:** The article states that the regulatory authority has the duty of monitoring and assessing the performance of transmission system operators and

[23] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2020:824:FIN

distribution system operators in relation to the development of a smart grid that promotes energy efficiency and the integration of energy from renewable sources.

- **Article 3 on the principles of market operation:** This article lists down the principles of operation of electricity markets, some of them being: prices shall be formed based on demand and supply, market rules shall facilitate the development of more flexible and sustainable low carbon generation, more bendable demand and market rules shall enable the decarbonisation of the electricity system.

- **Article 12 on non-discriminatory DR dispatch:** This article states that the dispatching of power-generating facilities and demand response shall be non-discriminatory, transparent, and based on market research.

- **Article 18 on network tariff design and on DSO incentives:** This article states that charges applied by network operators shall be cost-effective, transparent, and are applied in a non-discriminatory manner. The tariff methodologies should reflect fixed costs of TSOs and DSOs and shall also provide incentives to both in the short and long term to increase efficiencies, including energy efficiency.

- **Article 20 on market reform plans:** The article states that member states shall develop and publish implementation plans with measures to identify and eliminate regulatory distortions or market failures and should submit the implementation plan to the Commission for a review.

- **Article 22 on design principles for capacity mechanisms:** The article lists out steps for designing capacity mechanisms which includes designs of strategic reserves, requirements regarding CO2 emission limits, and compliance requirements.

- **Article 12 on scenario assumptions:** The article lists down scenarios for the ten-year network development plans and states that by 31st July 2022, the agency shall publish the framework guidelines for the joint scenarios to be developed by ENTSO for Electricity and ENTSO for Gas and the guidelines shall include the Energy Efficiency First Principle.

- **Article 13 on non-wire solutions:** The article states that in every two years ENTSO for electricity and ENTSO for gas shall publish and submit to the Commission and the Agency the infrastructure gaps developed within the framework of the ten-year network development plans of the Union. Further, while assessing the infrastructure gaps, the ENTSO for electricity and ENTSO for gas shall implement The Energy Efficiency First Principle and prioritise non-infrastructure related solutions to address the identified gaps.

- **Annex V on the integration of E1st in cost-benefit analysis**[24]**:** This annexure states the energy-system wide cost-benefit analysis. It includes the methodology for a harmonised energy system-wide cost-benefit analysis for projects and explains the implementation of the energy efficiency first principle in all the steps of the ten-year 'Network Development Plans.'

- **District heating:** The table gives a mapping of the main EU legislations for the district heating sector and key provisions for considering the Energy Efficiency First Principle. A detailed description of the relevant articles is given below.

Table 3 Detailed description of the relevant articles for district heating

Main EU legislation for the district heating sector	Key provisions for considering the Energy Efficiency First Principle	Summary

[24] https://eur-lex.europa.eu/resource.html?uri=cellar:cc5ea219-3ec7-11eb-b27b-01aa75ed71a1.0002.02/DOC_2&format=PDF

Energy Efficiency Directive ((EU) 2018/2002)[25]	• Article 14 on promotion of efficiency in heating and cooling • Annex VII on potential for efficiency in heating and cooling • Annex IX on cost-benefit analysis	This provides an opportunity to integrate the DHC planning, but the provisions are limited to supply-side efficiency and disregards contribution of demand-side efficiency measures to meet the cooling and heating needs.
Renewable Energy Directive ((EU) 2018/2001)[26]	• Article 15 on administrative procedures, regulation, and codes • Article 24 on district heating and cooling	It states that the deployment of District Heating plants must also incorporate the Energy Efficiency First Principle.

- **Article 14 on promotion of efficiency in heating and cooling:** The Energy Efficiency Directive (EED) requires Member States to carry out comprehensive assessments to find out the efficiency of district cooling and heating systems to meet the state's identified cooling and heating needs, and it includes a cost-benefit analysis (CBA).

- **Annex VII on potential for efficiency in heating and cooling:** This annexure states the minimum requirements for billing and billing information based on actual consumption. It further narrates that the energy distributors, DSOs, and retail energy sales companies shall provide the customers with information about where they can obtain advice on available energy efficiency measures, benchmark profiles for their energy consumption, and technical specifications of energy using appliances that can serve to reduce the consumption of these appliances.

- **Annex IX on cost-benefit analysis:** It contain two parts, and it lays down the general principles of cost-benefit analysis, economic analysis, sensitivity analysis, and principles for applying these analyses.

- **End-use energy efficiency:** The table gives a mapping of the main EU legislations for the end-use energy efficiency sector and key provisions for considering the Energy Efficiency First Principle. A detailed description of the relevant articles is given below.

Table 4 Detailed description of the relevant articles for end-use energy efficiency

Main EU Legislation for the end-use energy efficiency sector	Key provisions for considering the Energy Efficiency First Principle	Summary
Energy Efficiency Directive (2012/27/EU[27]; (EU) 2018/2002[28])	• Articles 1 and 3: headlines energy efficiency target • Article 5: renovation target for central government buildings • Article 7: energy savings obligation, EEOS and alternative measures • Article 8(4): mandatory energy audits for non-SMEs • Articles 14 and 15: efficiency in the supply side	The EED sets the energy efficiency target at the EU-level, and other provisions relating to this directive aims at ensuring that the conditions for the target can be achieved. The directive mandates investors and stakeholders to consider energy efficiency options in their investment plans and this way it implements the Energy Efficiency First Principle.

[25] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32018L2002
[26] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32018L2001
[27] https://eur-lex.europa.eu/eli/dir/2012/27/oj
[28] https://eur-lex.europa.eu/eli/dir/2018/2002/oj

Directive 2009/125/EC establishing a framework for the setting of eco-design requirements for energy related products[29]	• Article 15: implementing measures	This article provides inputs about the energy efficiency improvements for scenarios and energy planning and is complementary to the Energy Efficiency First Principle.
Regulation (EU) 2017/1369 setting a framework for energy labelling	• Articles 3 to 8: defining obligations of market actors	This regulation acts as a support measure for market transformation with impacts that can be considered in energy planning.

- **Article 1 and 3: Headline energy efficiency targets:** Both these articles set the overall objectives of achieving the energy efficiency improvements of 20% by 2020 and 32.5% by 2030. Article 1 states that 'this Directive contributes to the implementation of the Energy Efficiency First Principle.' Articles 1 and 3 of the Energy Efficiency Directive also require each EU Member States to adopt their national energy efficiency targets for 2020 and 2030.

- **Article 5: Renovation targets for central government buildings:** Each member state should ensure that from 1st January 2014, 3% of the total floor area of heated and/or cooled buildings which is owned or occupied by the central government shall be renovated each year to meet the minimum energy performance requirements.

- **Article 7: Energy savings obligation, EEOS and alternative measures:** The article states that each EU Member States shall setup energy efficiency obligation scheme.

- **Article 8(4): mandatory energy audits for non-SMEs:** The article states that "Member States shall ensure that enterprises that are not SMEs are subject to an energy audit carried out in an independent and cost-effective manner by qualified and/or accredited experts or implemented and supervised by independent authorities under national legislation by 5 December 2015 and at least every four years from the date of the previous energy audit."

- **Articles 14 and 15: efficiency in the supply side:** Article 14 states that member states should carry out a comprehensive assessment of potential of high-efficiency cogeneration and efficient district cooling and heating. Article 15 relates to energy transformation, transmission and distribution, and states that 'Member States shall ensure that national energy regulatory authorities pay due regard to energy efficiency in carrying out the regulatory tasks specified in Directives 2009/72/EC and 2009/73/EC regarding their decisions on the operation of the gas and electricity infrastructure.'

- **Article 15: Implementing measures:** This article provides the criteria for implementing measure or by a self-regulation measure in accordance with the paragraph 3(b) of the article under the directive (DIRECTIVE 2009/125/EC) for establishing a framework for the setting of eco-design requirements for energy-related products.

