PRINCIPLES OF REGULATION TO PROMOTE ENERGY EFFICIENCY IN THE BLACK SEA REGION

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ACRONYMS

ACER	–	Agency for the Cooperation of Energy Regulators
BSRI	–	Black Sea Regulatory Initiative
CBA	–	Cost Benefit Analysis
CEE	–	Central Eastern Europe
DSO	–	Distribution System Operator
EED	–	Energy Efficiency Directive (EED - 2012/27/EU)
EERS	–	Energy Efficiency Resource Standard
ERRA	–	Energy Regulators Regional Association
ESCO	–	Energy Service Company
ESD	–	Energy Service Directive (ESD - 2006/32/EC)
EU ETS	–	The EU's Emission Trading Scheme
NERA	–	National Energy Regulatory Authority
PJ	–	Petajoule
RTO	–	Regional Transmission Organization
TSO	–	Transmission System Operator
UNFCCC	–	United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

As global economic growth puts increasing pressure on the demand and price of energy resources, policies to improve the efficiency of energy use have become the cornerstone of energy policies in several regions of the world. It is widely recognized that energy efficiency offers several low cost opportunities to reduce import dependence and to improve supply security. In 2012, the European Union passed its Energy Efficiency Directive to further promote reaching a 20% energy saving target on a 1990 basis of the EU. The Ministerial Council of the Energy Community has proposed the implementation of this regulation, but with certain modifications in June 2013.[1] By early 2013, twenty US states established obligatory energy efficiency resource standards and additional seven states non-binding energy efficiency goals. Fast developing emerging economies like China and India are keen to utilize their energy efficiency potential to ease the pressure on their energy import bills.

The promotion of energy efficiency has not been a standard component of an energy regulatory authority's statue. Since energy efficiency policies are wide-ranging horizontal policies, the responsible party for implementation is often the energy ministry or some specialised government authority or a dedicated energy efficiency agency. This situation is, however, changing. It is increasingly recognized that certain decisions of energy regulators, e.g. on final customer prices or on network companies' remuneration, have significant impacts on energy companies' and customers' decisions with an implication for their efficiency in energy use. Energy regulators get also increasingly involved in implementing national or state level energy efficiency programs by an explicit mandate.

The objective of the 'Principles of Regulation to Promote Energy Efficiency in the Black Sea Region' is to map the link between the activities of National Energy Regulatory Authorities (NERAs) and the decisions of licensed companies and final customers with regard to energy efficiency. It provides a concise overview of the incentives and obligations NERAs can apply to encourage energy efficient behavior on their side. The document intends to promote the application of good regulatory practices with regard to energy efficiency in the Black Sea region.

The 'Principles of Regulation to Promote Energy Efficiency in the Black Sea Region' was prepared by the Regional Center for Energy Policy Research/REKK based in Budapest, Hungary, and represents a yearlong combined drafting process of the national regulatory agencies in Armenia (the Public Services Regulatory Commission/PSRC), Azerbaijan (the Tariff Council/TC and the State Agency for Renewable Energy/SARE), Georgia (Georgian National Energy and Water Supply Regulatory Commission/GNEWRC), Moldova (the National Energy Regulatory Commission/ANRE), Turkey (the Energy Market Regulatory Authority/EMRA), and Ukraine (the National Energy Regulatory Commission/NERC), with the Organization of MISO States (OMS) serving as a project resource, and the National Association of Regulatory Utility Commissioners (NARUC) serving as a project manager.

The National Association of Regulatory Utility Commissioners (NARUC) implements the Black Sea Regulatory Initiative (BSRI), a project framework for the Principles, under the auspices of a cooperative agreement with the United States Agency for International Development (USAID). The BSRI provides special focus on regulatory developments in an expanded regional context for consideration of issues related to electricity transmission system regulation and electricity trading across national borders in order to move toward regional harmonization of the national regulatory arrangements consistent with the European Union Directives.

[1] Recommendation of the Ministerial Council, R/2013/01/MC-EnC on Energy Efficiency, ANNEX 17/11 MC/25-06-2013.

The introductory Sections 1, 2 and 3 define the context of the Principles, provide for the definitions and indicators of energy efficiency, and describe briefly the policy context for energy regulators.

Sections 4 and 5 discuss supply side energy efficiency issues in generation and networks, accordingly. Section 4 is about regulatory practices to reduce transformation losses in electricity generation, while Section 5 describes regulatory incentives to encourage network loss reduction by distribution operators, successfully applied in several emerging countries.

Section 5 further elaborates on those issues between network operators and final customers being the most relevant for energy efficiency. Since proper metering, meter reading, pricing, billing and settlement for consumed energy services are all necessary preconditions for having energy conscious customers, the role of regulation in this regard is discussed.
How to remove the potential counter-incentives of network operators / utilities to engage final customers in energy efficiency and demand response programs? Potential revenue remuneration schemes and revenue decoupling are discussed to answer this pressing regulatory issue.

Sections 6 to 8 go deeper into demand side energy efficiency related regulatory issues.

Section 6 discusses the relationship between cost reflectivity of final customer tariffs and energy efficiency. It argues that NERAs should fully remove general price subsidies and largely remove cross-subsidies from final customer prices to promote energy efficiency.

Section 7 covers regulatory arrangements for demand response programs. Demand response is a way to tap, through voluntary customer participation, into the potential of efficient use of energy infrastructure by reducing demand at peak time, shifting demand between times of day or seasons or increasing demand at night hours. Demand response will reduce the overall system cost by limiting use of the most expensive generation and replacing it with cheaper generation available at off-peak times. NERAs, especially in the US, have accumulated significant experience with utility implemented demand response programs.

Section 8 reviews recent arrangements for energy regulators in the context of energy efficiency programs like energy efficiency obligation schemes in the US and the EU. NRAs might play a key role in designing, implementing and monitoring such programs.

Section 9 discusses critical issues regulators must consider when assessing energy efficiency programs. Measurement and verification of energy usage and performance consider improvements against a reference or 'business and usual' development scenario. These necessary conditions establish the basis for effective and fair programs. It is crucial that program support is only provided for actions and activities that bring real improvements in a measurable, verifiable and cost-effective way.

While Annex D provides for a brief summary of the energy efficiency profiles of the BSRI participating countries, Annex E contains country specific regulatory case examples on supply and demand side energy efficiency issues.

Section 1 - Context of the energy efficiency principles

1. It is recognized that more efficient utilization of energy resources, transportation and transformation technologies could reduce pressure on the overall energy consumption needed to fuel future economic growth in the countries involved in the BSRI process. Increased energy efficiency can ease the dependence of some BSRI countries on imported energy resources (Armenia, Turkey, Moldova, Georgia and Ukraine) and allow others to increase the export of their indigenous energy resources and consequently increase national budget revenues (Azerbaijan).

2. In addition, the reduced pressure on energy use would also reduce the pressure on greenhouse gas emissions in those countries that are all involved in the international effort under the UNFCCC to combat climate change.

3. After the introduction of relevant terms and a brief discussion of the wider energy efficiency policy context of the EU, the US and the Black Sea countries, these Principles will focus on activities of National Energy Regulatory Authorities (NRA) with most relevance for demand and supply side energy efficiency, including:

    a. measures to reduce transformation loss in electricity and heat generation;

    b. incentives to reduce network loss;

    c. regulatory arrangements for metering, meter reading, billing and settlement;

    d. revenue recovery options of local integrated utilities or distribution system operators (DSO) to motivate end customer energy efficiency (revenue decoupling);

    e. implications of end customer price and tariff regulation for energy efficiency; and

    f. arrangements to encourage demand response programs.

Section 2 - Definitions and indicators of energy efficiency

4. Consumers have no demand for primary energy carriers (e.g. coal, oil or natural gas) *per se* but for energy services (e.g. light, heat or motor force). *To provide the same level of service with less primary energy use is an improvement in energy efficiency*.

5. *Energy efficiency* – meaning the product/service that can be produced with a given amount of energy – features all the different stages of the energy value chain: generation, transmission, distribution and final consumption. The key notion in generation is conversion efficiency (e.g. PJ coal/PJ electricity), in transmission and distribution it is network loss (total energy injected to the grid at the power plant minus total energy distributed to final consumers), whereas in consumption it is the level of energy service produced from a given amount of energy (e.g. kwh/m2/a denoting the energy efficiency of buildings). Energy efficiency policy generally refers to a set of measures aimed at increasing efficiency throughout the value chain.

6. *Energy efficiency* and *energy saving* are terms that are often used interchangeably. Strictly speaking, energy efficiency is an input/output ratio (PJ/PJ) whereas energy saving

is the reduction in energy use (PJ) – often as the result of a measure or program – against a baseline (business-as-usual) consumption or from past consumption defined in absolute amount (PJ).

7. The overall energy efficiency of a country is characterized by its *energy intensity* (PJ/USD). Energy intensity is measured by the quantity of energy required per unit output or activity: using less energy to produce a product reduces the intensity. Reduction of energy intensity is evidence that economic development can occur simultaneously with the reduction of energy use.

Section 3 - Energy efficiency policies and related NERA roles

8. It is quite common that national governments set an energy efficiency policy target that specifies the amount of energy to be saved or improve the energy intensity of production (PJ/USD) by a certain target year. Policy targets do not necessarily have to result from international commitments but can be national targets.

    - The member states of the European Union have indicatory energy savings targets under the Energy Service Directive (ESD - 2006/32/EC) that is 1% annually (of preceding final energy consumption) between 2007 and 2016. The new Energy Efficiency Directive that repeals the ESD (EED - 2012/27/EU) requires member states to set new targets for 2020 so that jointly they reach a 20% energy saving target on a 1990 basis of the EU. The reason behind the regulatory initiative of the Commission is that of the 20-20-20 targets of the EU, the 20% primary energy savings goal is unlikely to be met based on the present trajectory of energy use (that is, considering already adopted measures), and actual savings are likely to be less than 10% by 2020.

    - EED now is the main regulation that not only sets mandatory national energy savings targets but defines some compulsory policy tools to reach the common 20% savings target of the European Union.The main provisions of the EED include

        - the setting of an indicative national energy efficiency target by each member state in either primary/final savings or intensity but translated into absolute level of primary and final energy consumption in 2020 to allow for compliance assessment,

        - the achievement of a certain amount of final energy savings between 2014 and 2020 by using energy efficiency obligations schemes or other targeted policy measures,

        - guaranteeing easy and free-of-charge access to data on real-time and historical energy consumption for consumers through more accurate individual metering (implementation by 2015),

        - obligation for large enterprises to carry out an energy audit at least every four years (the first executed by 5 December 2015) and incentives for SMEs to undergo energy audits to identify energy saving options,

- renovating 3% of the space area of buildings owned and occupied by the central governments (from 2014 onwards and annually) to a level that meets the requirements of Directive 2010/31/EU on the Energy Performance of Buildings,

- introduce energy efficiency considerations in public procurement,

- comprehensive assessment of the heating/cooling potential for the application of high-efficiency cogeneration and efficient district heating and cooling (by 2015),

- mandatory cost benefit analyses whenever existing thermal electricity generation installations, industrial installations or district heating networks (above 20 MWth) are planned or substantially refurbished with a view of promoting co-generation,

- identifying measures and investments for energy efficiency improvements in the network infrastructure (with timetable for their introduction).

- According to the Commission's estimates, the energy efficiency obligation schemes will be the key instruments in attaining the community level energy savings target.[2] The general framework for such schemes:

    - Baseline for target calculation: average final energy consumption of 2009-2011 but energy used by transport can be excluded (optional)

    - Compliance period: 2014-2020

    - Target: new annual energy saving equaling to 1.5% of the baseline[3]

    - Energy savings should be achieved at the end consumer.

- Even though the EED requires the setting up of obligation schemes, it also allows for their substitution (fully or partially) by other policy measures such as energy tax, labeling schemes, financial incentives, standards and norms, voluntary agreements etc. if the resulting energy savings at least equals the target defined for the obligation scheme.

- In addition to the concession of deducting the energy use of transport from the baseline, MSs can reduce their calculated target up to 25% by the followings:

    - Gradual phase-in of savings rate: 1% in 2014 and 2015; 1.25% in 2016 and 2017; 1.5% in 2018-2020

    - Exclusion of energy use of industrial installation covered by the EU ETS

    - Exclusion of energy savings from transformation, transmission and distribution

[2] NON-PAPER OF THE SERVICES OF THE EUROPEAN COMMISSION ON ENERGY EFFICIENCY DIRECTIVE, INFORMAL ENERGY COUNCIL, 19-20 APRIL 2012

[3] Example: if the baseline is 100 Mtoe then the savings target is 42 Mtoe

- Exclusion of savings from early action (implemented after 2008 and having effect at least until 2020)

- The experience with the implementation of the EED is very limited as it is still in the phase of legal transposition. As far as the EE obligation scheme provision concerned (Art 7 of EED) almost all EU member states has used the target reduction options (deduction of transport energy use and the 4 exemptions) that clearly signals that the proposed policy goals require considerable effort from the MSs. Many MSs were also very keen to substitute the obligation scheme with more traditional policy tools such as financial incentives (EU funds in cohesion countries), energy tax, information tools (soft measure) etc. In these cases they have to prove to the Commission that these measures are either new or the existing measures are scaled up to result in savings that are additional to the "Business As Usual" case.

- Members of the Energy Community such as Moldova have adopted the ESD and are in the decision process to implement EED as well.[4]

- By early 2013 twenty US states established obligatory energy efficiency resource standards and additional seven non-binding energy efficiency goals. Typical state level energy efficiency standards / goals foresee the reduction of electricity and/or natural gas demand or sales by a target year (2015-30) in absolute terms or compared to a reference year.[5] Regulatory Commissions tend to play an active role in the implementation of these policies. The below Table compares the main features of the Minnesota and Wisconsin energy efficiency program models (for more details on these programs see ANNEX E).

	Wisconsin	Minnesota
Funding	○ Fixed, annual amount = 1.2% of investor-owned utility revenues. ○ Efficiency funding recovered in utility rates. ○ Funding held in private, non-governmental account.	○ Amount varies by utility type. ○ Minimum investment of between 0.5% - 2.0% of gross operating revenues. ○ Efficiency funding recovered in utility rates, plus performance-based incentive rewards. ○ Funding managed directly by utilities – not held in governmental account.
Structure	○ Public Service Commission (PSCW) is responsible for program policy oversight, enforcement, and rate recovery of program funding. ○ Utilities collect and provide program funding, and contract with a third-party, private program administrator. ○ Program administrator designs, manages, and ensures delivery of the energy efficiency programming. Uses subcontracting for program implementation.	○ Utilities directly administer energy efficiency programs on an individual utility basis. ○ Department of Commerce (DOC) is responsible for utility conservation plan review and approval, including energy savings calculations. ○ Minnesota Public Utilities Commission (MPUC) adjudicates rate recovery of efficiency funding, subject to a prudence standard.
Program Detail	○ PSCW sets both energy and demand savings goals over a quadrennial period. The program administrator is then charged with meeting those goals.	○ Legal requirement that utilities establish annual energy savings goal equivalent to 1.5% of gross retail energy sales. Supply side efficiency may contribute to savings goals.

[4] For more details visit http://www.energy-community.org/portal/page/portal/ENC_HOME/INST_AND_MEETINGS?event_reg.category=C10504
[5] For more details on EERS policies, see www.dsireusa.org and www.aceee.org/topics/eers.

	○ Program funding is primarily energy efficiency related. For 2014, funding = 94% energy efficiency, 5% renewables, and 1% research. ○ About 40% of program funding goes to the residential class, and 60% to commercial and industrial classes. ○ Legal requirement of program cost-effectiveness, on a portfolio-wide basis. The program uses the Modified Resource Cost test to determine cost-effectiveness. ○ Renewables component of program is shrinking somewhat in recent years. It is aimed primarily at smaller scale, customer-sited projects.	○ Utilities may ask the DOC to lower the annual goal to a minimum of 1.0%. ○ DOC review standards are aimed at program cost-effectiveness and reaching a broad spectrum of customers, across the various customer classifications. ○ Minimum of 0.2% of residential gross operating revenues must be spent on low income programs. ○ Maximum of 10% of overall minimum spending may be spent on R & D projects. ○ Maximum of 10% of overall minimum spending may be spent on renewable DG projects. ○ Lighting/lamp recycling = required programs.

- Countries of the BSRI have all adopted strategic documents with energy efficiency/saving targets.[6]

9. Monitoring of the achievement of energy efficiency policies is a complex task considering that saving is calculated against a theoretical baseline consumption trajectory, thus presenting the risk of measurement and verification errors or abuses.

Supply side energy efficiency issues for regulators

10. Regulated energy sector activities are responsible for the rest of the difference between the *total final energy consumption* and the *primary energy consumption* of an economy.[7] The difference is made up by energy *transformation losses*, *self-consumption* and *network losses* – largely in the electricity sector.[8] This section reviews available regulatory measures to address these supply side energy efficiency issues.

Section 4 – Minimum efficiency requirements for electricity and heat generation through licensing

11. The level and development of efficiency of electricity generation is dominantly market driven. Generation owners and investors are the primary decision makers about building and operating electricity and heat generation units. As far as electricity demand is fulfilled on the basis of merit order, units that can produce electricity and/or heat at lower cost provide supply. This creates a strong incentive to reduce cost, and consequently to improve the conversion efficiency - an important determinant of production cost - as much as possible.

12. Economic dispatch based on merit order can be distorted when the system operator (dispatcher) is not independent from generation owners / operators. In such cases the

[6] National Program on Energy Saving and Renewable Energy of Republic of Armenia, 2007; ENERGY EFFICIENCY STRATEGY PAPER2012-2023 of Turkey: decrease at least 20% of amount of energy consumed per GDP of Turkey in the year 2023; Ukraine: http://www.ukrainian-energy.com/en/energy_legislation/legal_forum/

[7] In the EU transformation losses are over 20% of primary energy consumption. The electricity sector is responsible for the rest of energy transformation losses and self-consumption. Distribution losses account for about 2-3% of primary energy consumption. Besides electricity distribution, network loss is also significant in the heat sector.

[8] Other relevant sectors contributing to such losses are the natural gas sector, oil refining, metallurgy and some other industrial activities.

system operator might be interested in dispatching non-efficient units in order to keep them running. For this reason regulators are better to monitor the behavior of the dispatcher as well as the efficiency and utilization rate of the generation units. The lack of developed energy statistics might object such monitoring.

13. As energy lost in the transformation processes is a cost pertaining to all consumers, NERAs might have a role to *promote the application of energy transformation technologies with high energy efficiency standards*. In cases when these electricity and heat generating companies are the licensees of NERAs, *energy sector legislation should authorize NERAs to incorporate such regulatory elements to the licensing procedure.* Otherwise NERAs can play a role in monitoring the actual performance of high efficiency generators.

14. The monitoring effort is especially relevant in the case of generation units that receive regulatory or financial support from the state and as such the awarding of production and/or investment support is often linked to a minimum efficiency requirement. Feed-in tariffs offered for combined heat and power generation (cogeneration) and renewable electricity generation can be conditioned on such requirement. For example, the relevant EU Directive[9] encourages the promotion of high-efficiency cogeneration when these technologies meet some pre-defined level of production efficiency (75% or 80% annual overall efficiency to produce electricity and heat). For example, based on the provisions of the Directive, the Hungarian regulator conditioned feed-in tariff payments for smaller size cogenerating plants on a 75% minimum overall efficiency before July 2011. The condition ceased to exist when cogeneration units were excluded from the feed-in tariff scheme. (See Annex E for a regulatory case study on Hungary's CHP promotion experiences). Regulatory monitoring should ensure that only those generators receive subsidy that actually meet the required efficiency standard.

Section 5 – Regulating the revenue recovery of electricity network operators

15. NERAs tend to have tight control over the recovery of the justified costs of privately owned local utilities (in the US) or, under an unbundled industry structure, transmission and distribution system operators (TSOs and DSOs in the EU). This section covers a wide range of regulatory issues related to electricity network operators that influence their own energy efficiency performance and their willingness and ability to assist end customers getting involved in energy efficiency improving activities.

Incentives to reduce network loss

16. *Network loss*, especially in electricity, makes up a significant part of energy consumption of an economy. In some emerging economies network loss might be as high as 30-50% of the electricity injected into the distribution grid. Comparable figures for OECD countries are 5-8%.

17. Regulators should apply regulatory solutions to encourage network operators (primarily distribution network operators) to be engaged in loss-reducing commercial, maintenance and investment activities. *Incentive regulatory schemes* – along with other measures –

[9] Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market.

have proven to be very successful in many developing economies to achieve significant network loss reductions at the distribution level.

18. A key component of such a scheme is first to estimate the *justified level of technical loss* of network operators. The remaining part of network loss is called *commercial loss* (including theft of electricity and measurement errors). It is adequate to apply different regulatory approaches to justified technical losses and commercial losses. While full cost recovery to purchase technical losses for the network operator is justified, the regulator should judge the share of commercial losses to recover for the operator.

19. The following incentive scheme can be applied to encourage network operators to eliminate non-justified commercial losses. First, the regulator establishes a forward looking, decreasing path for justified network loss (composed of technical loss and the share of justified commercial loss) for a fixed term and promises *only* to recover the cost of this pre-announced level of loss for the operator in its tariffs. This path should approach the level of justified technical losses[10] but should also take into account the capability of the network operator to improve its performance over time (share of different voltage levels at the network, share of underground cables etc.). In addition, the regulator promises that the *operator can earn the savings from larger than expected network loss reduction*. At the same time the cost of network loss that exceeds the expected regulatory level will be born by the owners of the network operator.

20. The potential gains from larger than expected network loss reduction together with the remuneration scheme for network loss reduction related investments will determine the optimal level of involvement in loss reduction for the network operator.

21. Network loss remuneration on such a forward looking or benchmarking, instead of a historical, basis has been widely and successfully applied by many ERRA regulators, including Black Sea regulators (Armenia, Georgia, Moldova and Turkey).

22. *The privatization of network operators* can also open up opportunities for regulatory arrangements to reduce network losses. For example, in 2009 the privatization agreements of the Albanian DSO included explicit requirements for the new owner / operator to reduce network losses. According to the agreement the new operator was expected to increase the collection rate by 5% and reduce total losses in distribution by 17% from end of 2008 levels (83,3% and 34%, accordingly) by 2014. In order to ensure the new (often private) operator about sufficient cost recovery for their efforts, the NERAs is better involved in completing such privatization arrangements.

23. The penetration of distributed generation (by definition connected to the distribution grid) in an electricity system significantly affects the level of network losses. While moderate penetration will decrease, higher penetration will increase network losses[11] and thus affect the finances of DSOs. To get DSOs on board to promote the penetration of distributed generation (e.g. for climate and energy efficiency policy purposes) the

[10] The regulator might need the assistance of outside technical experts to establish the level of justified technical losses. International benchmarking can also help the regulator.

[11] See Joode et al. (2010). De Joode, J., Van der Welle, A., Jansen, J. (2010), *Distributed Generation and the Regulation of Distribution Networks*, book chapter in: Distributed Generation, D.N. Gaonkar (ed.), InTech, February 2010.

regulatory arrangements to recover their costs will be crucial. We come back to this issue when discussing *revenue decoupling*.

24. As their penetration is steadily growing, regulators should monitor the impact of distributed generation on network losses.

Metering – traditional and smart

25. Proper *metering, meter reading, pricing, billing and settlement* for consumed energy services are *all* necessary preconditions for having energy conscious customers.

26. Billing and settlement for energy supply services might be based on *metered* or *estimated* consumption. The stronger the relationship between actual (metered) and settled consumption, the easier to introduce energy efficiency improving and demand response incentives for end customers.

27. Individual customers having no installed meter will be settled on their estimated consumption and will not be interested in using energy supply services efficiently. It may still be socially desirable to install insulation, flow restrictors or other means to control the energy consumption of these customers.

28. The decoupling of actual consumption, meter reading and settlement in time[12] will weaken the opportunity and incentive for end customers to participate in energy efficiency improving and demand response activities even if they have an installed meter.

29. *Metering* and meter reading of end-customer energy consumption is a *key function of network operators*.[13] Regulatory arrangements for metering end-customer energy consumption will have a crucial impact on the finances of network operators as well as on the opportunities of customers to participate in demand side programs (including energy efficiency programs).

30. *A fundamental regulatory requirement for NERAs* in this regard is *to ensure a close to 100% enrolment of at least basic metering devices* (e.g. electro-mechanical induction electricity meters) *for individual customers (both industrial and household)*.[14] While commercial customers often provide and pay for meters, full cost recovery of meters installed by network operators for non-commercial customers is to be ensured by the regulator.

31. Even when customers have *traditional meters*, there might be some limited scope for customer participation in demand response programs (see Section 7 on demand response programs). For example, the installation of *remotely controllable traditional meters* might allow network operators for a limited adjustment of end-customer energy consumption patterns to system balancing needs. For example, many CEE countries utilize radiofrequency controlled meters for night and day tariffs: customers pay less for electricity supply that is controllable by the network operator (mainly electric boilers and heaters).

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[12] For example an arrangement of once a year meter reading and monthly settlements on estimated consumption.

[13] Metering market arrangements when an independent Metering Service Provider performs metering, or when metering is performed by the supplier in a liberalized metering environment is not relevant for BSRI countries.

[14] For example, replacing aggregated heat consumption metering in district heated blocks of houses with individual end-customer heat meters has dramatically improved end customer energy efficiency in such buildings in Central and Eastern Europe.

32. Energy policy objectives related to climate change and energy market competition together with recent and parallel innovations in information technology and energy market arrangements have prompted *national deployment programs for smart metering and smart grids* worldwide.[15]

33. The Electricity and Gas Directives of the EU (2009/72 and 2009/73) oblige member states to develop national smart metering deployment plans and carry out related pilot projects and social cost benefit analyses. The policy objective is to have 80% penetration of smart meters by 2020 in the EU, contingent upon positive benefit-cost ratio. It is estimated that the level of penetration will be around 56% by 2017. Several member states have already completed 100% deployment (Italy, Sweden, Finland) or expected to do so in the near future (Estonia by 2017, France and Spain by 2018, Austria, Ireland, The Netherlands and the UK by 2020). On the other hand, Germany and the Czech Republic decided not to mandate the roll-out of smart meters due to the negative outcome of the CBA. In the US the level of penetration was 23% in 2011.

34. NERAs play a key role in implementing national smart metering deployment programs. These include at least

    - to ensure the *overall efficiency* of the national smart meter deployment strategy;
    - the *development of a privacy policy and data security standards* to ensure customer energy consumption data is not accessed by unauthorized parties or misused;
    - the *recovery of the justified cost* of the deployment program for the network operators;
    - to ensure that installed smart meters meet some *minimum functionalities* that support end customers in demand response as well as in market participation, and
    - to ensure the application of *new tariff schemes enabled by smart technologies* (e.g. *time of use tariffs or real time pricing*) to reduce final energy consumption and to reduce the cost of system management by reducing the fluctuation of load.

35. Smart meter rollout programs are expensive social investment programs. In order to ensure their efficiency, the NERA might carry out or commission a *social cost benefit analysis*, probably *after supporting pilot projects* testing technical possibilities and assessing costs and benefits. When devising such a deployment plan, it is also necessary to analyse very carefully the potential barriers to a successful smart metering roll-out.

36. The classical role of the regulator is *to accommodate the new investments in smart metering during the price control process for metering* and/or network usage charges. When deciding about the incentives to recover the investment costs, consideration should be given to the savings on the supply/network side e.g. due to improved processes, obsolete manual meter readings, less theft and improved asset management. The issue of whether these company level benefits outweigh the costs also has to be

[15] The following points on smart metering rely heavily on the ERRA Licensing and Competition Committee Issue Paper on '*Regulatory Aspects of Smart Metering*', prepared by KEMA, 2010.

considered in the revenue control process. However, experience so far shows that the DSO is highly unlikely to achieve a positive net benefit if it bears the full cost of smart metering infrastructure development.

37. The benefit of smart meter roll-out can be extended by the smarting of the distribution grid. The CBA prepared by Germany on smart meter rollout yielded positive result only if coupled with smart grid applications.

38. Existing regulatory schemes to recover the cost of smart metering investments for network operators vary widely.

39. Once smart meters are deployed, metered data will accurately reflect the final customer's actual consumption and will provide information on actual time of use. Settlement for energy services, even on an hourly or shorter basis becomes possible.

40. Regulators should ensure that final customers have easy access to information on their historic consumption.

41. It is up to regulatory consideration whether, once smart meters are in place, time of use tariffs should be made obligatory for suppliers to offer for final customers.

42. Once smart meters are in place, it can also allow for *net metering arrangements* to support the penetration of decentralized generation and households to become electricity consumers and producers at the same time (prosumers).[16]

43. Regulators can also use new smart technologies to *improve the performance of existing regulatory arrangements*. Smart metering can be especially valuable if a *quality of supply regulation* scheme is applied or needs to be set-up. If widely deployed, smart metering provides accurate information on and enables monitoring of voltage and power quality, interruption duration and frequency. In particular very short interruptions are often not recorded by existing systems. Smart metering would thus provide the basis to significantly improve the regulator's data basis and increase feasibility of quality regulation schemes. Such functionalities – however – need to be made public in advance and required by regulation.

Incentive tariff regulation for network operators to enhance final customer participation in demand side management programs

44. The remuneration of DSOs for investments in smart metering/grid that are also necessary for the large scale deployment of distributed electricity generation (predominantly renewable-based) is a critical regulatory issue.

45. The present regulatory challenge for DSOs is that while the distribution costs are relatively independent of the amount of transported energy in the short term, yet they are recovered mainly via volumetric tariffs pertaining to residential and small commercial consumers. Relying on volumetric tariffs becomes especially problematic with the advancement of distributed generation and energy efficiency improvement in final energy consumption. Traditional regulatory methods provide DSOs a strong incentive for

[16] Note however that smart meters are not a prerequisite for DG to take place.

increased sales because increased sales lead to increased profit. This throughput incentive is at odds with public policy objectives like conservation and reduced emissions.

46. Distributed generation units operate – in most countries – on a net metering basis meaning that even though they use the network for injection and consumption in most of the time, they pay a negligible amount of the network tariff i.e. on the net consumed volume in the settlement period. In this way simple electricity consumers finance the network use of, probably more wealthy 'prosumers'. Hence it is not only the overall level of remuneration but also the fair contribution of network users to network maintenance and development cost poses regulatory challenge.

47. The effect of energy efficiency investment on a massive scale is quite similar: the same network needs to operate from a decreasing tariff base creating cost-recovery problems for DSOs.

48. The throughput incentive can be mitigated by stabilizing the utility revenues by employing methods like higher fixed customer charges, lost revenue charges, recovery of revenue through tracker accounts, or revenue decoupling. *Revenue decoupling*[17] breaks the mathematical link between sales volumes and revenues (and ultimately profits). It is intended to leave revenue levels unchanged due to variation in sales, and thus encourages desired behavior like conservation/EE. It also enables recovery of the utility's prudently incurred fixed costs, including return on investment, in a way that doesn't create incentives for unwanted outcomes.

49. The concept of decoupling is to determine a utility's revenue requirement through traditional methods, calculate the revenue requirement for future periods, track the difference between the allowed revenues and actual revenues, and make adjustments in rates, positive or negative, in future periods to make the utility whole. Major types of decoupling are:

    - Full decoupling accounts for any variation in sales (conservation, weather, economic cycle, or other defined causes) with subsequent adjustment of utility revenues relative to allowed revenues.
    - Partial decoupling accounts for some defined variation in sales, or recovery to a prescribed level, with subsequent adjustment of utility revenues relative to allowed revenues.
    - Limited decoupling will allow for adjustment of utility revenues for certain specific events of factors (e.g. weather only).

[17] On revenue decoupling in the US see NARUC (2007), *Decoupling for Electric and Gas Utilities: Frequently Asked Questions.* For a more general discussion on energy efficiency incentives, including rate decoupling, see RAP (2012), *Policies to Achieve Greater Energy Efficiency*, pp. 70-71.