- **Examples of EU Member states that have implemented the EE1st principle:**

The below examples provide experience of EU Member states that have implemented the EE1st principle in practice and gives an overview of the role of the policies, regulatory frameworks, and other initiatives that have supported the implementation of the principle. It also provides the lessons learnt and the possible next steps which can be used to further enhance the application of the principle in the future and also serve as a guidance for other countries.[30]

- **Example 1 (Energy Sector):** Usage of time-of-use (ToU) tariffs for integrating variable renewable technologies and limiting investments in peak capacity is one example which is implemented in Europe

[29] https://eur-lex.europa.eu/eli/dir/2009/125/oj

[30] https://enefirst.eu/wp-content/uploads/D2-2-Report-on-international-experiences-with-E1st.pdf

since the 1960s. ToU tariffs incentivise customers to voluntarily adjust their electricity usage to reduce their expenses, either through automation or manually. The price signals vary depending on the time of day to reflect the increased marginal network costs and/or generating cost of electricity.

- **Implementation of the Energy Efficiency First principle:** To implement ToU tariffs, advanced metering devices need to be provided to the customers to track their consumption patterns. If the investments are done in such cost-effective ToU equipment, as well as in the operating of the overall demand response programmes, and if such investments are preferred over investments in supply-side infrastructure, the Energy Efficiency First Principle is met.
  Many EU Member States have already implemented ToU tariffs. Real-time pricing (hourly) is the preferred method in six countries: Estonia, Latvia, Spain, Slovakia, Slovenia, and Bulgaria. Static pricing is the most common type of ToU tariff method which is applied to 15 countries in the EU. This method of demand response mechanism using the ToU tariffs can be implemented for different types of consumers, be it residential, commercial, or industrial, and it requires advanced metering infrastructure.

- **Example 2 (Demand-side management):** Regulating the demand response or demand-side management by improving the load factor in the households in EU Member States. The aim of DSM is not only to reduce the energy consumption but it also avoids cost relating to grid and capacity expansion. By shaping the heat demand and reducing the demand peaks, it has the potential to increase the network efficiency, integrate renewable energy sources, and reduce the capital costs within the network.
  - **Implementation of the Energy Efficiency First principle:** This example implements both the energy efficiency and demand response mechanisms to achieve the objectives of the principle. By reducing the peak demand or increasing the load factor, it allows the option to reduce the network size or reduce the operational costs. Demand-side management is an important method which is foreseen to be imbedded in the future energy systems.
  - The European Commission's proposal on the Energy Performance of Buildings Directive (EPBD) integrates the readiness of buildings for demand response by introducing a 'smart indicator' which rates the readiness of buildings to adapt to the occupant as well as to the grid to improve performance. Implementation of demand response (DR) into district heating projects will help increase the flexibility and efficiency of the entire system.

- **Example 3 (Electricity markets):** The Block Exchange Notification of Demand Response mechanism, known as "NEBEF", in France allows aggregators and third-party players to render demand response services at wholesale power markets. The main objective of the NEBEF scheme is to organise financial flows between actors to allow them to participate for demand response on the wholesale electricity market which includes direct participation of aggregators and third-party players. This mechanism is operational since 2014.
  - One of the mechanisms managed by the TSO (Transmission System Operator) to balance electricity demand and supply in real-time is to open up primary and secondary reserves for the resources connected to the grid.
  - **Implementation of the Energy Efficiency First principle:** The participation of demand response in electricity markets reduces the electricity produced and avoids unnecessary investments in the supply side in the long term. It also benefits consumers by lowering energy bills and allows accommodation of a larger share of variable renewables. Its participation in the energy markets has been associated with enabling the Energy Efficiency First principle. The scalability potential is high as many EU Member States lag in terms of valuing demand response in electricity markets and the regulatory safeguards in France can act as a good starting point for other countries in the EU and elsewhere that plan to rely on demand-side resources more in the future.

- **Example 4 (Digital building logbook for the buildings sector):** A digital building logbook to identify and exploit efficiency potentials in buildings has been developed in Belgium to collect information on a specific building's renovation history and in future reduce the energy demand in buildings. The implementing body is the Flemish Energy Agency (VEA), and it is ongoing since 2018. A digital building logbook is a digital repository which collects information of buildings such as the ownership, building design, structures and material used, investments, operational costs, maintenance costs, performance indicators, certifications

etc. The digital logbook collates the data and updates it when new changes occur. The Dutch Woningpas[31] is a building-specific datafile and it is the most advanced logbook in the EU (as of 2020). The Dutch Woningpas collects buildings data such as the energy performance, housing quality, and data on the environment. Its first version was launched in 2018.

- Through the development of the digital logbook and the EPC+ (Energy Performance Certificate), the Flemish Energy Agency (VEA) intends to improve the energy performance of buildings and contribute to the country's long-term climate objectives.
- **Implementation of the Energy Efficiency First principle:** The digital building logbook records and gives details about the current energy performance level of the buildings and acts as a register to record all the efficiency measures taken so far and combines that with a roadmap for improving the energy performance. The Energy Efficiency First Principle is applied as the logbook puts energy efficiency measures before the renewable energy measures. The logbook lists the measures that can be taken to reduce the overall energy demand of the specific building before increasing the capacity of energy supply and it also gives the cost information of different measures. The replicability potential is high which can be seen by countries such as Germany and France taking similar measures such as the 'Individueller Sanierungsfahrplan' in Germany and the 'EFFICeat' in France[32]. The European Commission has conducted a feasibility study and more countries are expected to develop a building logbook and registries.

Policy assessment and proposed guidelines to ensure Energy Efficiency First Principle:

A policy assessment to determine the alternatives on the demand side should be conducted after the identification of options that could provide desirable objectives to ensure enabling conditions for energy-efficient solutions. Strategies for energy efficiency could explore ambitious energy efficiency actions e.g., modelling a high energy efficiency scenario, determined with its cost effectiveness or feasibility.

Regulatory impact assessment or cost-benefit analysis (CBA) should analyse the viable options preceding political, planning, or investment decisions. To assess the impact of policy and ensure Energy Efficiency First Principle, the following guidelines can be considered:

- Barriers to the application of energy efficiency should be considered.
- Policy objectives should define the use and priority of cost-efficient energy efficiency solutions.
- Wide spectrum of options should be identified, specifically looking at demand-side solutions and energy efficiency improvements.
- Impacts of various options on energy consumption should be evaluated (preferably both for final and primary energy consumption) and the assessment should consider these impacts in current projections of energy demand.
- Costs and benefits of the options from the perspectives of different stakeholders such as the society, the market actors, energy efficiency plans implementing agency, and the final consumer should be evaluated.
- The assessment should apply the Life Cycle Assessment approach and carbon pricing assumptions to assess environmental, social, and economic impacts, including distributional impacts and the alleviation of energy poverty.
- Sensitivity analysis for different discount rates considered in the CBA analysis as well as energy efficiency measures should be pushed to the maximum in case of a full CBA analysis.
- The preferred option should be evaluated in terms of its integrity with energy efficiency targets and actions as well as with other strategic objectives and principles.
- Operational steps and objectives should be identified to enable implementation of energy-efficient solutions.
- Monitoring of energy savings achieved should be included in the policy or investment evaluation provisions.

Possible tools and methodologies:

As analysed in the various articles in the previous section of this report, there is an obligation to ensure that energy efficiency solutions are considered in energy systems and non-energy sectors planning, policy and investment decisions. This obligation is coupled with requirements to develop and ensure application of cost-benefit assessment methodologies that allow proper assessment of wider benefits of energy efficiency solutions from the societal

[31] http://www.energiesparen.be/woningpas
[32] http://www.passeport-efficacite-energetique.fr/

perspective and monitoring of the application of the principle. This section proposes the tools and approaches to identify the mechanism for the implementation of the EE1st principle.

A cost benefit analysis (CBA) can be a stand-alone analysis or a key component of a more comprehensive impact assessment. All CBAs should use Life Cycle Assessment methods[33]and consider carbon pricing projections. CBA for Energy Efficiency First Principle should consider the societal perspective when evaluating the costs and benefits of various options. Comparison and analysis of options should consider all impacts of energy savings. A CBA should consider the wider benefits, including those that are not easily priced.