Regulatory questions to be addressed when designing a revenue decoupling scheme include the followings

- How specific should the regulator be in detailing standards/criteria for decoupling ("one size fits all" or "case-by-case" determination)?
- Should standards/criteria be individually tailored to capture differences between the electric industry and the gas industry?
- When should a plan be implemented?
- How to avoid adversely affecting ratepayers?
- Should a showing of energy savings/conservation investment be required?
- Should there be a cap on rate adjustments?
- Does decoupling reduce utility business risk? If so, should other adjustments be made?
- Should plan include service quality standards? If so, what standards?
- Should any customer classes be excluded from a decoupling plan?

50. The current European network regulation is characterized by the predominance of flat rate volumetric network tariffs (€/kWh) for households, and the mixture of power demand charge (€/kW), reactive energy charge (€/kvarh) and fixed charge (e.g. €/month) for industrial consumers. The energy charge is - in half of the 17 countries covered by a recent EURELECTRIC survey[18] - coupled with a fixed charge component for households but capacity charge is not a common tariff element.

51. In the US, some states are already employing *revenue decoupling* as an element of their energy efficiency policies. According to the database of the American Council of and Energy-Efficient Economy, the leading states in the field of energy efficiency are Vermont, California and Massachusetts.[19] Utility rate decoupling policies are always accompanied by ambitious state level energy efficiency targets. (For a case study on revenue decoupling in Minnesota, USA, see ANNEX E).

52. With the advancement of distributed generation the grid investment requirement is expected to increase and the share of network cost in the electricity bill is likely to gain share against the energy component. Consequently, the political sensitivity towards network cost inevitably will increase. Regulatory initiatives to tackle this issue are essential to the modernization of the grid at a cost that is politically acceptable.

Demand side energy efficiency issues for regulators

53. Final energy consumers are key market participants in energy saving and hence in the compliance with energy efficiency/saving targets. Energy efficiency policy includes a number of tools to induce and assist the final consumer in saving energy. Energy efficiency policy tools can be *administrative, informational, voluntary and economic*. The following table lists the most common policy tools.

[18] EURELECTRIC: Network tariff structure for a smart energy system, May 2013.
[19] http://www.aceee.org

administrative	product standards
	building standards
	public procurement rules
informational	product labelling
	building labelling
	metering and billing
	energy saving advice
voluntary agreements	
economic	grants and preferential credits
	tax advantages
	energy efficiency obligation schemes/tradable EE certificates

54. Most of the above listed energy efficiency policy tools are not within the mandate of NERAs. However some of them (in bold) such as regulating metering and billing requirements (discussed in section 6) and the participation in implementing energy efficiency obligation schemes delegate important tasks to NERAs.

55. Next we discuss those activities and decisions of NERAs' that affect the short and longer term efficiency of final customers' energy use. Among the most important are

- final customer price setting and regulation (where relevant);
- regulatory arrangements for network operators (see Section 5 above);
- regulatory arrangements for demand response programs; and
- assistance in implementing state level energy efficiency programs (e.g. energy efficiency obligation schemes)

Section 6 – Final customer tariff setting

56. The application of cost reflective energy prices is the fundamental driver of final consumers to use energy in the most efficient way.
57. It has long been the core business of NERAs to establish final customer tariffs for energy supply services. While one of the objectives of energy market liberalization reforms is to cancel final customer price regulation, this process is slow even in the most dedicated countries.[20] Final customer price regulation is still a relevant regulatory task for BSRI countries.

58. Final customers modify their consumption as a response to the (relative) level and changes in end customer prices in the short and the longer term. In the short run, customers will modify their consumption as a response to price changes, depending on

[20] In its 2012 Annual Market Monitoring Report ACER reported that still 15 member states regulated household and 5 member states industrial customer gas prices.

their *short term price elasticity of demand*.[21] In the longer term, final customers react to energy prices through *investments into energy savings*.

59. Final customer tariff setting should meet several regulatory requirements (e.g. social fairness, transparency, stability, reliability). For energy efficiency purposes, the two most important requirements are *full cost coverage* and *cost reflectivity* of tariffs to encourage economically efficient production and consumption structures.

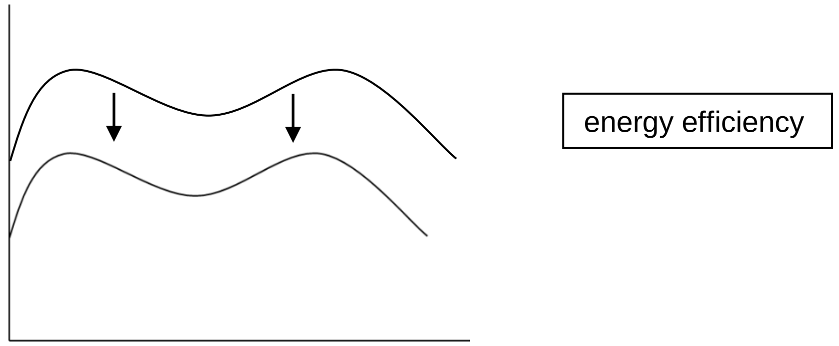
60. *General and cross price subsidies will, in general, destroy the efficiency of final customer energy use*. General subsidies will encourage wasteful energy use and reduce incentives for energy efficiency investments by final customers. The typical cross subsidisation (e.g. when industrial customers cross subsidise households) will result in destroyed industrial competitiveness and energy wasting households.

61. Thus a general guidance for NERAs is that they should, as far as possible, *fully remove general price subsidies and cross-subsidies from final customer prices to promote energy efficiency*.

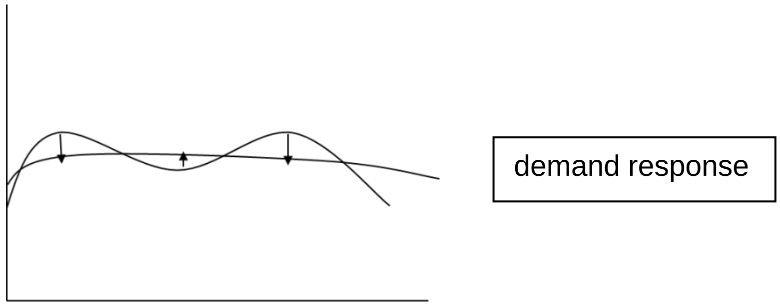
62. Although *increasing block tariffs for households* involve a certain level of cross-subsidisation, under certain conditions they might promote improved energy efficiency. In this case the below cost price for smaller customers is cross financed by above-cost tariffs for larger customers. Increased tariffs for larger customers might encourage energy efficiency investment among more capable, wealthier customers while providing for an increased affordability for the poor. However, since increasing block tariffs invited corruption, some regulators decided or consider to cancel its application (e.g. Armenia, Albania).

Section 7 – Regulatory arrangements for demand response programs

63. NERAs should promote regulatory arrangements that encourage final customers to get involved in *demand side management* programs so far as it is technically possible, financially reasonable and proportionate in relation to the potential energy and cost savings.
64. Demand side management includes *energy efficiency measures* (e.g. insulation of a house) and *demand response measures*. The difference between energy efficiency measures and demand response measures is that while the former aims at the reduction of overall consumption, the latter alters the timing of consumption.



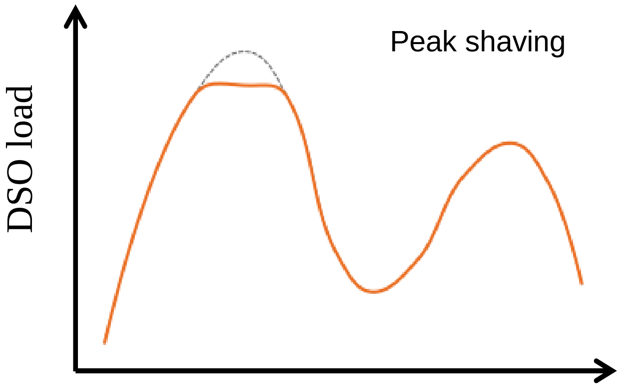
[21] The price elasticity of demand means a percentage change in consumption as a response to a percentage change in the price of the product, *ceteris paribus*.



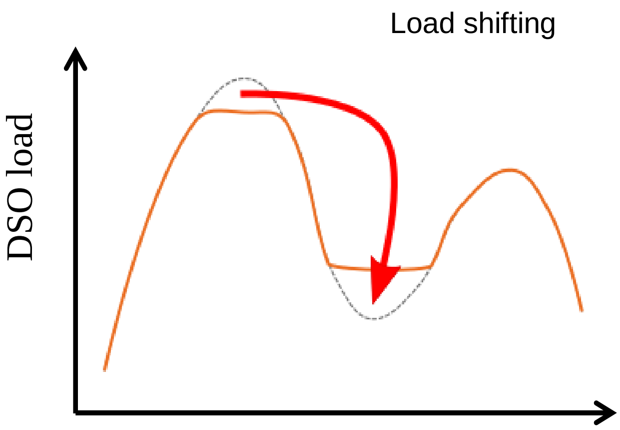
65. Demand response can be defined as “*the [voluntary] changes in electric usage by end-customers from their normal consumption patterns in response to changes in the price of electricity [market price or tariff] over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized*”.[22] In case of incentive payments, demand adjustment can also be taken by a counter-party (e.g. TSO) based on an agreement with the final customer.

66. Demand response is a way to tap into the potential of energy efficient use of infrastructure (energy efficiency in network design and investment into peak generation) by reducing demand at peak time (peak shaving), shifting demand between times of day or seasons (load shifting) or increasing demand at night hours (valley filling). Demand response will reduce electricity production cost by limiting use of the most expensive generation and replacing it with cheaper generation available at off-peak times.

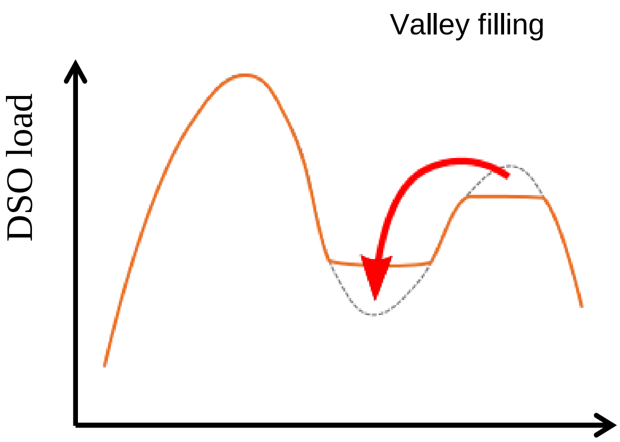
[22] US Department of Energy, 2006: *Benefits of demand response in electricity markets and recommendations for achieving them: A report to the US Congress pursuant to Section 1252 of the Energy Policy Act of 2005.*



- Reduces network costs (investment)
- Reduces losses



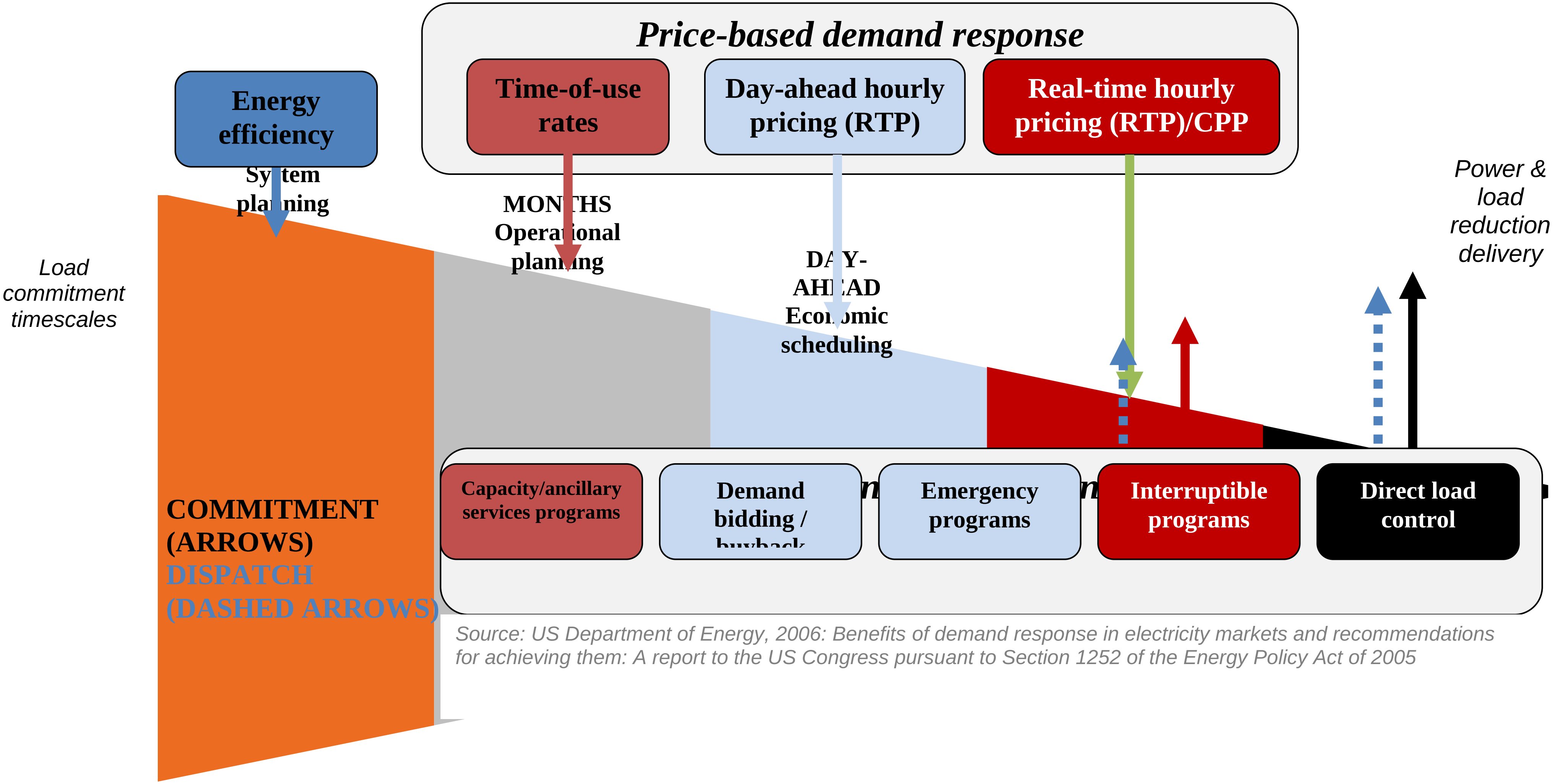
- Reduces network costs (investment)
- Less loss reduction



- Does not reduce network costs (investment)
- Minimal losses reduction

67. The various forms of price- and incentive-based demand-response programs are summarized in Figure 1.

Figure 1: Role of demand response in electric system planning and operations



Source: US Department of Energy, 2006: Benefits of demand response in electricity markets and recommendations for achieving them: A report to the US Congress pursuant to Section 1252 of the Energy Policy Act of 2005

68. Price based demand response schemes aim to move away from flat rate tariffs and create an ever closer link between wholesale energy price/cost variations and final customer prices in order to motivate customers to adjust their demand accordingly.

- *Time-of-use* (TOU) *tariffs* are predetermined and vary across periods of the day and seasons. They reflect the average cost of production in the given period.

- *Critical Peak Pricing* means that the organizer of the program (e.g. network operator, supplier) can – on a short notice – announce critical periods (either due to system security or simply high wholesale electricity price) with high price which is either pre-set or linked to the wholesale price. The critical price is always higher than the "normal" price the consumer faces (flat rate or the highest TOU tariff). The maximum number and length of such critical periods is usually set in advance.

- In *real time pricing programs* the final customer price fluctuates at least hourly reflecting the changes in the wholesale price. Final customer prices are announced day-ahead or hour ahead.

69. Incentive-based programs are more diverse than price based ones. Under these programs final customers agree with the organizers of the program (e.g. DSO, TSO) to modify their load under pre-defined conditions in exchange for a price discount or an incentive payment. Important variables include whether the customer or the utility makes the final decision and whether the incentive is market –based or a pre-determined price.

- *Direct load control* assumes the existence of household appliances (e.g. boilers, electric heaters, air conditioners or refrigerators) that can be remotely switched off in case of system contingencies in exchange for reliability payment.

- *Interruptible/curtailable service* means that consumers reduce their load to the pre-set level in case of contingencies in return for a rate discount. Non-compliance is penalized. Variations in notice periods, frequency of interruptions, number of interruptions, and duration of interruption will influence individual customers differently based on their industrial process.

- Consumers participating in *emergency demand response programs* receive incentive payments for load reduction in emergency events.

- *Demand bidding program* participants bid directly into the scheduling process i.e. bid a price and a level of curtailment on a day-ahead basis. It allows the consumer to remain in a risk-free flat rate tariff system but at the same time allows the whole system to take advantage of his/her consumption flexibility.

- Consumers may – as well – participate in the *ancillary service markets* to provide operating reserves. Mostly large consumers that can frequently, safely and quickly curtail load are able to integrate to this market.

70. NERAs play a key role in facilitating the involvement of consumers by developing regulation that incentivize DSOs (being the key actors in this regard) to deploy advanced

metering infrastructure and ‘smarting’ distribution grid (see Section 5 for a discussion on appropriate DSO incentives).

71. There exist several barriers to the successful implementation of demand response programs. NERAs should find appropriate remedies at least to the following issues.

- Utility / DSO costs are generally recovered through simple volumetric tariffs so that their revenue is based on the amount of electricity they sell / transport. If consumption decreases during peak periods due to demand response initiatives and is not increased during off peak hours, utilities could lose revenue. This *potential loss of revenue* may discourage utilities from supporting demand response initiatives despite the benefits they create. A proper regulatory response to address this issue can be the *decoupling of utility revenues to from sales volumes* (see more details in Section 5).

- Loads, especially smaller loads cannot individually participate in an organized ancillary services or balancing market. However, NERAs can require DSOs / TSOs to amend their market rules as necessary to permit an *aggregator of retail customers* to bid demand response on behalf of its retail customers directly into the organized markets. *The EU’s Energy Efficiency Directive requires enabling demand response to participate alongside supply in wholesale and retail markets, including balancing and ancillary services provision*. It also requires that the technical specifications for participation in these markets include the participation of aggregation. The forthcoming EU network code on electricity balancing is supposed to enable provision of balancing reserves from system users connected to distribution networks, including the aggregation of both small demand and/or generation units.

- Access to customer meter data for independent aggregators of retail customers is often time consuming and expensive. NERAs should ensure non-discriminatory access to customer data for the successful of demand response programs. Also, by making such information more readily available for independent aggregators, RTOs and DSOs could encourage participation in demand response programs.[23]

Section 8 – Regulatory assistance in implementing state level energy efficiency programs

72. Some energy regulators are deeply involved in managing end-customer energy efficiency programs, often called e*nergy efficiency obligation schemes.* These schemes require energy companies to invest in projects that yield a pre-defined level of energy saving. A variety of such programs are in operation for a number of years.[24] The UK, Italy, France, Denmark and the Flemish region of Belgium have introduced obligations on some categories of energy market operators (in particular electricity and gas distributors or

[23] Art 9. of the Energy Efficiency Directive (2012/27/EU) says:
„If final customers request it, metering data on their electricity input and off-take must be made available to them or to a third party acting on behalf of the final customer (e.g. an energy services company (ESCO) or energy aggregator) in an easily understandable format that they can use to compare deals on a like-for-like basis;”
[24] For a review *see* Silvia Rezessy and Paolo Bertoldi (2010) *Energy Supplier Obligations and White Certificate Schemes: Comparative Analysis of Results in the European Union*. European Commission, Institute for Energy Joint Research Centre

suppliers) to deliver a certain amount of energy savings.[25] The major characteristics of these schemes can be found in ANNEX A. In order to identify and realize the required energy savings in a cost efficient manner, third parties (e.g. ESCOs) are tendered by the obliged market participants.

73. Energy saving obligations imposed on energy companies – referred to as utility or supplier obligations, or energy efficiency resource standards – include energy saving targets. The company level targets are usually the derivative of national targets (expressed in energy saved or CO_2 mitigated). Company targets are based on energy market shares, or for simplicity in the residential sector, on the number of customers served.[26] Obligated parties are either energy suppliers or energy distributors and most often are delineated according to energy carrier. The number of complying entities varies. On the one hand, the UK CERT scheme covered 6 big electricity- and gas supplier companies. Conversely in France over 2500 electricity, gas, LPG, heat, heating oil and motor fuels supplying companies are involved in the energy efficiency obligation scheme.

74. In the EU the main target sector of these programs is the residential sector but some countries – during the evolution of their scheme – gradually extended the scope. Economic logic dictates the eligibility of all possible energy saving options but the transaction costs and the novelty of operating such a system inclined states to focus on sectors with considerable cheap energy saving potential (residential sector). In the US, however, the focus of similar programs is often on the commercial and industrial sectors.

75. The schemes aim at reducing energy use in final consumption but in some countries network loss and certain small scale renewable projects can be accounted against the savings target. Some programs also focus on peak (capacity) savings, particularly when generation reserves are tight.

76. Energy efficiency obligation schemes might – but not necessarily – allow for the tradability of energy saving certificates. These certificates are sometimes called “white certificates” (to differentiate from the “green certificates” of renewable electricity) and they embody a unit of saved energy. Obligated parties can transfer these certificates among themselves or from third parties either at bilateral exchange or – like in Italy – on a centralized market. This ‘tradability’ allows the realization of further efficiency gains in the system, as trading enables participants to fulfill their energy savings obligations by the cheapest available options.

77. The administrative settings behind state level energy efficiency obligation schemes are quite diverse, however in some countries NERA is the organization operating the system. The national targets are usually set by the government, however, the definition of company level targets most likely requires the involvement of NERA as it is the key information holder (retail market share or consumer base) on licensed energy companies.

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[25] Other European countries, such as the Netherlands and most recently Poland, Bulgaria and Romania, have expressed interest in introducing such schemes. As of 2014, more than half of the states in the USA have some kind of energy efficiency or energy savings obligations, either as a stand-alone target (referred to as energy efficiency resource standards, EERSs) or as part of renewable energy obligations (referred to as renewable portfolio standards, RPSs).

[26] In the US obligations have been expressed as a percentage of demand, peak demand, load growth or retail sales.

Certificate trading can be integrated into the electricity exchange so that the operator of the exchange is responsible for the trading and registration of this additional product. Defining the measures that are eligible for accounting in the scheme and verifying and certifying the achieved energy saving needs to be done by some public body: either the ministry, its institution, the NERA, or a supervised third party.

	FR	IT	UK	DK	BE (Fla)
Development of regulatory framework and target setting	government	government	government	government	government
Monitoring and operation	ministry (MEEDDAT)	NERA (AEEG)	NERA (OFGEM)	NERA (ENS)	ministerial body (VEA)
Certificate issuing body	regional governmental body (DREAL)	electricity exchange operator (GME)	-	-	-
Operation of registry/trading platform	ministerial body	electricity exchange operator (GME)	-	-	-

78. The ultimate source of financing investments under an energy efficiency obligation scheme is the energy price. If the obligated parties operate in the free market then they can recover (part of) the cost according to market conditions. Regulated energy companies recover their cost in the regulated tariff so it will end up in the end-user prices of the involved energy carriers. Some countries opted for the full ex post recovery of cost in the tariff, others recover a fixed amount for each MWh saved (e.g. Italy).

79. Defining the cost recovery scheme for the obligated regulated companies necessarily involves NERAs being in charge of developing the tariff methodology that would now involve a new element, the cost of the energy efficiency obligation scheme. NERAs should pay attention to design cost recovery rules in a way to incentivize energy companies to search for the least cost energy saving options first and then gradually move to the more expensive ones, all while balancing the benefits of the programs to those who pay.

Section 9 – Measurement and verification needs in the context of energy efficiency programs

80. Energy efficiency programs that give credits or payments to customers for implementing energy efficiency projects generally require some level of measurement and verification ("M&V") of the expected or claimed energy savings. These requirements are a reasonable way to assure that benefits are received for the payment or subsidy provided. M&V assures that the project has been installed, that it is operating correctly, and that it is producing the expected savings. M&V is an internationally recognized element of energy efficiency programs.[27]

[27] See International Performance Measurement and Verification Protocol, http://www.evo-world.org/ (available in English, Russian, Ukrainian and other languages) and Introduction to Measurement and Verification, Australian Efficiency Council, http://www.eec.org.au/UserFiles/File/M&V/Introduction%20to%20M&V.pdf and http://www.eec.org.au/Best%20Practice%20Guides.

If the payment comes from an energy market, that market may determine the methods for measuring and reporting the savings. A market operator may have particular reporting requirements that tie to its planning year or its reliability calculations.[28]

When the energy efficiency actions are taken by the customer without outside subsidy or payment, measurement and verification of the savings may be required under the terms of any loans or third-party financing arrangements.

81. Measurement may take the form of physical inspection and metering to observe installation and operation of the project. Comparison to past usage may be used to demonstrate savings. Comparison may also be made to engineering estimates or other projects. Simulation techniques are also available.[29]

[28] For instance, PJM Manual 18B, www.pjm.com/~/media/documents/manuals/m18b.ashx.

[29] The State of Minnesota uses an electronic platform to provide consistent reporting of energy efficiency savings. That site is available to other users. www.energyplatforms.com/

ANNEX A: Major characteristics of European energy efficiency obligation schemes

	UK	FR	DK	IT	BE (FL)
periods	2002-2005 (EEC1) 2005-2008 (EEC2) 2008-2012 (CERT) 2009-2012 (CESP)	2006-2009 2011-2013	2006-2013	2005-2012	2003-
target (in the last period)	293 MtCO2 (CERT) - lifetime savings	345 TWh final energy - lifetime savings	6,1 PJ first year savings in final energy	6 Mtoe cumulated primary energy	Kb. 580 GWh primary energy (2009) – company level target setting
obigated parties	suppliers	suppliers	DSOs	DSOs	DSOs
	electricity and gas	electricity, gas, LPG, heat, heating oil and motor fuels	electricity, gas, district heating	electricity and gas	electricity
minimum size	50000 consumer	electricity, gas, heat: 400 GWh/a; LPG: 7000 t/a; heating oil: 500 m3/a; motor fuel: 7000 m3/a	no mimimum size	50000 consumer in year t-2	no mimimum size
compliance check	end of period	end of period	annual	annual	annual
energy carriers involved	electricity, gas, coal, oil, LPG	electricity, gas, LPG, heat, heating oil and motor fuels	electricity, gas, district heating, heating oil	all	all
target sectors	households	all, excluding sectors unde the ETS	all, except transport	all	households and non energy intensive sectors
scope of eligible measures	final consumption	final consumption	final consumption, network loss and certain household sized renewable units	final consumption, network loss and certain household sized renewable units	final consumption
penalty	case-by-case	2 c€/kWh	10 c€/kWh	case-by-case	10 c€/kWh
method of savings accounting	estimated (ex-ante) + project-based	estimated (ex-ante) + project-based	estimated (ex-ante) + project-based	estimated (ex-ante) + engineering estimations + project-based	estimated (ex ante)
cost recovery	n.a.	exists but based on implicit rules	full recovery	annualy paid fixed amount (EUR/MWh)	full recovery
trading	bilateral	bilateral	organised market and bilateral	bilateral	-

Source: REKK, 2012

ANNEX B: Financing sources for energy efficiency programs

Apart from placing an obligation on energy companies to invest in energy efficiency measures for final consumers, there are various other financing practices. In cases of state grants and state bank financing, the taxpayer finances a share of energy efficiency investments. Energy service companies (ESCOs) are pre-financing the investment that is paid back from the earnings due to lower energy bills. ESCOs usually contract larger consumers due to the high transaction cost of such contractual relationship but the UK's Green Deal scheme tries to operate such a system on a household level. The following table summarizes the main forms of EE financing:

		Operation	**Cost of borne by**	**Example**
State grant		non-refundable payment for households and/or companies to refurbish their buildings	all taxpayers	Green Investment Scheme in Hungary (2009-2011)
State fund		the state requires energy companies to contribute to a public fund that finances energy efficiency investments; company level contributions are equal to their individual energy saving target under the EED	energy consumer	EED offers this option as an alternative to energy efficiency obligation scheme
State bank		household acquires loan from his/her commercial bank; the loan is refinanced by the state bank on preferential terms	household and taxpayer	Kreditanstalt für Wiederaufbau (KfW) – Germany
ESCO (energy service company)		household repays the cost of refurbishment from his/her energy cost savings on a monthly basis to the ESCO pre-financing the investment	household	Green Deal since 2013 in the UK
Energy efficiency obligation scheme	DSO	mandatory volume of energy efficiency investment for DSOs that yields the company level energy saving targets	energy consumer vie the network tariff	Italy, Denmark, Flanerds and any membes state under the EED
	Supplier	mandatory volume of energy efficiency investment for energy suppliers that yields the company level energy saving targets	supplier and energy consumer (to the extent the supplier can raise its price on the energy market)	UK (CERT), France and any member states under the EED

ANNEX C: Glossary of Terms

Acronym	Definition
Demand-response	The voluntary changes in electric usage by end-customers from their normal consumption patterns in response to changes in the price of electricity [market price or tariff] over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.
Demand side management (DSM)	A set of interconnected and flexible programs which allow customers a greater role in shifting their own demand for electricity during peak periods (demand-response), and reducing their energy consumption overall. Thus DSM programmes comprise two principal activities: demand response and energy efficiency / conservation programs.
Distributed generation	The installation and operation of electric power generation units connected directly to the distribution network or connected to the network on the customer side of the meter. The purpose of distributed generation is to provide a source of active electric power.
Net metering	Net metering is a service to an electric consumer under which electric energy generated by that electric consumer from an eligible on-site generating facility and delivered to the local distribution facilities may be used to offset electric energy provided by the electric utility to the electric consumer during the applicable billing period.
Revenue decoupling	Revenue decoupling breaks the mathematical link between sales volumes and revenues (and ultimately profits) in order to leave revenue levels unchanged due to variation in sales, and thus encourage behaviour like conservation or energy efficiency improvement. It enables recovery of the utility's prudently incurred fixed costs, including return on investment, in a way that doesn't create incentives for unwanted actions and outcomes.

ANNEX D: Country Profiles

The aim of this annex is to provide some preliminary information on the various energy efficiency features of the Black Sea countries. The sources of the information are – on the one hand – international public databases, on the other the information provided in the questionnaire distributed to the representative of the BS countries.

Energy intensity

Energy intensity shows how much energy is needed to produce one unit of GDP. This figure is most easily calculated by dividing annual total primary energy consumption of a country by GDP. The figures of different energy agencies are shown in the following table:

- EIA: International Energy Statistics, Energy Intensity - Total Primary Energy Consumption per Dollar of GDP (Btu per Year 2005 U.S. Dollars on PPP)[30]
- IEA: Energy balances of non-OECD countries, 2012 edition p. II.436
- Enerdata: Energy intensity of GDP at constant purchasing power parities[31]

	Primary energy intensity, toe/1000 USD 2005 PPP				
	EIA	**IEA**	**Enerdata**	**Country submission**	**Note**
AR	0.35	0.16	n.a.	n.a.	
AZ	0.17	0.15	n.a.	0.19	
GE	0.23	0.15	n.a.	0.15	IEA 2010 data reported
MD	0.31	0.26	n.a.	0.32	
TR	0.13	0.19	0.12	0.18	IEA 2011 data reported
UA	0.46	0.47	0.47	0.39	
DE	0.13	0.12	0.12		
FR	0.14	0.12	0.14		
IT	0.12	0.10	0.10		
HU	0.16	0.23	n.a.		