Wider benefits of energy efficiency may be difficult to quantify or monetise. Finding the right data and capturing the links between energy efficiency and social, environmental, or economic indicators may be challenging. The lack of information may be an issue at the local level and is also linked to the availability of data on actual energy savings achieved after implementation of a measure.

A comprehensive impact assessment can be conducted as a part of investment or policy decisions with impact on energy consumption or energy supply. The energy-efficient solutions should also be analysed through the perspectives of the society, implementing entity or final user. Table 1 shows the benefits and cost components for the assessment of energy-efficient measures from different perspectives, which is followed by detailing out the impact of energy efficiency measures and its linkages with social, environmental and economic aspects.

Table 5 Benefit and cost components for the assessment of energy efficiency measures from different perspectives

Cost Benefit Analysis (CBA) for energy efficiency measure Perspective of:	Society	Market actors implementing measures, (e.g., energy company)	Final consumer
Avoided energy supply system costs (generation and capacity costs, grid losses, transformation losses and grid reinforcement costs, etc.)	Benefit	Benefit	
Wider benefits or co-benefits	Benefit	Benefit	Benefit
Incremental technology costs	Cost		Cost
Programme/measure implementation costs	Cost	Cost	
Incentive payments		Cost	Benefit
Energy bill savings			Benefit
Lost marginal revenue		Loss	

- **Social impacts:**
  - **Human health and well- being**
    - Human health is one of the most important co-benefits of energy efficiency. Health benefits of energy efficiency and its impacts in terms of air quality can be translated into economic terms using an approach based on coefficients (e.g., health costs associated with illnesses).
    - Methods employed to measure this output indicator are generally based on the mean value of life, obtained through contingent valuation studies or willingness to pay surveys.
    - BPIE[34] developed a methodology on how to define, measure, quantify, and monetise the impact of improved indoor environmental quality (improved thermal comfort, indoor air quality, lighting, and acoustics[35]) in schools, hospitals, and offices. The presented approach extrapolates average results into achievable percentage improvements in performance and productivity.
  - **Energy poverty**

[33] https://eplca.jrc.ec.europa.eu/

[34] https://www.bpie.eu/wp-content/uploads/2018/12/BPIE_methodology_031218.pdf

[35] https://ec.europa.eu/environment/archives/noise/pdf/020414noisereport.pdf

- Energy poverty can be understood as a state of deprivation of basic energy services, which is an energy-related manifestation of general poverty, and which has been shown to hold the risk of increased morbidity or even mortality.
- The projected or energy cost savings for vulnerable households or increased indoor comfort levels should be the focus of impact assessment while examining the benefits of energy efficiency programmes concerning energy poverty alleviation.
- In countries where healthcare costs are high, improved housing conditions can help in health improvements and lowering the medical expenses, which will help in conserving the disposable income.

- **Environmental impacts:** Energy efficiency improvements can positively affect the environment in different respects:
  - **Energy and climate change** – Measures to improve energy efficiency led to a reduction in consumption of fossil fuels, which reduced emissions of greenhouse gases.
  - **Sustainable consumption and production (SCP) –** This category relate to the emission of local air pollutants and consumption of materials. Energy efficiency measures can improve human health as it leads to a decrease in the level of emissions of Sulphur, particulates, and other pollutants. However, energy efficiency measures may lead to an increase in material usage, e.g., building energy retrofits.
  - **Ecosystems –** Reduction in water demand and land use by the power generation sector can be achieved with lower energy demand due to improved energy efficiency. In an urban scenario, habitats for plants and animals can be improved with energy efficiency renovations of buildings that make use of green walls and roofs.
  - **Reductions in greenhouse gas emissions**
    - To evaluate the relationship between energy savings and CO2 emissions is usually, a linear approach, applied using fixed emission factors of units of CO_2 per unit of fuel consumption.
    - The relation between energy savings and GHG emission reduction can be estimated based on the GHG intensity of electricity generation.
  - **Reductions in emissions of local air pollutants and other GHGs**
    - The scale of energy savings, the fuel type saved, technology, and air pollution control equipment will help in reducing the air pollution (Sulphur dioxide - SO2, Nitrogen oxides – NOx, Volatile organic compounds – VOCs, particulate matter with a diameter of less than 10 µm – PM10, particulate matter with a diameter of less than 2.5 µm – PM2.5) and other GHGs emissions (nitrous oxide - N2O, methane - CH4).
    - Generally, emissions of SO2 and NOx can be converted to monetary terms linked to health damages and loss of productivity.
  - **Impact on ecosystems (including impacts on water consumption)**
    - Ecosystems can be negatively impacted in case the critical loads for absorption capacities of pollutants are exceeded. The impacts may include reduced vegetation growth, changing properties of water bodies, changing soil mineral composition, and reduction in agricultural harvests.
    - Power generation has impacts on water consumption which is mainly used for cooling. The change in water temperature can negatively impact the growth and regeneration capacity of the aquatic life. It is possible to estimate water consumption by the power sector by converting generation in GWh to cubic metres of water.
    - It is also possible to estimate impacts on land use requirements by the power sector in terms of number of square kilometres required per GW of capacity, or GWh of generation. However, results tend to be dominated by changes in biomass use (which has a far larger land requirement than any other generation technology).[36]
  - **Impacts on material consumption**
    - The links between energy consumption and material consumption are highly complex and relatively unexplored. It cannot be indicated whether the relationship is positive or negative.

[36] https://link.springer.com/article/10.1007/s11367-019-01652-4

Although, there are clear linkages between some material extraction/production and their energy consumption (e.g., steel and cement are energy intensive), however, capital-intensive energy-efficient goods are often quite material-intensive in nature.

- Material Flow Analysis (MFA) has generally utilised the input-output analysis to understand existing material demands, however, complex scenario analysis is avoided due to the fixed nature of the input-output analysis. Some macroeconomic models (E3ME[37], EXIOMOD[38],GINFORS[39]) incorporate MFA into their core structure.

- **Economic impacts:**
  - The economic impacts of energy efficiency investments are usually assessed with the help of macroeconomic models. The main drivers determining the macroeconomic effects of energy efficiency measures come from investments in energy efficiency technologies and services compared against the reduction of energy cost.[40]
  - The high capital costs of energy efficiency can be covered from external sources with long-term payback. Energy efficiency improves energy security and economic independence. As reduced spending on energy can increase the discretionary income of households or profits of companies, these could stimulate an increase in economic activity. Also, a reduction in energy imports could boost local demand by increasing spending on goods and services that are produced domestically.[41]
  - The complexity of the multiple impacts on GDP is best captured by economic models. The tools have some limitations and apply various economic theories to capture the impacts of additional investments on GDP. The examples of the tools that can be used for assessment of economic impacts include:
    - **GEM-E3**[42] **–** an applied general equilibrium model that covers the interactions between the economy, the energy system and the environment.
    - **E3ME**[43] – global macro-econometric model designed to address major economic and economy-environment policy challenges.
    - **ASTRA-EC**[44] **–** a dynamic input and output-based macroeconomic model which allows for explicit imbalances of the supply and the demand side.
    - **EXIMOD (EXtended Input-Output MODel)**[45] **–** Multisector, multi-region, and computational general equilibrium model that is able to measure the environmental and economic impacts of policies.

[37] https://www.e3me.com/

[38] https://repository.tno.nl/islandora/object/uuid%3A3c658012-966f-4e7a-8cfe-d92f258e109b

[39] https://www.gws-os.com/de/index.php/energy-and-climate/models/model-details/ginfors-e.html

[40] https://publications.jrc.ec.europa.eu/repository/handle/JRC113215

[41] https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2015/1-foundations-of-future-energy-policy/the-macroeconomic-benefits-of-ambitious-energy-efficiency-policy-8211-a-case-study-for-germany/2015/1-384-15_Braungardt_pre.pdf/

[42] GEM-E3 model (europa.eu)

[43] E3ME by Cambridge Econometrics

[44] http://www.astra-model.eu/astra-ec-home.htm

[45] https://repository.tno.nl/islandora/object/uuid%3A3c658012-966f-4e7a-8cfe-d92f258e109b

3. Potential sectors for integration of Energy Efficiency First Principle in India

3.1 Energy Efficiency First Principle in context of India

India's energy transition is inter alia driven by the national target of becoming net zero by the year 2070, set by the honourable Prime Minister of India, Mr Narendra Modi at COP26. In addition, the country has pledged the following clean energy targets (part of the five elements of Panchamrit[46]) for the year 2030:

- India will reach its non-fossil energy capacity to 500 GW by 2030
- India will meet 50 percent of its energy requirements from renewable energy by 2030
- India will reduce the total projected carbon emissions by one billion tonnes from now onwards till 2030 and
- By 2030, India will reduce the carbon intensity of its economy by less than 45 percent

These Panchamrits will be an unprecedented contribution of India to climate action.