At first glance we can conclude that energy intensity data are not harmonized and sometimes we can observe more than twofold differences (see EIA and IEA data of Armenia for instance). Country submissions are mainly in line with either of EIA or IEA data. The only exception is Ukraine, where national data submitted is 7-8% lower than those reported by the agencies. For comparison, we displayed the energy intensities in developed countries. Armenia, Azerbaijan, Georgia and Turkey are much in line with the quoted EU countries. Moldova and Ukraine – however – are much less efficient on the macro level. It is recommended to investigate the issue and indentify the least cost measures to alleviate the high energy intensity in these countries.

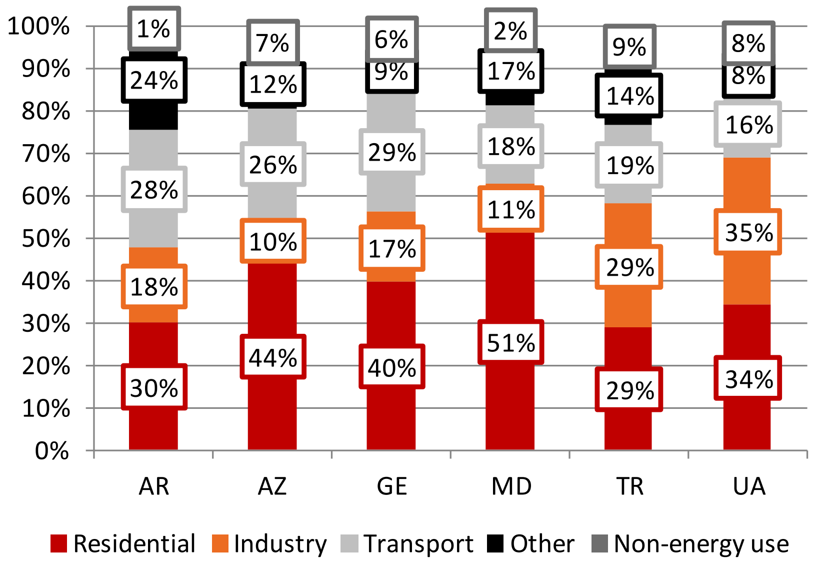
Total final energy consumption

TFEC figures were solely obtained from IEA energy balances. The sector having the greatest share in overall energy consumption is usually the residential sector (except for Ukraine, where industry has a slightly bigger share). In Armenia, Azerbaijan, Georgia and Moldova,

[30]http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=92&pid=47&aid=2&cid=AM,AJ,GG,MD,TU,UP,&syid=2007&eyid=2011&unit=BTUPUSDP

[31] http://yearbook.enerdata.net/#energy-intensity-GDP-by-region.html

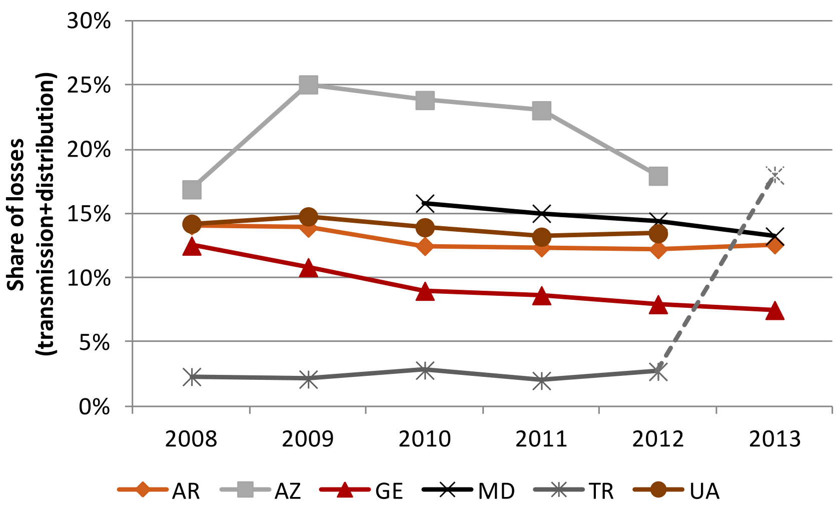
the consumption of transport sector is the second while in Turkey industry and in Ukraine residential sector follows. Other sectors cover commercial and public services, agriculture and other energy consumption (the latter is mostly agricultural and services sector consumption). It is important to note that in Armenia and Moldova 17% and 7% of consumption is unaccounted for (listed as ‘Other energy consumption’ even after taking services sector and agriculture consumption into account).



What we can conclude examining the TFEC is that energy efficiency policies should target the sectors with highest energy consumption, which is the residential sector. In addition, industry is also significant energy consumer in case of Ukraine, Turkey, Armenia and Georgia.

Network losses

Network losses can be divided into three main categories: transmission losses, distribution technical losses and distribution commercial losses. While transmission losses are generally reported by the TSOs, distribution technical and commercial losses data are scarce. Transmission losses make up 2-3% on average, while distribution losses are an additional 10-15%. Losses exhibit a decreasing trend in all Black Sea countries. Highest losses were found in Azerbaijan and Turkey.



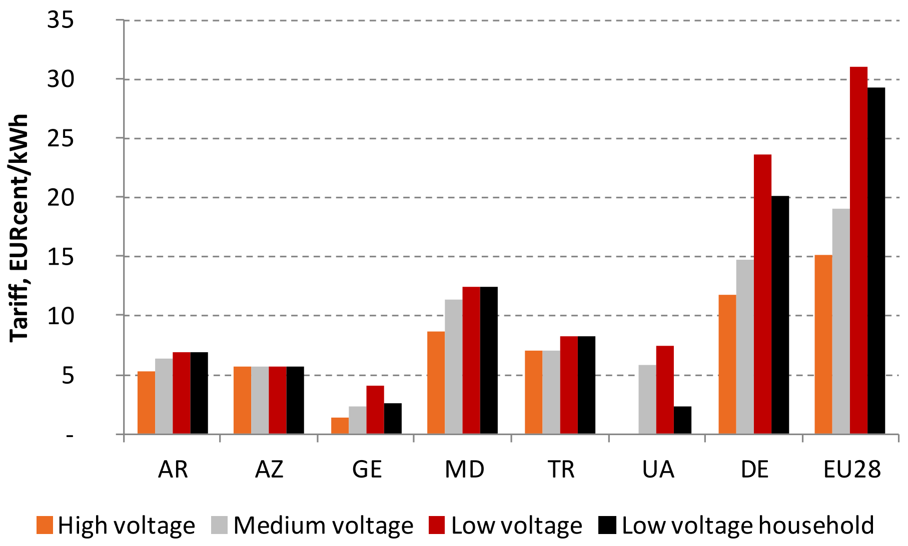
For Turkey, only transmission figures are shown for 2008-2012. The 2013 figure includes both transmission and distribution losses.

Energy prices

The fundamental driver of energy savings is the setting of energy prices at levels that reflect the cost of production. Artificially low prices render the effect of any other energy saving policy tools inefficient. To compare end user electricity prices, we selected four main consumer categories:

- high voltage
- medium voltage
- low voltage non-residential
- low voltage residential

For comparison, EU28 and Germany averages are shown for 2013 Q2.[32] Data was collected from regulator's website, in all cases single tariff including VAT was used. Prices were converted into EURcent/kWh on market rates, not on PPP. What is apparent is the difference in pattern of prices in EU and in some countries of the Black Sea region: EU prices are lowest in the high voltage and increasing as we proceed to lower voltage levels, and cut back for residential consumers a bit, but medium voltage prices are still higher. Cross-financing is most apparent in Ukraine: residential consumers pay way less than medium voltage consumers. In Turkey, high voltage consumption has to pay the same rate as medium voltage consumption. In Azerbaijan, prices are not differentiated among consumer categories at all.



Generation and energy transport

	Armenia	Moldova	Azerbaijan	Georgia	Ukraine	Turkey
Minimum efficiency requirements in generation licensing?						

[32] Eurostat

In case of subsidized generation?						80% minimum efficiency requirement for CHPs
Are network companies incentivized to reduce network loss?	√	√	NA	planned	√	√

Electricity generation licenses are not conditional on efficiency in the region. Only Turkey applies a 80% minimum requirement for CHPs. The majority of countries set a level of network loss rate for the DSOs that are to be recovered: failing to keep losses within this limit incurs losses to the companies (and extra-revenue is generated by achieving lower than the preset loss level) and as such the revenue of these companies is dependent on the efficiency of transporting electricity.

Energy efficiency policy tools

		Armenia	**Moldova**	**Azerbaijan**	**Georgia**	**Ukraine**	**Turkey**
administrative	**product standards**					√	√
	building standards		planned	√		√	√
	public procurement rules						√
informational	**product labeling**		√			√	√
	building labeling		planned				√
	metering and billing	√			√	√	
	energy saving advice		√			√	√
voluntary							√
economic	**grants and preferential credits**	√	√			√	√
	tax advantages						√
	energy efficiency obligation schemes						√

Countries of the Black Sea region employ a variety of tools to incentivize economic actors to improve end use energy efficiency. In general, Ukraine and Turkey have more diverse energy efficiency policy toolkit. The latter already operates an energy efficiency obligation scheme that is currently under preparation in many EU member states as required by the Energy Efficiency Directive of 2012. The most commonly used means of incentivization is to provide grants/preferential credits to end users and the application of building standards. Moldova is at the planning stage to tackle the energy consumption of buildings by introducing both standards and labeling.

Tariffs structures conducive for load shifting and energy saving

Once consumers are offered time-of-use tariffs, they have an incentive to shift consumption from high- to low-tariff periods (associated with periods of high and low demand, respectively). Except for Georgia, all countries already apply this regulatory tool to reduce the daily fluctuation of electricity demand. In Armenia approximately 35% of consumers use meters that enables the charging for night and day tariffs. On the other hand, block tariff design – that penalizes high consumption with higher tariffs – is only used in Georgia and Ukraine. In the rest of the countries end consumers pay the same amount for each kWh regardless their overall consumption in the metering period.

	Armenia	Moldova	Azerbaijan	Georgia	Ukraine	Turkey
Application of time-of-use tariffs	√	√	√		√	√
Application of block tariffs				√	√	

Finance, policy plans and responsible institutions

Dedicated public funding for EE investment is not a general option used in the region. Only Moldova, Ukraine and Turkey had reported the availability of such funds.[33] The Turkish government provides such support for industry and SMEs. International institutions are active in energy efficiency issues across the whole region. Although information received is scarce on the sectors with major energy saving potential, residential buildings and industry are the likely sectors where the major savings can be achieved. The role of NERA played in energy efficiency issues is seen quite differently by the countries of the region: network loss reduction and smart grid/demand response are the tasks quoted by the respondents. Governmental institutions responsible for administering EE policies are generally various ministries within the same country, the NERA and - in Moldova ad Ukraine - a separate agency focusing on energy efficiency.

[33] Although Armenia indicated that it provides grants in policy tool section.

	Armenia	Moldova	Azerbaijan	Georgia	Ukraine	Turkey
Public funding for EE investments		√			√	√
International grants and/or lending from donor governments or international institutions	GEF, World Bank		no info	√	IFC, EBRD	EBRD
Sectors with major energy saving potential	Households, industry, transport				Heavy industry, residential buildings	
Planned EE policy steps	Developing the concept of energy efficiency and energy saving				Natural gas consumption reduction, RES development	
Role of NERA in EE		Reduction of network losses, increase the efficiency of electricity generation	NERA not yet created	No such functions	Approval of energy efficiency policy, its coordination, support in implementation	Progressive tariffs, smart networks and market integration of demand response
Governmental actors involved in EE	Ministry of Energy and Natural Resources, Ministry of Economy, Ministry of Environmental Protection, Ministry of Construction	Ministry of Economy and the Energy Efficiency Agency		Ministry of Energy	Cabinet of Ministers of Ukraine, Ministry of Energy and Coal industry, State Agency for Energy Efficiency, National Commission for State Energy Regulation	Ministry of Energy and Natural Resources (Directorate General of Renewable Energy)

ANNEX E. Country regulatory case studies in energy efficiency

1. STATE LEVEL ENERGY EFFICIENCY PROGRAMS IN THE US

A. Minnesota - Energy Efficiency Program Model (MN Stat. 216B.241)

Statutory Summary

- Minnesota law states that utilities shall have an annual energy-savings goal equivalent to 1.5 percent of gross annual retail energy sales.
- Conservation programs are administered by the individual utilities, with state oversight and verification.
- Supply side efficiency can contribute to the annual savings goal.

Funding

- Utilities are obligated to invest in conservation programs (at minimum, 0.5%-2.0% of gross operating revenues, depending on exact type of utility). Statute demands performance, thus investment alone is not sufficient to satisfy the statutory obligation to conserve energy.
- Utilities are allowed to recover their prudent investments in conservation programs after state review and verification, plus incentive rewards for superior performance.

Structure

Minnesota's Conservation Improvement Program (CIP) Goals

The goals of utility conservation improvement programs are to:

- Promote awareness and adoption of energy efficient technologies
- Help households and businesses reduce their energy costs
- Defer costly utility infrastructure investments
- Reduce emissions and conserve resources

Conservation Improvement Plans

Each electric and natural gas utility develops its own conservation plan, offering a variety of programs to assist residential and business customers become more energy efficient. The responsible Minnesota agency, the Department of Commerce (DOC), reviews and approves each plan and the associated energy savings calculations. Utilities that meet their annual State approved energy savings goal are compensated financially. Financial recovery is adjudicated by the Minnesota Public Utilities Commission.

Traditionally, utility programs have focused on incenting customers to purchase energy efficient products over standard efficiency products. Moving forward, as utilities strive to meet higher energy savings goals, the DOC and Minnesota utilities are piloting new approaches to save energy such as offering packaged services and measuring savings that result from operation and maintenance or behavioral measures, such as fine-tuning building control systems or simply turning off lights when not in use.

When reviewing a utility's CIP plan, the DOC looks for programs that are cost-effective and that reach a broad spectrum of the utility's customers including residential, commercial, industrial and agricultural customers. Special programs that specifically meet the needs of low-income customers are also required by statute.

Typical programs for residential customers have included:

- Energy audits, where a trained energy consultant examines a home and offers the owner specific advice on energy improvements
- Rebates on high efficiency heating, cooling, and water heating appliances
- Air-conditioner cycling programs, which allow the utility to manage its peak energy demand in return for discounted electric bills for participating customers
- Compact fluorescent lighting and light emitting diode rebates
- Low-flow showerhead rebates, which serve a dual purpose by conserving water and the energy needed to heat the water
- Energy efficient home construction guidelines, calling for high insulation levels coupled with mechanical ventilation systems and efficient appliances

Typical programs for commercial or industrial customers have included:

- Rebates for high efficiency boilers, chillers, and rooftop units
- Rebates for high efficiency lighting and lighting control systems
- Rebates for high efficiency motors and drives
- Building re-commissioning studies
- Manufacturing process improvements that reduce energy intensity and improve productivity

Statutory Requirements (see Minnesota Statutes 216B.241)

The Next Generation Energy Act of 2007 (NGEA) established an energy savings goal of 1.5 percent of average retail sales for each electric and gas utility beginning in 2010. Utilities may petition the Department of Commerce to adjust their savings goals to a minimum of 1 percent based on a conservation potential study, a utility's historic CIP experience, or other factors at the discretion of the Director. Legislation passed in 2009 established an interim savings goal of 0.75 percent over 2010-2012 for qualifying natural gas utilities.

The NGEA further established the potential for electric utilities to count the savings that result from qualified improvements to its generation, transmission, or distribution infrastructure, or conservation measures in its own facilities toward the 1.5 percent savings goal, once plans are in place to achieve at least 1 percent savings through conservation improvements. Further legislation passed in 2009 also allowed natural gas utilities to count biomethane purchases toward their savings goal in a similar fashion.

The CIP statutes contain important stipulations in regards to how utilities spend CIP funds:

- Electric utilities, except for Xcel Energy, must spend a minimum of 1.5 percent of annual gross operating revenues (GOR) on CIP programs. As an owner of nuclear generation facilities, Xcel Energy must spend at least 2 percent of annual GOR.
- Natural gas utilities must spend a minimum of 0.5 percent of annual GOR on CIP programs
- At least 0.2 percent of residential GOR must be spent on programs specifically serving low income customers
- Up to 10 percent of the overall minimum spending requirement may be spent on R&D projects
- Up to 10 percent of the overall minimum spending requirement may be spent on qualifying solar energy projects. Up to 5 percent of the overall minimum spending requirement may be spent on other renewable and distributed generation projects.
- Each electric utility must include in its CIP plan programs intended to encourage the use of energy efficient lighting by its customers and recycling of spent lamps.

Utilities must file their CIP plans with the DOC at least every three years. Utilities report their actual CIP spending and savings achieved on an annual basis to the DOC using a standardized, web based tool (see http://www.energyplatforms.com/). Reporting and verification are greatly improved with this tool.

B. Wisconsin – Energy Efficiency Program Model

Funding

- The Wisconsin program (known as Focus on Energy) is based on a fixed, annual spending requirement, set by statute. Annual funding amounts may not be changed except by statute.

- The required annual spending amount is 1.2% of investor-owned utility revenues. In addition, $8/meter are assessed for municipal utilities and non-utility cooperatives.

- Total annual funding typically ranges from $85 million to $100 million.

- Program funding is secure. Utilities collect the required revenues in rates and deposit the segregated amounts in a non-governmental, privately-held account. Program dollars are not part of the state budget and cannot be diverted to state accounts. They must be spent on approved energy efficiency and renewable resource program offerings.

- The annual program amounts that utilities collect in rates are not designated as a separate line item on customer bills. However, the state's utility regulator – the Public Service Commission of Wisconsin (PSCW) – does review the revenues collected for the program and these amounts are subject to PSCW audit in utility rate cases.

Structure

- The Wisconsin program is run via a 3-way cooperative partnership among: (i) the PSCW, (ii) Wisconsin utilities, and (iii) a private, third-party program administrator. Each plays a separate and distinct role.

- The PSCW is charged with policy oversight and enforcement. Among its duties are:
    - Review/approval of the program administrator.
    - Review/approval of the contracts between the utilities and the program administrator.
    - Contracting for independent, annual performance evaluation.
    - Contracting for independent, annual financial audit.
    - Enforcing the statutory funding requirement.
    - Ensuring that statutory cost-effectiveness requirements are met.
    - Ensuring that statutory policy goals are achieved.
    - Publishing annual report and providing program updates to the Legislature and Governor.
    - Day-to-day program policy oversight.
    - Conduct a comprehensive review of the program at least every four years.

- For administrative ease, the utilities collectively organize themselves into a single non-profit entity. Together, the utilities are responsible for:
    - Collecting and providing the required program funding.

  - Selecting a program administrator, using a competitive bid process.
  - Contracting with the program administrator to operate the programs.
  - In addition to the 1.2% annual funding, utilities may also run their own "voluntary" programs, which are also subject to PSCW oversight.

- Program administration is handled by a third-party administrator that is under contract with the utilities. The program administrator is a non-governmental, non-utility, private third party with expertise in energy program design and delivery. Program administration includes:
  - Contract management.
  - Program design.
  - Financial management.
  - Incentive payouts.
  - Quality assurance.
  - Tracking and reporting.

- The program administrator subcontracts program implementation. Program implementers deliver the services to end use customers. Program implementers are non-governmental, non-utility, private entities operating in the energy efficiency and renewable resource marketplace. They include consultants, energy auditors, installers, and other energy-related contractors.

<u>Program Scope, Goals and Performance</u>

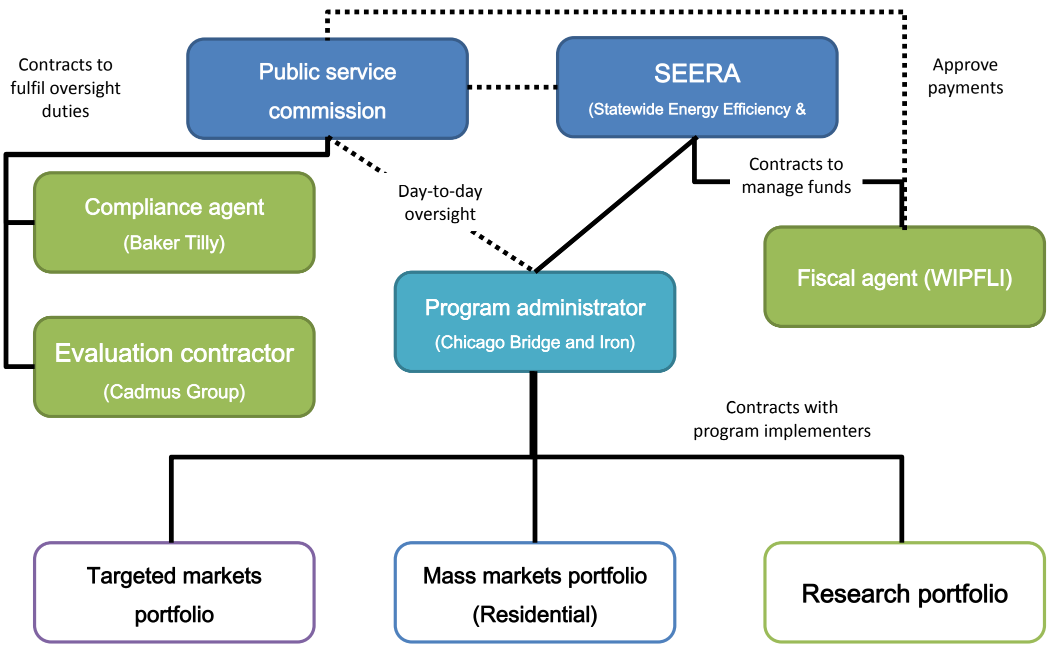
- The program is state-wide in scope and includes energy efficiency, renewables, and research components. Approximately 40% of program dollars go toward residential customer class offerings, and 60% go toward commercial and industrial.

- The program is primarily an energy efficiency program. For 2014, the funding breakdown is: 94% energy efficiency, 5% renewables, and 1% research.

- The renewables component of the program is aimed mostly at smaller scale, customer-sited projects. Wisconsin also has a Renewable Portfolio Standard policy, separate from the Focus on Energy program, which is the main driver of renewable build-out for Wisconsin.

- By statute, the program's goals include:
  - Moderate growth in electric and natural gas demand and usage.
  - Facilitate energy efficiency markets.
  - Promote energy reliability and adequacy.
  - Avoid adverse environmental impacts from energy usage.
  - Promote rural economic development.

Program cost-effectiveness is evaluated annually using the Modified Total Resource Cost test. There is a statutory requirement that, on a portfolio wide basis, the program pass a cost-effectiveness analysis. The following Figure is the program governance scheme.



2. CHP incentive system in Hungary

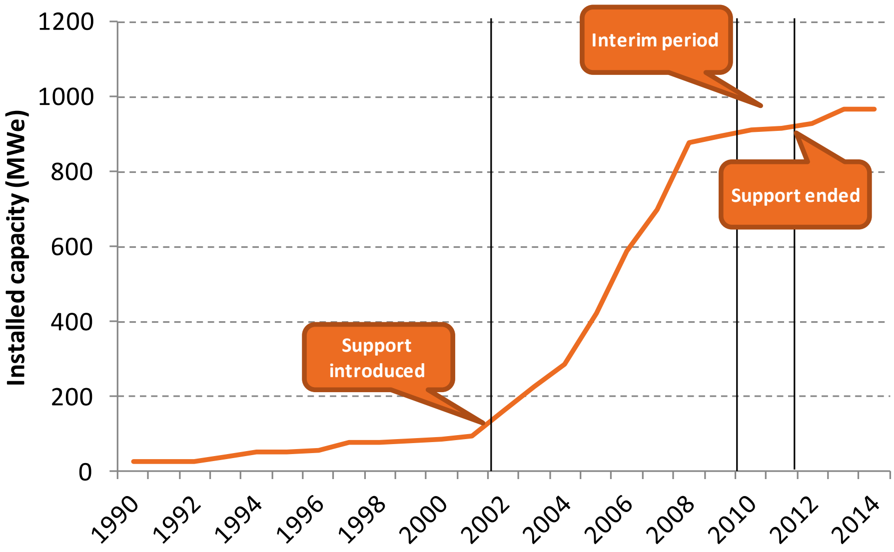
Brief overview and goal of the support system

Combined heat and power production had been supported from 2002 to 2012. The goal of the support was to encourage the renewal of power plant fleet in Hungary, and achieve savings in primary energy consumption. Operating units at the beginning of the 2000s were rather old and the government chose to support new investments by granting any small (having a capacity below 50 MW) CHP unit a feed-in obligation and a guaranteed price until 31 December, 2010. The guaranteed feed-in caused a boom in gas-fired CHP investments.

Any gas-fired power plants below 50 MW capacity was eligible for FIT if it produced and sold heat for either district heating or other heat uses. From 2008 on, due to changes in regulation, larger CHP producers became eligible as well. As the end of the support period was nearing, the feed-in obligation was lengthened until the end of 2012 for some smaller power producers. The support of large producers ended in 2010.

The level of FIT was differentiated between CHP technologies, time of electricity generation, power plant size and even the time of commissioning. Tariff was inflation and gas price corrected, to ensure cost recovery. As a rule of thumb, smaller gas-fired units received the higher feed-in than larger units. The feed-in price was set way above the market price – for comparison, a gas engine having a capacity below 20 MW in 2011 received a feed-in of 33.35 HUF/kWh (~111 EUR/MWh) for its generation in peak hours, while if it had been selling its production to the Hungarian Power Exchange, it would have received merely 19.34 HUF/kWh (~65 EUR/MWh). Such high guaranteed feed-in allowed quick recovery of investment for small (below 20 MW) gas engines and triggered an investment boom.

Figure 2 Cumulated capacity of installed small gas-fired CHP units



Source: MEKH 2014

As expected, a number of gas engines were connected to the grid: in 2000, total installed capacity of small CHP (smaller than 50 MW) units was around 100 MW. By the end of the support period in 2010, this number was nearing 1000 MW. The policy was successful in, as it achieved its goal of renewing and extending the power plant capacities. However, the support system had considerable market distorting effects.

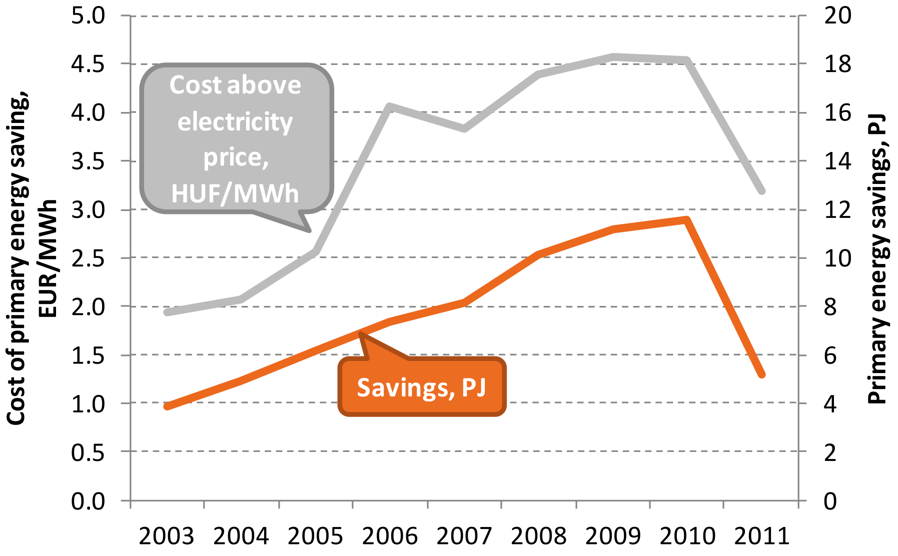
Primary energy savings achieved

To evaluate the effectiveness of the support, we estimate the primary energy savings of CHP production in the 2003-2012 period. We compare the primary energy used by CHP plants with the primary energy that should had been used to produce the same level of electricity and heat outputs by heat-only and electricity-only plants. The difference is considered to be the primary energy saving from CHP production. [34]
Estimated saving of the supported generation made up 4-11 PJ/year, which is 1.5-5% of primary energy consumption of conventional thermal plants. Unit cost of primary energy saving paid over the electricity price – ie. total cost of support paid to CHP producers above the electricity price divided by supported CHP production – ranged between 600 and 1400 HUF/MWh (~2-5 EUR/MWh).

Figure 3 shows the correlation of total primary energy savings of supported CHP production and unit cost of savings. What is apparent that unit cost is not constant, but increasing with the amount of savings.

[34] We assumed 75% combined efficiency for CHP plants, 90% efficiency for boilers and 45% efficiency for electricity-only plants. It must be noted that the results are highly sensitive to efficiency parameters: for example, setting electricity-only efficiency to 30% results in 40 PJ/year savings.

Figure 3 Primary energy savings and unit cost of savings



Source: REKK estimation based on MKET production and MEKH capacity data.

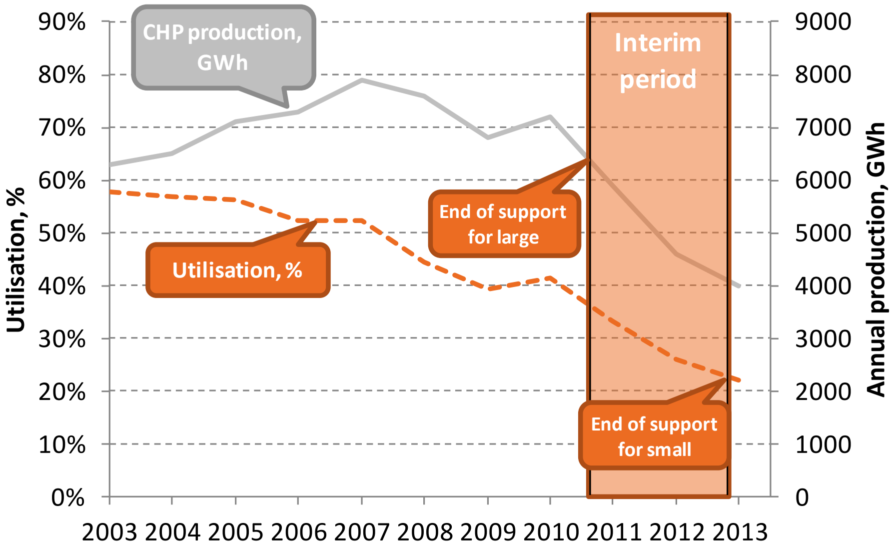
Note: Cost means the extra paid above electricity price, ie. the actual saving must be increased with the baseload power price.

Market distorting effects of the support

Excessive capacity expansion and overproduction of electricity

From the utilisation rates of CHP capacities it is apparent that the new capacities were only running because the feed-in prices made them: after their operation support ended in 2010 for large power producers, a sharp drop in utilization of CHP units can be observed.

Figure 4 Average yearly utilisation of CHP units



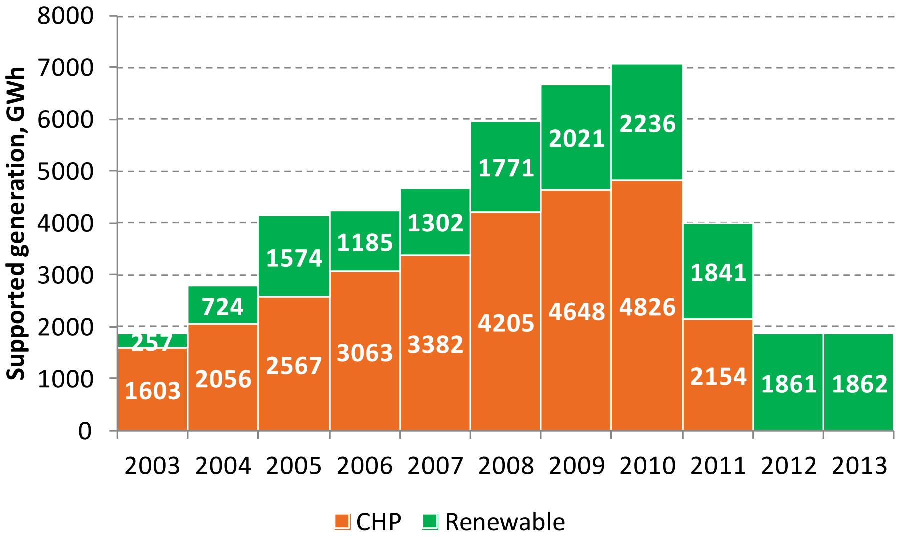
Source: REKK estimation based on MKET production and MEKH capacity data.