Energy efficiency is an important strategy for India to achieve the above-mentioned targets. Recognising the fact that efficient use of energy and its conservation is the least-cost option to meet the increasing energy demand, Government of India has enacted the Energy Conservation Act 2001 and established the Bureau of Energy Efficiency in March 2002. The ensures institutionalising and strengthening delivery mechanism for energy efficiency services in the country and provides the essential coordination between the various entities.

In India, the energy policies are set by the Ministry of Power, which is responsible for overseeing electricity production and infrastructure development including generation, transmission and distribution, as well as energy efficiency through the Bureau of Energy Efficiency, the Ministry of New and Renewable Energy, which is responsible for research and development, international cooperation and coordination in renewable energy sources, the Ministry of Petroleum and Natural Gas, which is responsible for exploration and production of oil and natural gas and allied activities, the Ministry of Coal, which is responsible for exploration and development of coal and lignite reserves. The nodal ministry for climate action policies is the Ministry of Environment, Forest, and Climate Change.

The Energy Efficiency First Principle implies making decisions that have an impact on the energy demand and focuses on reducing the energy demand. Based on the learnings from EU's initiatives, following are the potential sectors for integrating the Energy Efficiency First Principle in the Indian context:

- Electricity markets
- Energy supply and distribution
- Energy demand (industry and services)
- Buildings
- Transport
- Information and Communications Technology (ICT)
- Financial sector

Table 6 Mapping of main Energy Efficiency related schemes in India by sectors of operation:

Sector/ Sub-sector	Programs/ Schemes in the sector
Power	• Integrated Power Development Scheme (IPDS)[47] • Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) • National Electricity Fund (NEF) • Financial Restructuring Scheme

[46] https://pib.gov.in/PressReleseDetail.aspx?PRID=1768712
[47] https://powermin.gov.in/en/content/distribution-0#:~:text=As%20the%20only%20interface%20between,consumers%20rests%20with%20the%20states.

	• Energy Efficiency Financing Platform (EEFP)
Residential	• Saubhagya Scheme
Transportation	• Faster Adoption and Manufacturing of (Hybrid &) Electric vehicles in India (FAME I and FAME II) • Go Electric campaign • PAT and Non-PAT EE initiatives • Corporate Average Fuel Economy (CAFE) • National Electric Mobility Mission Plan (NEMMP) Scheme[48]
Buildings	• Energy Conservation Building Codes • Retrofit in old building guidelines • BEE – Star Rating Programme • Building Energy Efficiency Programme (BEEP) • Other Green Building programmes
Industry	• Perform, Achieve and Trade (PAT) Scheme
Domestic (Lighting & appliances)	• Standards & Labelling (S&L) • UJALA • Market Transformation for Energy Efficiency (MTEE)[49]
Urban	• Unnat Jyoti by Affordable LEDs for All (UJALA) programme • Street Lighting National Programme (SLNP)
Agriculture	• AgDSM • PM KUSUM scheme

3.2 Key Energy Efficiency First Principle sectoral strategies /status in India:

The Bureau of Energy Efficiency (BEE) is the statutory body formed under the provision of Energy Conservation Act 2001. The following section presents the possible integration of EE1st principle strategies into existing policies in India on sectors such as electricity markets, energy supply and distribution, energy demand, buildings, transport, information & communications technology and financial sectors. Additionally, the following section also lists out the current status of the respective policies and provides an elaborate discussion on the usefulness of integrating EE1st principle into existing policies.

1. **Electricity markets:** Application of EE1st principle emphasizes on addressing the regulatory barriers to enable market access of demand-side resources. Also, it is necessary to set incentives or requirements to remove the regulatory barriers in power markets.

   Possible strategies:
   - Encouraging demand response and effectively enabling consumer load participation
   - Dynamic pricing including Critical Peak Pricing (CPP), Real-time Pricing (RTP), and introduction of shortage pricing functions for balancing energy
   - Support during installation of smart equipment which can respond to micro-cogeneration or other hybrid devices using renewable gas and electricity
   - Smart-metering systems, incentivise research, and investment in energy efficient solutions
   - Optimising local energy system efficiency (local sector integration)

[48] https://aeee.in/wp-content/uploads/2021/05/India's-Energy-Efficiency-Landscape-Report.pdf
[49] https://powermin.gov.in/en/content/energy-efficiency

Current legislation/status in India:

- Currently, demand response initiatives such as time-varying pricing is not widely used in India; time-of-day tariffs are offered to large commercial and industrial customers in some states.[50] Seven states in India have commissioned ToD tariff till 2016.[51]
- The Smart Meter National Programme aims to replace 25 crore conventional meters to smart meters in India. As on date, EESL has installed over 13.2 lakh smart meters[52].

2. **Energy supply and distribution:**
Priority should be given to energy efficiency before investing in energy infrastructure. Applying the EE1st principle is the most efficient alternative to optimize energy infrastructure, when a supply side decision is necessary.

Possible strategies:

- Considering demand-side resources while evaluating generation capacity investments
- Developing joint scenarios for infrastructure planning and using cost-benefit analysis in planning of electricity, gas, and district heating/cooling networks
- Deploying cost-optimal hydrogen infrastructures
- Consistency in assumptions of investment planning which considers the climate objectives and energy demand evolution from 2030 to 2050
- Integrated distribution system planning and planning of hydrogen transport infrastructures

Current legislation/status in India:

- At present, behavioural energy efficiency projects are being piloted by Jaipur Vidyut Vitran Nigam Limited (JVVNL) and BSES (Home energy report pilot in Delhi)[53]
- Development of joint scenarios for infrastructure planning and using cost-benefit analysis in planning of electricity, gas, and district heating/cooling networks is being adopted for all future scenario modelling.
- MNRE has been supporting a broad-based Research Development and Demonstration (R&D) programme on hydrogen energy and fuel.[54]

3. **Energy demand (industry and services):** Promotion of demand-side solutions which includes households, services, industry, and transportation. Promoting energy-efficient products and techniques (e.g., energy management)

Possible strategies:

- Procurement of energy-efficient goods and services with demand response capacities
- Reinforcement of circularity and energy-efficient technologies
- Investment incentives, reusing waste heat and cold, quality advisory services
- Developing requirements for purchasing of high energy performance goods
- Developing requirements and standards for demand-response capacities and financial assistance of energy efficiency investments
- Reinforcing energy management

Current legislation/status in India:

- The Energy Efficiency Financing Platform (EEFP) initiative is running to create mechanisms that would help finance demand-side management programmes in all sectors by capturing future energy savings[55]
- Circularity has been discussed but not considered as part of policy framework

[50] https://www.nrel.gov/docs/fy19osti/70630.pdf
[51] https://shaktifoundation.in/wp-content/uploads/2017/09/Demand-Response-in-India_2016.pdf
[52] https://eeslindia.org/en/smart-meters/#:~:text=Smart%20Meter%20National%20Programme%20aims,tool%20in%20power%20sector%20reforms.
[53] https://www.niti.gov.in/sites/default/files/2021-08/Electricity-Distribution-Report_030821.pdf
[54] https://mnre.gov.in/new-technologies/hydrogen-energy
[55] https://powermin.gov.in/en/content/energy-efficiency

4. **Buildings:** Application of the EE1st principle during renovation, planning and operations, circularity, and promoting energy efficiency improvements in buildings. Reducing end-user demand, using decentralised renewable energy production and storage, optimising energy efficiency and overall performance.

Possible strategies:

- Making finance for renovation programmes
- Integrating energy efficiency elements into the local urban planning including energy-efficient transport and charging points for electric vehicles
- Simplifying the administrative process
- Reinforcing energy-efficient technologies in buildings, circularity and developing building standards
- Disincentivising behaviour measures of over consumption
- Innovative financing schemes
- Modulating electricity price, distribution price, and other charges
- Considering green and blue infrastructure in local spatial planning
- Using energy performance contracts
- Using active or passive energy efficiency technologies
- Installing feedback system on energy consumption via smart meter and smart devices

Current legislation/status in India:

- Traditionally the focus has been more on new construction. This can be considered for future programmes
- Integration of energy efficiency elements into the local urban planning including energy-efficient transport and charging points for electric vehicles which is currently being discussed and adopted in India.
- There are general building requirements and standard space requirements for buildings[56]
- Circularity needs to be integrated on overall building energy efficiency plan.
- Innovative financing schemes are being discussed thoroughly. Business models for EE in buildings needs to be explored.
- There has been discussion around green infrastructure in spatial planning. It needs more consideration on blue infrastructure.
- Lot of work has been done in the space of energy performance contracts. It requires more adoption for large scale implementation.
- Some discussions have been done on using active or passive energy efficiency technologies. It requires further dialogues for possible adoption and implementation.
- Smart meters are at nascent stage of adoption. This is important and requires further discussions.

5. **Transport:** Application of energy-efficient transport through fuel switch, zero-emission vehicle, and transport system improvements

Possible strategies:

- Designing energy-efficient vehicles
- Sustainable urban mobility plans (SUMPs)
- Smart charging of electric vehicles
- Incentivising purchase of zero-emission vehicles
- Promoting collective transport

Current legislation/status in India:

- Good work has been done on fuel efficiency standards as well as electric vehicles
- Sustainable urban mobility plans (SUMPs) are discussed as part of future planning.
- Charging infrastructure for India is being developed. It is worth learning from the EU experience.
- Various incentive mechanisms are being discussed like sustainable urban mobility plans (SUMPs)
- Current urban transit systems consisting of metro rail, suburban railways, monorails, light rail/tramways, and bus rapid transit are in operation or under construction in over 30 cities in India.[57]

[56] https://mohua.gov.in/upload/uploadfiles/files/Chap-4.pdf
[57] https://en.wikipedia.org/wiki/Urban_rail_transit_in_India

6. **Information and Communications Technology (ICT):** Applying the EE1st principle in ICT can enable in selecting and implementing a portfolio of resources that can address the critically increasing energy service of data transfer, at the lower cost.

   Possible strategies:
   - Localisation of data centres close to heat network
   - Setting ICT system energy performance standards and requirements

   Current legislation/status in India:
   - There is discussion around data centres. This is an advantageous strategy and requires more consideration for adoption in India.
   - Setting of ICT system energy performance standards and requirements are under review and progress is being made by the Govt of India.

7. **Financial sector:** Sustainable finance helps in identifying green attributes of a bank's loan and asset portfolio. An increased focus on EE1st can increase funds lending, reduce risks of default and stranded assets, meet CSR objectives, and ensure compliance with financial regulations around sustainability.

   Possible strategies:
   - Pure energy efficiency investments
   - Development and construction finance
   - Structural or system-level investments such as grids, rail or bus systems, metros, electric vehicles infrastructure, energy storage facilities, or new port infrastructure
   - Conducting life cycle cost analysis of the asset for assessing its energy and carbon footprint.
   - Promoting the use of smart meter data in the financing process of productive assets, networks, and real estate assets

   Current legislation/status in India:
   - There is lot of discussion around green financing in India. Learnings from EU can be adopted to strengthen India's financing mandate.

The following section highlights the additional considerations post the integration of EE1st principle in existing policies in India such as electricity markets, energy supply and distribution, energy demand, buildings, transport, information & communications technology and financial sectors.

1. **Electricity markets:** The application of the Energy Efficiency First Principle would imply that all regulatory barriers to enable market access for demand-side resources are removed. Inserting the EE1st principle would result in the following additional considerations:
   - Dynamic pricing, including critical peak pricing (CPP), real time pricing (RTP), micro-cogeneration, time differentiated or flexible network tariffs, accelerating roll-out of smart metering systems, facilitation of grid connection, and flexible operation of high efficiency CHP.

   So far in India, ADR (automated demand response) pilots have been conducted in Delhi and Mumbai. In Karnataka, the utility provider BESCOM ran a pilot to energise irrigation pump sets in the same manner that broadly follows the solar generation patterns during daytime, which enabled them to serve the morning and evening peak loads better.[58] According to the National Energy Policy, TOD meters for large consumers with a minimum load of one MVA are to be encouraged.[59]

   The Govt of India has introduced the Smart Meter National Programme that aims to replace 25 crore conventional meters to smart meters in India. The application of the Energy Efficiency First Principle would include additional considerations of installing smart equipment that are able to respond to grid signals such as micro-cogeneration or other hybrid devices using renewable gas and electricity in addition to installing the smart meters.

[58] https://www.niti.gov.in/sites/default/files/2021-08/Electricity-Distribution-Report_030821.pdf
[59] https://powermin.gov.in/en/content/national-electricity-policy

2. **Energy supply and distribution:** Applying the Energy Efficiency First Principle would mean additional considerations in the form of prioritising energy efficiency over investments made in the energy infrastructure, and/or optimisation of the existing energy infrastructure. The application would mean verifying if construction of the whole or a part of these infrastructures can be substituted or delayed by using cost-effective energy efficiency measures and demand-response programmes. Inserting the EE1st principle would result in the following additional considerations:
    - Replacing peak fossil fuel plants with clean generation of power, integrated distribution system planning, use of cost-benefit analysis in the planning of co-generation units, and usage of energy efficiency test for all energy infrastructure projects.

   Several factors have enabled potential demand-response opportunities in India, which includes growing energy consumption, non-renumerated supply disruptions, and a greater shift towards cleaner energy sources.[60] In India, upgrading distribution infrastructure has been key to reduce technical losses, and states such as Gujarat took steps to upgrade infrastructure. Gujrat used HT lines, prepaid or smart meters in government buildings, installed new substations and optimal size of conductors and transformers.[61] By application of the EE1st principle in this sector, it can be verified if such investments in infrastructure can be substituted by other means such as using energy efficiency measures and other demand response programmes to reduce peak loads and the overall electricity usage. In addition, India instituted three key energy market reforms in 2020, which led to the creation of real-time power markets (RTM), the green team-ahead market and the Indian gas exchange (IGX).[62]

3. **Energy demand (industry and services):** The application of the Energy Efficiency First Principle in the energy end-use sectors such as households, services, and industries would lead to promotion of energy-efficient products, technologies, and techniques to increase the overall energy efficiency of the system. Inserting the EE1st principle would result in the following additional considerations:
    - Encouraging procurement of energy-efficient goods and services, reinforcing material efficiency, circularity, reusing waste heat and cold, investment and behavioural incentives and introducing requirements for purchase of high energy performance products.
    - Assessing the possibility of increasing stringency of allowances of the PAT scheme and creation of a carbon reduction programme

   To improve energy efficiency there are several technological, market-based policy and regulatory measures that can be applied. Focus should be on the heat services, where gas, oil, and coal can be substituted with electricity. For relatively low temperature process, heat pumps would be competitive with fossil fuel and for higher temperatures, special heat pumps, electro-fuels, or direct electrical heating should be promoted in contrast to coal fired processes. The strategy could be based on the EU ETS inspired schemes or incentives for investing in heat pumps or electrical heating such as rebates on electricity tariffs. Energy efficiency should be the first strategy to reduce the overall energy demand of the industrial sector and reduce the investment on the supply-side infrastructure.