The 2012 end of support for all CHP producers pushed utilization rate further down. This means that capacities built as a response to the operational support were not competitive enough to be able to run at market prices. From 2013, only a few gas engines withdrew their licenses so far.
Due to the economic crisis, power demand started to decrease not only in Hungary but also in the region, pushing vast amount of cheaper electricity to the market. Small gas-fired units are not able to compete with these products, and so their production was replaced with imports.
Some small power producers looked for alternative market opportunities. They started to form virtual power plant portfolios and entered the system services market. Those which were not willing or able to join virtual power plants, were running at low utilization rates and started supplying heat from boilers instead.

Crowding out renewables in the support scheme

CHP and renewable units are supported from the same budget that is financed by electricity consumers. The majority of the budget was used for the support of CHP until 2010 and consequently renewables could be deployed with a much limited support assuming that the end-user prices cannot be easily increased for political reasons with an even increasing surcharge on electricity price.

Figure 5 Total supported generation



Source: MEKH reports on the feed-in tariff system

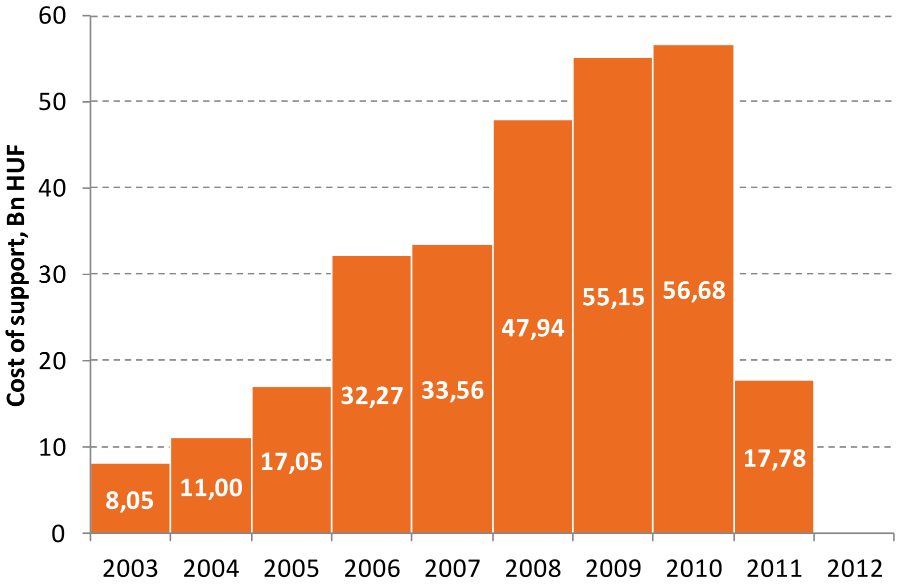
Distorting effects on the local heat market

The high feed-in tariffs were awarded to producers only if they produced heat with electricity together. This way power plants were encouraged to sell their heat at any price, to be able to reap the electricity feed-in tariff revenues. Thus heat prices did not reflect the real cost of heat generation, and discouraged new entrants from participating in the heat market.

Supporting large power generators

The CHP support was initially received only by small producers. However in 2007, a new regulation reformed the support system and allowed large (above 50 MW) power producers to sell their electricity in the heating season at a feed-in price from 2008. Note that only already operating large power producers became eligible. The large units meant a 95 MW CCGT in 2008 (DKCE) and three another power plants in 2009, totalling 405 MW (Kispest 110 MW, Újpest 110 MW and Kelenföld 185 MW). As a consequence, although in 2008-2010 only a few new small gas engines were commissioned, the cost of the support system surged with 7-8 bn HUF (~25-30 mn EUR).

Figure 6 Total cost of the support system for CHP production



Source: MEKH reports on the feed-in tariff system. 2011 financing for 6 months, in 2012 financing ceased.

This sum did not alter the power production of large power producers in any way or result in new capacity expansion – it was a mere transfer of funds. The inclusion of the large units in the support scheme did not concert with the original goals of the support system at all.

Burden for consumers

Since the support system was financed by the end users, all costs were included in the energy bill. To get a rough estimate of the effect of the support scheme on the end user price, we divided up the total annual cost of CHP support with the annual electricity consumption. This figure gives the HUF/kWh cost of the support system paid by consumers. At the peak years of support, this amounted to 4-5% of average end user prices.

Table 1 Burden of support paid by final consumers

	Unit	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*
Total cost of CHP support	*mn HUF*	*8048*	*10997*	*17054*	*32274*	*33555*	*47943*	*55148*	*56680*	*17780*
Final energy consumption	*GWh*	*34078*	*34473*	*35507*	*36590*	*37168*	*37398*	*35254*	*36008*	*36358*
Average final consumer price	*HUF/kWh*	*18,02*	*19,35*	*20,58*	*22,92*	*25,80*	*29,50*	*32,66*	*29,82*	*28,92*
Cost of support for consumers	*HUF/kWh*	*0,24*	*0,32*	*0,48*	*0,88*	*0,90*	*1,28*	*1,56*	*1,57*	*0,49*
Share of cost of support in end user prices	*%*	*1,3%*	*1,6%*	*2,3%*	*3,8%*	*3,5%*	*4,3%*	*4,8%*	*5,3%*	*1,7%*

Source: MEKH annual reports and MEKH reports on the feed-in tariff system

Conclusions

It can be concluded that the feed-in type support allowed for the quick expansion of CHP capacities. However, this simple yet effective type of support distorted the markets and once it ceased to exist capacities built were not utilized any more but replaced with imports or (heat-only) boilers. As the result, large amount of capital is locked-in in these investments. Support for existing large power producers was without any public benefit, since these units would have produces heat and power anyway.

3. Revenue decoupling cases in Minnesota, USA

Statutory

- Objective of decoupling is to minimize or remove financial disincentives utilities claim limit their investment in energy efficiency "behind the customer's meter."
- Minnesota Stat., Section 216B.2412 defines decoupling as:
  - "a regulatory tool designed to separate a utility's revenue from changes in energy rates. The purpose of decoupling is to reduce a utility's disincentive to promote energy efficiency."
- Minnesota Public Utilities Commission is to establish the decoupling criteria and standards to mitigate the impact on public utilities of the energy-savings goals without adversely affecting utility ratepayers. In designing the criteria, the commission shall consider energy efficiency, weather, and cost of capital, among other factors. Allow pilot program(s) to assess merits of decoupling in achieving energy savings.

Programs Approved to Date

Minnesota's largest natural gas local distribution company, CenterPoint Energy, applied for a partial decoupling (no weather normalization) pilot program that was in effect from July 2010 through June 2013. The company over collected its approved revenue from all customer classes during the pilot, thus refunded money to customers. When the program expired, the company asked for, and was approved, full decoupling in its most recent rate case.

Another Minnesota gas local distribution company, MERC, applied for a full decoupling pilot program that began on January 1, 2013. This is also a three year program so final results will not be known for some time. However, MERC is currently making refunds to its residential and small General Service customers due to colder than normal weather in 2013. The months of January through April 2014 were also colder than normal suggesting more refunds will result next year.

Finally, the state's largest electric distribution company, Xcel Energy, has an active rate case before the commission that includes discussion of full decoupling. If approved, this would be the first electric utility in Minnesota operating under a decoupled regime.

4. Gas substitution in Ukraine

Estimates by Naftogaz of natural gas consumption in Ukraine in 2013 was about 50 billion cubic meters (about 530 TWh). The largest consumers of natural gas in Ukraine are industry (38.9% of consumption), households (33.4%) and district heating (16.5%).

In Ukraine yearly household needs in thermal (heat) energy amounts up to 47 mln. Gcal. 8,3 billion cubic meters of natural gas (87,3 TWh) is used to produce such amount of heat.
World Bank experts believe that Ukraine has a high potential for natural gas substitution in the residential sector (up to 50% reduction of natural gas consumption).
According to National action plan for Renewable Energy till 2020 (adopted 01.10.2014) expected share of RES in the heating and cooling sector is 12.4% in 2020 (in 2009 this share

was 3.4%) and expected energy consumption from RES - 5850 ktoe (1473 ktoe in 2009). The estimated budget for the development of heat producing capacity for that period is about $9.8 billion.
Draft of National Action Plan for Energy Efficiency (its approval is expected in 2015) sets energy saving target by 2020 as 9% of average annual final energy consumption (6283 ktoe).
The main approaches which will facilitate reduction of natural gas consumption are:

- replacement of residential gas heating systems with electric or RES heating systems
- replacement of district gas heating systems with RES heating systems
- installation of meters and possibility to adjust the heat consumption
- thermal modernization of residential and government buildings.

In order to reduce natural gas consumption and encourage heat producers to substitute natural gas with other fuels some measures have been implemented:

- reducing of natural gas quotas for heat producers, public sector and households (Decree of the Cabinet of Ministers of Ukraine (CMU) №293 of 09.07.2014)
- Establishing of compensation mechanisms for heat producers for natural gas substitution with other fuels (including RES) (Decree of CMU №293 of 09.07.2014 "On promotion of substitution of natural gas in the heating sector", Decree of CMU №453 of 10.09.2014). 118 mln. UAH. was allocated to incentivize substitution of natural gas
- Additional funds in amount of 493 mln. UAH was allocated for energy efficiency measures to reduce natural gas consumption (Decree of CMU №449 of 03.09.2014)
- Action Plan for implementation of Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (Resolution of CMU №791-r of 03.09.2014) was adopted
- Action Plan on reduction of the natural gas consumption (including its substitution with RES) till 2017 (Resolution of CMU №1014-r of 16.10.2014) was adopted

According to estimates by State Agency for Energy Efficiency and Energy Saving of Ukraine (SAEE) implementation of incentive mechanisms can reduce natural gas consumption in Ukraine by 50% till 2025.
One example of promotion for reduction of natural gas consumption is SAEE's project of granting premiums for substitution of natural gas in district heating systems (443 mln. UAH; 01.10.2014 – 01.01.2016):

	Phase	Subjects	Measures
1	Conclusion of contracts	Investor → district heating company (DHC)	Investor concludes contracts (contract for the supply of heat, contract for the lease of a land or building), puts into operation RES-boiler unit
2	Application	Investor → SAEE	Investor applies to SAEE a request for premium, copies of

			the contracts and data on gas consumption for the last three heating seasons.
3	Acceptance of request	SAEE → Investor	Acceptance of request or its rejection (in case of absence all documents needed)
4	Request for information	SAEE → Natural gas supplier, DHC	Request for information about all heat consuming units
5	Provision of information	Natural gas supplier, DHC → SAEE	Natural gas supplier provides information on: - amount of natural gas consumption for the heating season after putting into operation RES-boiler unit - amount of natural gas consumption for the last three heating seasons before putting into operation RES-boiler unit
6	Calculation and transfer of premium	SAEE → Investor	Calculation of premium based on the results of the heating season (minimum 90 days running of equipment). Waiting period for premium is about 10 months.

The premium is calculated as follows:

$$\text{Premium} = 0{,}5 * Q_{gas}^{susp} * (P_{gas}^{import} - P_{gas}^{DHC})$$

where:

- Q_{gas}^{susp} the amount of substituted gas,
- P_{gas}^{import} the price of imported gas,
- P_{gas}^{DHC} the price of natural gas for DHC.

Expected premium value is 2 194 UAH/tcm. Total expected amount of natural gas substituted is 191 mcm (2 TWh). Expected savings are $76,4 mln. in 2015

5. Energy Efficiency on Supply Side in Georgia

Setting Normatives and Electricity Loss Regulation in Transmission and Distribution Networks

National Commission on Water and Energy Regulation of Georgia

In the 1990s and early 2000s, the energy system of Georgia, as most of the former Soviet republics, was undergoing difficulties defined by political processes linked to collapse of the Soviet Union and formation of independent state. In particular the system was operating in emergency and pre-emergency regimes because of lack of operating generating capacities, extremely unsatisfactory condition of transmission and distribution lines which is predetermined by low solvency of population and enterprises, absence of investments in the sector and other factors. With considerable decrease of energy safety in the country, the above mentioned events were expressed in such an indicator as electricity losses, where the main component was commercial losses. According to official data electricity losses in distribution and transmission networks were as a minimum 35% of electricity delivered to the network. Of greater concern is distribution sector. In some of the distribution companies the losses reached 70%.

The National Commission on energy regulation of Georgia, founded in 1997, from the very beginning of its activity paid attention to the problem of reducing losses. Among other things norms of losses were approved (2000 and 2002), which were compensated via consumer rates. Also the Commission developed methodology of using meters of common use to meter electricity consumed by subscribers not having individual meters. This measure has given possibility to distribution companies to reduce the level of commercial losses considerably. In 2006 the commission by its decision cancelled distribution license for 30 companies, those together with other drawbacks had high indicators of actual electricity losses. At the beginning of 2006 the commission set up a special group on electricity losses analysis in transmission and distribution networks. According to the results of analysis of actual losses in 2006 the commission approved the normative losses in networks 500-330-220-110-35-10-6-0.4 kV at the level of 12.4%, of electricity supplied to the network (by that time actual losses were 18-20 %), including 4.41% in transmission network. In distribution companies normative of losses in average was approved at the level of 13% of electricity supplied to the network by individual company (by that time actual losses were around 28 - 30).

In 2006, considerable amendments were introduced in the law of Georgia “On Electricity and Natural Gas”. Market model of single buyer was replaced by the model of direct contracts. The law obliged commission to approve not only the norms of electricity losses but also the rules of calculation of norms of losses. As norms of losses so the rates for distribution companies (approved by commission also in 2006) at a certain level were preserved during more than 5 years, that provided incentive for distribution companies to conduct a number of organizational-technical measures on reduction of network losses. It is worth while noting large scale investment projects on organizing individual electricity metering (currently 85% of consumers have individual metering devices. By 2016 individual metering will cover 100% subscribers), complete rehabilitation of networks 0.4 kV (including replacement of bare wires by isolated ones), installing automated commercial metering system including 6-10 kV voltage level, cleaning electricity lines routes from plant formation and so on. During that period of time according to presented data and in approved form the commission provided monitoring and analyzed the key performance indicators of the regulated network companies including indicators allowing defining the actual technological power consumption (network losses and own needs).

The diagram 1 shows dynamics of network losses in transmission and distribution networks 500-330-220-110-35-10-6-0.4 kV. In the diagram you can see that although the load is growing electricity losses in power system decreased by 6% and total annual electricity generation was 500 million kWh which is equal to 100-120 MW hydropower plant output.

in diagram 2, there is dynamics of power losses in transmission network in % of output into the network. On this diagram it is seen that during the period of 2005-20013 the losses decreased considerably, although later because of change of load regime and scheme topology the trend of losses starts to increase a little.