4. **Buildings:** The application of the Energy Efficiency First Principle and related energy efficiency improvements are relatively straightforward from a technical point of view. Inserting the EE1st principle would result in the following additional considerations:
    - Integrating energy efficiency elements into local spatial planning and urbanistic permitting, reinforcing circularity, material efficiency and energy-efficient technologies in buildings, digitalisation of buildings, building standards, innovative financing schemes for building renovation, making climate controlled appliances an element of technical design and mandating construction of e-vehicle charging points.

   The Energy Conservation Building Code (2017), Eco-Niwas Samhita (energy conservation code for residential buildings, 2018), the India Cooling Action Plan (ICAP, 2019) which aims to reduce cooling energy demand through a range of energy efficiency measures targeted at building's design and construction, and voluntary rating schemes are areas where action has been taken through a host of policy and regulatory processes. Additional actions which can be taken to minimise the material demands of an sprawling building construction, includes light weighting and recycling.

[60] https://www.nrel.gov/docs/fy19osti/70630.pdf
[61] https://www.niti.gov.in/sites/default/files/2021-08/Electricity-Distribution-Report_030821.pdf
[62] https://iea.blob.core.windows.net/assets/1de6d91e-e23f-4e02-b1fb-51fdd6283b22/India_Energy_Outlook_2021.pdf

Incorporation of EE1st principle in the existing policy such as the Energy Conservation Building Code, will ensure additional energy savings in construction and procurement guidelines. It will aid in establishing benchmarks for building energy use and offering tax incentives by pushing the mandate for energy efficiency.

5. **Transport:** India has a robust policy landscape supporting penetration of electric vehicles. Various cities have adopted pilots for electric vehicles. The 'Go Electric' campaign was launched by the Ministry of Power on 19 February 2021 to spread awareness on the benefits of e-mobility, charging, and electric cooking. The campaign aimed at creating awareness at the national level and boost the confidence of electric vehicle manufacturers and consumers. To ensure a wide reach of the information campaign, BEE will provide technical assistance to the State Designated Agencies (SDAs). The railway sector is also making significant progress in improving energy efficiency and switching to renewable energy sources.

   According to NITI Aayog, the EV market is expected to be around 28 million units by 2030.[63] The FAME II project aims to generate demand by supporting 7,000 electric buses (e-bus), five lakh electric three-wheelers (e-3W), 55000 electric four-wheeler passenger cars (including Strong Hybrid) (e-4W) and ten lakh electric two-wheelers (e-2W).[64] By inserting the EE1st principle, additional considerations can be taken, ensuring that the vehicles are designed and used in a way that they optimally energy efficient, so that minimal energy is used for various mobility activities and charging of electric vehicles can be looked at and incorporated into policy actions. Energy Efficiency Services Limited (EESL) has launched a programme for electric vehicles based on the ESCO route[65]. Additional considerations while deploying the EE1st principle can be: linking of considerations relating to climate change, clean air, affordable transport, and jobs with the policies and programmes on electric mobility.

6. **Information and Communications Technology (ICT):** India's information and communications technology sector is a significant global player and has unique strengths in digital-led technologies, which can help improve energy efficiency in the system through measures such as shaping logistics to reduce diesel demand for freight transport, making energy systems smarter, and helping to lower bills and integrate variable renewables.[66]

7. **Financial sector:** The application of the Energy Efficiency First Principle would result in ensuring that all energy saving opportunities are identified and cause acceleration of greening of asset portfolios. Inserting the EE1st principle would result in the following additional considerations:
   - Development and construction finance, adapting and incorporating the Energy Efficiency First Principle into different financing processes, applying full asset life analysis of the energy and carbon footprint of the investments, promoting use of smart meter data in the financing process of productive assets, networks, and real estate assets.

The Indian Government had launched the UDAY scheme in 2015 to improve DISCOM finances. The scheme focused mainly on writing off up to 75% of the debt and restructuring remaining loans. Application of the EE1st principle can help in additional consideration during the due diligence phase which can include full asset life analysis during its entire lifetime to raise possible red flags as early as during the design and development phase for the financer of the financing institution.

Relevance of the Energy Efficiency First Principle in the Indian context:
Taking cues from the application of EE1st principle in the EU, relevance of EE1st principle and strategies to incorporate EE1st principle into specific sectors in India such as industry, buildings (residential), transportation and demand side management are described below. For each of these sectors, possible key interventions is also listed in the section below.

1. Industry:
The EU industry sector has transitioned towards cleaner energy sources and reduced its carbon footprint through a mix of technological and policy measures. Majority of the industrial processes have been shifted to electricity and biomass. Heat pumps for temperature-specific heating, renewable energy, hydrogen, and electro fuel-based heating solutions

[63] https://niti.gov.in/writereaddata/files/document_publication/RMI_India_Report_web.pdf
[64] https://fame2.heavyindustry.gov.in/content/english/13_1_brief.aspx
[65] https://www.eeslindia.org/content/raj/eesl/en/Programs/ElectricVehicles/e-Vehicles.html
[66] https://iea.blob.core.windows.net/assets/1de6d91e-e23f-4e02-b1fb-51fdd6283b22/India_Energy_Outlook_2021.pdf

are some of the successful technological advancements that have enabled this shift. On the policy and regulatory front, the EU Emission Trading Scheme (ETS) is the key enabling instrument. By increasing the cost of emissions, the ETS has become a major driver for fuel switch towards less carbon-intensive energy, of which electricity from renewable sources is one of the most favourable options. This had led to an increased demand for green electricity and motivated producers to increase supply of electricity from renewable sources as the most competitive way.

In India, the strategies can be based on the EU ETS inspired schemes or incentives for investing in heat pumps or electrical heating such as rebates on electricity tariffs. Based on the current situation in India and the experiences in the EU, the following strategies can be used to further the application of the Energy Efficiency First Principle in the Indian context:

Strategy: Prioritising energy efficiency in industrial processes

Energy efficiency should be the first strategy to reduce the overall energy demand of the industrial sector and reduce the investment on the supply-side infrastructure. Energy Efficiency First Principle is also at the core of the circular economy by reducing energy waste and reusing industrial waste in processes or any other sectors, similar to the approach developed under the EU strategy for energy system integration.

Key interventions:

- **Deep dive to identify energy intensive industrial processes and measures to make them energy efficient:** In order to introduce and implement energy efficiency, it is essential to first benchmark the existing energy intensive processes, review the new technologies that could increase the efficiency of the existing ones and assess their impact. The assessment should result into a national energy efficiency repository with benchmarks. This exercise could be carried out to implement the objectives of the PAT scheme and circular economy concept to identify the potential of reuse of waste heat.
- **Assessing the possibility of increasing stringency of allowances of the PAT scheme and creation of a carbon reduction programme:** The EU ETS through stringent allowances and carbon pricing, has been successful as a regulatory instrument in reducing the energy intensity of the European industry sector. Since the size and diversification of the Indian industry sector is different compared to its EU counterpart, an impact assessment analysis needs to be conducted prior to increasing stringency of the PAT scheme and development of carbon pricing programme.

- **Promote alliances across large companies, SMEs, service providers:** Alliances within the sector and across other sectors including residential and services are important from the perspective of circular economy and sector coupling. For instance, waste heat from the industry could be used as an input for some industrial processes and could also be used to power absorption cooling machines and micro turbines.

2. Residential (Buildings):

Cooling is an important end-use area under the residential sector. The requirement for cooling both in the urban and rural areas in India is on the rise. To mitigate the negative impact of air-conditioning, a transition from conventional cooling to low carbon cooling technologies such as super-efficient room air conditioners, evaporative cooling systems, community-level district cooling, etc. are recommended. Efforts are made in the EU towards community-scale cooling using the sector coupling approach. Smart home technologies further present the potential to save operational energy and is being used as a key demand-response measure, globally. The EU is encouraging the development of smarter energy systems and smarter buildings. Building standards are also being developed to support the development and interoperability of smart devices and complement the Energy Efficiency First Principle.

Based on the current scenario of cooling energy use in India, transition to electric cooking, promotion of energy efficient and low-carbon cooling, efficient integration of cooling, and building appliances in energy management systems are mapped in which the Energy Efficiency First Principle can be applied.

Strategy: Increasing energy efficiency of residential end uses

Increasing energy efficiency is the first step towards decarbonisation of the residential sector. There are several initiatives in place such as Eco Niwas Samhita (ENS), star rating of homes, and star rating of appliances to improve

energy efficiency in this sector. Efforts need to be made to further the enhancement and implementation of these initiatives.

Strategy: Promotion of energy efficient and low-carbon cooling

The ICAP 2019 emphasises the need for switching to efficient and low-carbon cooling and provides a set of recommendations encompassing diverse aspects like reduction of cooling demand, refrigerant transition, ways of enhancing energy efficiency, and better technology options.

Key interventions:

- Development of an implementation roadmap for the India Cooling Action Plan (ICAP) (see section 2.2)
- Harmonisation of ENS with ICAP: development and implementation of harmonized guidelines catering to dual objectives of ENS and ICAP recommendations for different climate zones in India

Strategy: Cross-sectoral integration for a more circular economy

Cross-sectoral integration means that energy exchange between different sectors is enabled, which would lead to a circular economy. For instance, waste heat from industries could be used to run absorption cooling machines in district cooling systems to provide free cooling. Such initiatives are being explored in the EU for district heating and cooling purposes.

There is a need to assess the possibility of alliances with industries for Power-to-X collaboration to enable sector coupling and circular economy, encourage development of smarter energy systems and smarter buildings to promote integrated systems with a focus on market assessment and policy integration for smart appliances and controls, user acceptance, local manufacturing capacity, affordability, etc.

3. Transportation:

Strategy: Electrification of Indian railways

- Action plans towards implementation of Indian Railways target on electrification of routes on broad gauge planned by 2023 and goal of becoming 'Green railway' (net-zero emissions) by 2030.

Strategy: Enhance electric vehicle penetration level

- Designing EV mandates specific to Indian manufacturing ecosystem
- Designing better incentives, financing schemes, business models for segments with higher Total Cost of Ownership (TCO) including polluting segments on passenger four-wheelers, urban freight, and HDVs
- Linking of narratives on clean air, climate change, affordable transport, and jobs with policies and programmes on the electric mobility.[67]
- Developing interoperability of charging stations by setting a common charging infrastructure for all types of vehicles.[68]
- Developing innovative business models, incentives, and financing schemes.

4. Demand-side management:

Energy savings from introducing the DSM practices can defer the need for investments in generation and transmission infrastructure. In India, where imports of fuel accounts for almost 66% of the total energy supply (Ministry of Power)[69], the introduction of utility-scale DSM programmes can reduce fuel imports, improve India's balance of payments, and increase the economic competitiveness.

[67] There is a lack of awareness amongst the general consumer about electric mobility as well as policy makers. Most city level action plans have no linkage to electric mobility. Electric mobility is a significant route for cities to drive clean air, jobs and encourage efficient and sustainable transport. There is a need to link such narratives at the administrative level with electric mobility.

[68] Issues in which conflicting standards and approaches still exist include open access and payment, charger to network communication, network to network communication, and vehicle to charger communication. With interoperability, EV drivers can access public charge points from any owner/operator through a common platform and a single network subscription or contract. Just like cellular networks, there is a need to ensure that EVs have access to charging stations across the country.

[69] https://www.oracle.com/a/ocom/docs/industries/utilities/behavioural-energy-efficiency-wp.pdf

4. Conclusions and possible next actions

As part of the European Green Deal proposed in December 2019, the Commission presented an EU strategy for energy system integration. The energy system integration will be facilitated by the implementation of the eight legal acts of the clean energy for all Europeans packages. 'Energy efficiency first' is the core of the strategy where energy savings initiatives will always be the first step to reduce the carbon footprint. The principle aims to treat energy efficiency as a source of energy in which the public and the private sector can invest ahead of other more complex or costly energy sources.

Recognising the fact that efficient use of energy and its conservation is the least-cost option to meet the increasing energy demand, Government of India has enacted the Energy Conservation Act 2001 and established the Bureau of energy efficiency in March 2002. The act provides for institutionalising and strengthening of the delivery mechanism for energy efficiency services in the country. Sector specific detailed assessment can be done taking cues from experiences in the EU as outlined in section 2 including overview of role of policies and regulatory frameworks, and an action plan can be developed for India by integrating energy efficiency policies in India as a part of the next actions:

1. **Defining policy targets** would require setting objectives based on results and desired impact. It would be important to define indicators and methodology for monitoring targets, including monitoring and evaluation protocols to monitor the impacts of energy consumption of the actions taken. Defining policy targets would ideally include the following steps:
    - Setting the right rules and legislation
    - Identifying barriers to the Energy Efficiency First Principle
    - Integrating the principle in the policy and legal framework
    - Incentivising Energy Efficiency First Principle
    - Funding and financial support
    - Providing information
    - Leading role of public sector

2. **Analysing policy impacts**: Desirable objectives, enabling conditions for energy-efficient solutions, and alternatives on the demand side could be some of the considerations during assessment of policies. Some of the tasks which could be looked into are defined below:
    - A comprehensive impact assessment can be conducted as a part of investment or policy decisions with impact on energy consumption or energy supply. The energy-efficient solutions should also be analysed applying the societal, implementing entity or end-user perspective.
    - Methodologies for impact assessment: For the guidance, two research projects have been used: (1) COMBI (Calculating and Operationalising the Multiple Benefits of Energy Efficiency in Europe), a project under Horizon 2020, and (2) the study prepared for the European Commission 'the macro-level and sectoral impacts of energy efficiency policies'. Also, the Horizon 2020 MICAT research project is developing a methodology and tool that could help in such assessment.
    - Impacts of energy efficiency that should be analysed:
        - **Social impacts** such as human health and well- being, and energy poverty.
        - **Environmental impacts** such as reductions in greenhouse gas emissions, local air pollutants, impacts on ecosystems (including impacts on water consumption), and impacts on material consumption.
        - **Economic impacts** such as the impact on energy security, economic independence, employment, and GDP.

The potential sectors for integration of Energy Efficiency First Principle are presented below:

1. **Electricity markets**

    Some of the initiatives undertaken by the Government to boost the Indian power sector are listed below:
    - The Pradhan Mantri Sahaj Bijli Har Ghar Yojana, 'Saubhagya', was launched by the Government of India with an aim to achieve universal household electrification.
    - In June 2021, India launched the Mission Innovation CleanTech Exchange, a global initiative that will create a whole network of incubators across member countries to accelerate clean energy innovation.

The following points could be considered as possible strategies for integrating Energy Efficiency First Principle in this sector:

- Demand-response initiatives and enabling customer load participation can be encouraged.
- Dynamic pricing including Critical Peak Pricing (CPP), Real-time Pricing (RTP), and introduction of shortage pricing functions for balancing energy.
- It is also critical to set the incentives right in the power markets.
- Optimising local energy system efficiency (local sector integration).

2. Energy supply and distribution

Some notable initiatives by the Government in the energy supply and distribution sector are as under:

- Electrification in the country has been increasing with support from schemes like Deen Dayal Upadhyay Gram Jyoti Yojana (DDUGJY), Ujwal DISCOM Assurance Yojana (UDAY), and Integrated Power Development Scheme (IPDS).
- PM-KUSUM (Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan) scheme was launched aimed at ensuring energy security for farmers in India, along with honouring India's commitment to increase the share of installed capacity of electric power from non-fossil fuel sources to 40% by 2030 as part of Intended Nationally Determined Contributions (INDCs).

The following could be considered as possible strategies for integrating the Energy Efficiency First Principle in this sector:

- Considering demand-side resources while evaluating generation capacity investments.
- Developing joint scenarios for infrastructure planning and using cost-benefit analysis in planning of electricity, gas, and district heating/cooling networks.
- Consistency in assumptions of investment planning which considers the climate objectives and energy demand evolution from 2030 to 2050.
- Integrated distribution system planning and planning of hydrogen transport infrastructures.

3. Energy demand (industry and services)

As per BEE's National Strategic Plan on Energy Efficiency (UNNATEE), the industrial sector has 52 MTOE energy saving potential by 2031, which is highest amongst various demand sectors in India. The following lists down some notable initiatives in this sector:

- While Perform, Achieve and Trade (PAT) framework provides a mandatory approach for reducing energy intensity of the larger enterprises, EE in the MSME sector has remained as the programme agenda of several IDAs in collaboration with Bureau of Energy Efficiency.
- Other policies and programmes such as National Manufacturing Policy, National Manufacturing Competitiveness Program (NMCP), Zero Effect Zero Defect (ZED), Credit Linked Capital Subsidy for Technology Upgradation (CLCSS), Technology and Quality Upgradation (TEQUP) scheme have contributed significantly in terms of raising awareness among the industries (especially MSMEs) and providing and enabling environment for implementation of EE measures.
- The Bureau of Energy Efficiency (BEE) is also mulling the idea of introducing a framework like PAT for small and medium enterprises on a voluntary participation basis.

The following points highlight the possible strategies for integrating the Energy Efficiency First Principle in this sector:

- Procurement of energy-efficient goods and services with demand-response capacities.
- Developing requirements and standards for demand-response capacities and financial assistance of energy efficiency investments.
- Developing requirements for purchasing of high energy performance goods and demand response capacities to reinforce energy management including circularity and energy-efficient technologies.

4. Buildings

A range of policies, legislations, and local building bye-laws have emerged that should shape up the regulatory framework, which will help mitigate impact on environment due to the growing building sector.

- This includes Energy Conservation Building Code (ECBC) for commercial buildings, which sets minimum energy standards for commercial buildings having a connected load of 100kW or contract demand of 120 KVA and above. This is complemented by star labelling programme and Eco Niwas Samhita (ENS) which focuses on the residential sector.
- The Buildings Energy Efficiency Program (BEEP) offered a retrofit solution for buildings of the government, industry, and institutions to implement and retrofit energy-efficient appliances and systems including LED lights, ceiling fans, and energy-efficient ACs at affordable prices.
- In addition to the above, several rating systems such as nationally accredited Green Building rating system for buildings i.e., Green Rating for Integrated Housing Assessment (GRIHA), Indian Green Building Council (IGBC), Leadership in Energy & Environmental Design (LEED) have paved a way forward.
- BEE is actively pursuing the upcoming concepts and technologies in areas such as NZEB, smart readiness indicators, connected buildings, innovative low-carbon district cooling solutions, etc.

However, based on the learnings from EU, the following points can be considered for integrating into policies which shall help the government move towards achieving the Energy First Principle:

- Advanced meters can be provided to customers for tracking the electricity consumption which will enable users to voluntarily adjust electricity consumption to reduce expenses.
- Building standards to support the development and interoperability of smart devices can be considered to complement the Energy Efficiency First Principle.
- Reinforcing energy-efficient technologies in buildings, circularity, and developing building standards using energy performance contracts and active/passive energy efficiency technologies.
- Integrating energy efficiency elements into local urban planning such as charging points for electric vehicles.

5. Transport

The Ministry has taken several initiatives in the transport sector which are listed below:

- A notification for dual fuel usage which covers emission of smoke and vapour from agriculture tractors, power tillers, construction equipment vehicles by use of Compressed Natural Gas (CNG) or Bio-Compressed Natural Gas (Bio-CNG) or Liquefied Natural Gas (LNG) engines along with conventional fuel engines.
- The Ministry issued a notification regarding the blending of gasoline with Methanol in order to reduce vehicle exhaust emissions.
- The Ministry has notified emission standards for construction equipment vehicles and tractors i.e., Bharat Stage (CEV/Trem)-V), which would help in ensuring environment friendly construction and mining activities.
- Promoting electric mobility and alternate fuels, the government has exempted battery-operated vehicles, as well as vehicles driven on Methanol fuel or Ethanol fuel from the requirement of mandatory permits.
- Several initiatives for promotion of EVs include advisory by government to waive road tax, permitting private EV charging infrastructure in residences and offices, and reduction on GST on EV and charging stations from 12% to 5% and from 18% to 5%, respectively.

The following points can be considered to be integrated into policies with respect to the transport sector:

- Designing of energy-efficient vehicles and integration of Sustainable Urban Mobility Plans (SUMPs).
- Integrating of smart charging infrastructure of electric vehicles and further mechanisms for incentivisation of electric vehicles.

6. Information and Communications Technology (ICT)

Contributing over 13 % to India's GDP, the ICT sector and the digital economy are major economic drivers for the country. India aims to grow the ICT sector to USD one trillion by 2025, or 20 percent of GDP. [70] Some notable initiatives undertaken in this sector are illustrated below:

- Appropriate concepts for integrating smart technologies, demand-response ready building technologies in residential buildings are being conducted by IDAs which include strategies for

[70] International Trade Administration

incentivising consumers and utilities to respectively participate in and start demand-response programmes.
- Although there are no specific policies with respect to rating 'smartness' in an existing infrastructure, policies undertaken by the government in the building sector showcase potential of integrating smart technologies.

The following points can be integrated to provide a push regarding energy efficiency in the Information and Communications Technology (ICT) sector:

- Localisation of data centres close to heat network.
- Setting ICT system energy performance standards and requirements.
- Installing feedback system on energy consumption via smart meter and smart devices.
- Incorporation of 'smart meters' to measure end use in new and existing infrastructure.

7. **Financial sector**

Some notable initiatives under this sector are illustrated below:

- Energy Efficiency Financing Platform (EEFP) was launched as one of the initiatives under National Mission for Enhanced Energy Efficiency to provide a platform to interact with financial institutions (FIs) and project developers for implementation of energy efficiency projects.
- Presently, BEE is working on conducting 'investment bazaar for energy efficiency' in various states/UTs to accelerate and facilitate financing of EE projects/technologies through State Designated Agencies.
- BEE has launched a pilot programme for uptake of financing energy efficiency projects by providing graded EE projects to financial institutions.

The following points could be looked at for integrating into this sector:

- Pure energy efficiency investments and development and construction finance.
- Structural or system-level investments such as grids, rail or bus systems, metros, electric vehicles infrastructure, energy storage facilities, or new port infrastructure.
- Applying full asset life analysis of the energy and carbon footprint of the investment during its entire lifetime.

Challenges for integrating EE1st principle:

The following points can be considered as major challenges to integrate the EE1st principle into current policies and can be looked at going forward into the next phase of the study:

- Lack of an agreed definition of ESG / green serves as a hindrance to integrate parameters into decision making or garner investment interest. Standardization, clarity from regulators, monitoring and accurate disclosures are key to propelling actions in developing markets.
- Accessibility of quality ESG data and tools for integration in risk and valuation frameworks needs to be assessed. Data authenticity, quality, timeliness and granularity, often impede prompt detection of vulnerabilities in capital intensive projects.
- Mandatory corporate disclosure provides minimum information on ESG related risks and opportunities. Moreover, voluntary disclosures are unverified and non -standardised, exaggerating information as suitable to entities.
- There are often cost implications associated to integrate aspects related to EE1st principle for e.g., ESG.
- Limited technical capacity to capture interdependent challenges linked to ESG, which hinders integration and assessment. Lack of relevant skill set is also a hindrance in integrating EE1st principle.
- There are energy and supply chain pressures that exists which can be attributed to rise in energy prices. Also, fuel subsidy, which is often a point of discussion, may not be sustainable in the longer run.
- India's energy depends on buildings & facilities which are yet to be built, and appliances which are yet to be evolved. Building policies in regulatory environments is the very key.

Next steps would include detailed information sharing on how the EU and EU Member States will operationalize the Energy Efficiency First Principle, based on which a study will be conducted on how this principle can be best fitted into the Indian policy context as detailed in the above. Some of the proposed activities for the way forward could be:

- Stakeholder consultation to discuss the desk study developed under Phase I and to see whether, how and in what form such a principle would be relevant in the Indian context.
- A development of an action plan, based on the stakeholder consultation.
- The study and action plan will be disseminated in a stakeholder event, in which European experiences and best practices will be shared. This stakeholder consultation will also be useful in closing the activity.