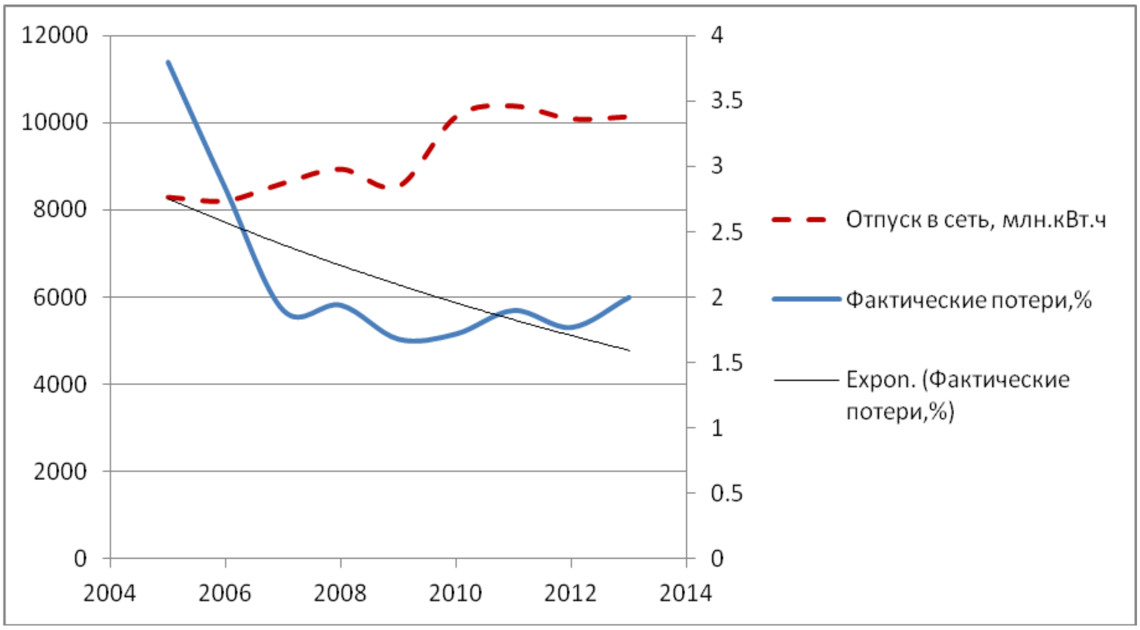


Diagram 2. Dynamics of electricity transmission losses

In diagram 3, there is a typical curve of losses dynamics of one of the distribution companies. In the curve you can see that company investments into network infrastructure and the system of energy metering and also strict measures of fighting theft and non payments for consumed electricity have given positive results, in particular in spite of sharp increase of sales (approximately by 30-40%), the losses were reduced considerably and are close to a stable established regime of future development proceeding from exponential character of the curve.

In diagram 4, there is a non typical curve of dynamics of distribution company losses. The curves clearly show the lack of investments in network infrastructure and the problems in company organization and management. Because company normative losses are different from actual losses values, the company carries additional losses connected with taxation for not delivered energy.

Diagram 3. Typical curve of dynamics of distribution company losses

Diagram 4. Non typical dynamics of distribution company losses

By the end of 2013, the commission started developing new tariff methodology that provides incentive for distribution companies to provide investments into network and optimize operational costs. New methodology of calculations and rate setting (with defining periods of regulation), demanded to specify and harmonize the approaches to defining and regulation of normative losses.

To meet the needs of creating common methodological basis for network losses regulation the commission has developed and approved the “Rules of calculation of normative electricity losses” which are based on tried and tested in international practice principle providing incentive for regulated company activity to reduce network losses. According to these rules normative losses for each period of regulation are set on the basis of actual losses of the previous period and they are not changed during the whole regulation period. The above mentioned provides incentive for network company to reduce network losses within regulated period and to get profit (diagram 5).

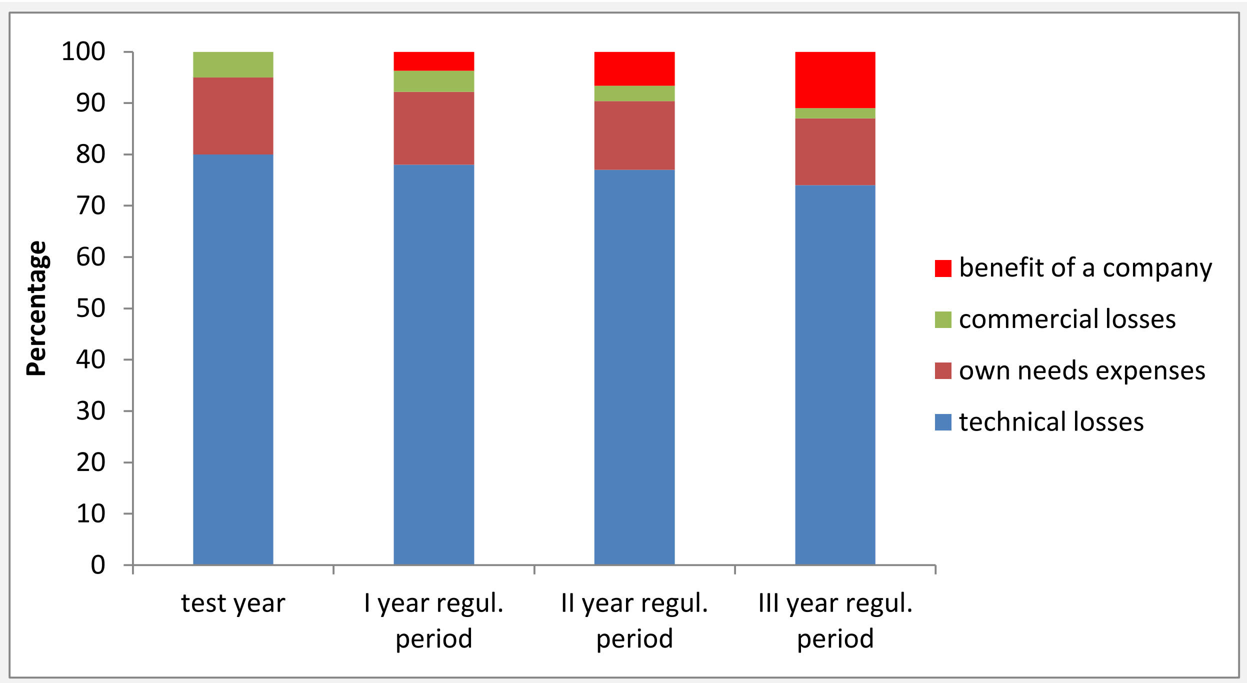


Diagram 5. Principle of incentive regulation of network losses

“The Rules of calculation of normative electricity losses” contain all the necessary definitions (see slides 1 and 2). The main formulae to define normative losses for the company with typical trend of losses dynamics are presented in Box 1. Normative losses of network company with typical dynamics of losses trend (diagram 3) at the moment **t** (year) for coming period of regulation (t+1; t+2; t+3), are defined on the basis of actual losses of test period (year) t-1 in the following way (diagram 6):

- Average value of actual losses [1] of the three previous years (t-2; t-3; t-4) is defined;
- the indicator of trend [2] of three previous years (t-2; t-3; t-4) is defined;
- the expected value of losses [3] in the test year(t-1) is defined;
- the lower value between actual and expected values [4] of losses during the test year is approved by the normative for the next regulated period.

Box 1: The main definitions (1)

Normative power losses are acceptable energy consumption for transmission and distribution. Usually it is defined by percentage of correlation of absolute losses values and electricity supply into the network;
- Expenses to cover the energy losses are compensated by network companies according to established legal procedure;
- Normative energy losses contain technical energy losses, own energy consumption and commercial energy losses (not more than 5% of established normative);

Technical energy losses – energy losses in wires and network facilities defined by physical processes relevant to power transportation process;
Electricity consumption for own need – volume of electricity to provide substation operation and operational personnel activity;

Commercial energy losses – Losses as a result of technical characteristics and operation regime of metering system elements and drawbacks of organizing primary metering data collection/ electricity metering.

If a network company has ascending (diagram 4) or zero trend of losses during the test or before the test period or the company has no history or in the coming period substantial change of topology and/or load regime is confirmed, setting of normative takes place in the following way (diagram 7):

- Expected value of losses of test year is defined by application of positive trend of comparable topology of scheme of the network company;
- Manual calculation according to standard methodology or with application of certified software;

- As a normative of losses the lower value between the expected losses value in the test year and calculated technical losses increased by 5% is selected [5]

> **Box 2: The main definitions (2)**
>
> **Actual energy consumption –** a sum of actual losses and electricity consumption for own needs;
>
> **Actual electricity losses** consist of technical and commercial losses and is defined by metering devices as a difference between electricity volumes received in the network and supplied from the network (diagram 8), except electricity for own needs;
> Percentage of actual losses is defined by electricity supplied to the network.

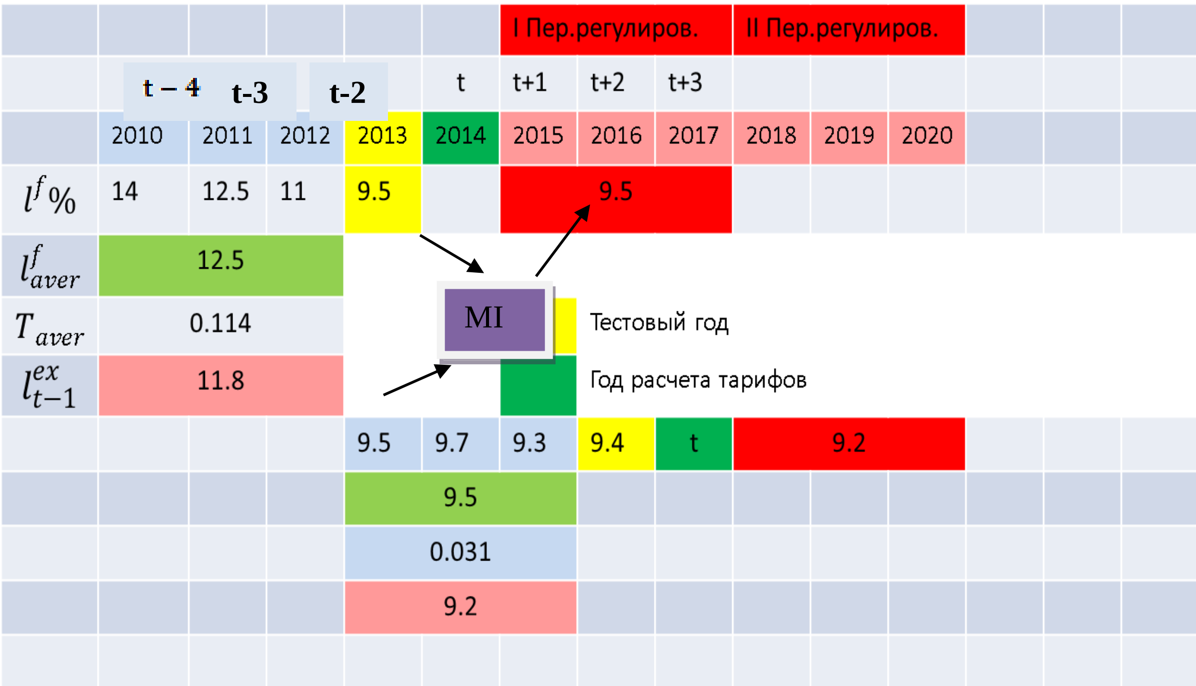


Diagram 6. Defining normative losses for the company with typical trend of actual losses

Box 3: Sequence of setting normative losses (3)
(for the typical trend of actual losses - diagram 3)

- Arithmetic mean value of actual losses during the three preceding to test period years:
-

$$l^{f}_{aver} = \frac{1}{3}\left(l^{f}_{t-2} + l^{f}_{t-3} + l^{f}_{t-4}\right), [1]$$

- Indicator of average trend of actual losses during the three years preceding the test period:
-

$$T_{aver} = \frac{1}{2}\left[\frac{l^{f}_{t-4} - l^{f}_{t-3}}{l^{f}_{t-4}} + \frac{l^{f}_{t-3} - l^{f}_{t-2}}{l^{f}_{t-3}}\right], [2]$$

- Anticipated value of losses in the test year

$$l^{ex}_{t-1} = (1 - T_{aver}) * l^{f}_{aver}, [3]$$

- Value of normative losses during the regulatory period:

$$l^{n}_{rp} = MIN(l^{ex}_{t-1}, l^{f}_{t-1}), [4]$$

Box 4: Setting normative losses for atypical trend of actual losses – diagram 4 (4)

- The amount of normative losses for the network company with atypical trend of actual losses dynamics

$$l^{n}_{rp} = MIN[l^{ex}_{t-1}, (l^{t+oc}_{t-1} * 1{,}05)], [5]$$

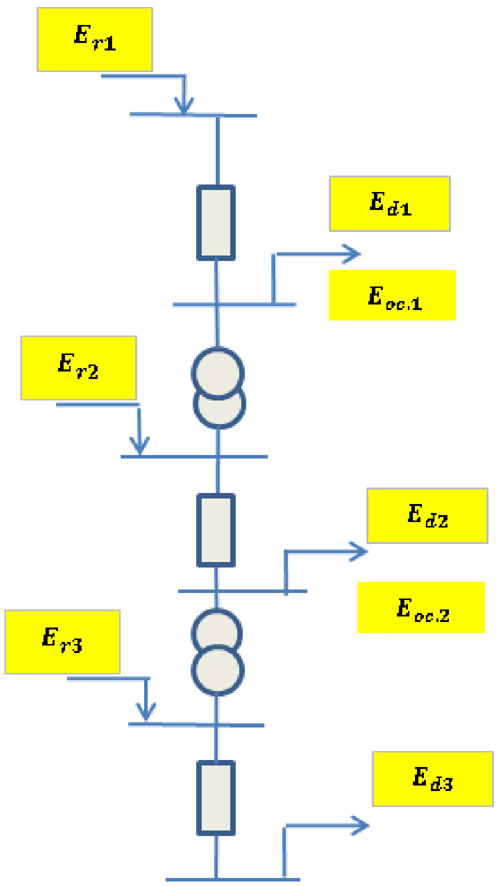
where, l^{ex}_{t-1} – expected amount of losses of the test year using trend of comparable company with the best average trend of decreasing losses;

l^{t+oc}_{t-1} - value of indicator of technical losses of the network company calculated according to standard methodology or using certified software

Diagram 7. Setting normative losses for the company with atypical trend of actual losses

An important thing is the question of purchasing electricity to cover losses. Purchase of electricity in the volume of normative is compensated at expense of consumer rates and excess losses are covered by network companies.

Certain difficulties are related to distributed generation, that is, generation connected to distribution network. Certain part of output of distributed generation is transported along distribution network and supplied to transmission network. Accordingly the losses caused by abovementioned load are compensated by the consumers of this distribution company and for that purpose to define the percentage of actual losses not full output into distribution network is put in the denominator but full output minus electricity supplied from the distribution network to transmission network.



Box 5: Defining actual losses (5)

On drawing 5 :

$E_{r.1}$, $E_{r.2}$, E_{r3} – electricity supplied to the network according to types of voltage (own needs) ;

E_{d1} , $E_{d.2}$, E_{d3} – electricity supplied from network for own needs;

$E_{oc.1}$, $E_{oc.2}$ - electricity output for own needs;

- total output into network - $E_{r.\Sigma} = \sum E_{r.i}$, [6]
- total output from network $E_{d.\Sigma} = \sum E_{d.i}$,[7]
- total output for own needs

$E_{oc.\Sigma} = \sum E_{oc.i}$

- total losses EE - $\Delta E_{\Sigma} = E_{r\Sigma} - E_{d.\Sigma} - E_{oc.\Sigma}$,[8]
- total consumption EE $- E_{\Sigma} = \Delta E_{\Sigma} + E_{oc.\Sigma}$

[9]

$$l_i^f \% = \frac{E_{\Sigma}}{E_{r\Sigma}} \times 100\% \quad [10]$$

Figure. 8 Principle network diagram

Allocation of network losses according to voltage levels should be defined by the data of commercial and technical metering. In case metering system is not implemented fully (there is lack of metering during interconnection of electricity between the stages of various voltages) and it is possible to define only total losses, we make imputed allocation according to the following principles:

According to incentive tariff methodology the rates are set for network companies (in our case distribution companies) according to stages of voltage, correspondingly it is necessary to split the assets used in regulated activity and operational costs according to voltage level, that is to allocate, as far as expenses for purchase of network losses is part of operational expenses, allocation of network losses is also needed. It is needed to implement energy efficiency, in particular to identify non efficient sections and measures and to decide about the measures of their optimization.

Box 6: Principles of imputed allocation of network losses according to voltage levels

- power losses at the first stage :

$$\Delta E_1 = \Delta E_\Sigma \left[0.15 \frac{S_1}{S_\Sigma} + 0.85 \frac{E_{r.1}}{E_{r.\Sigma}} \left(\frac{U'_{eq}}{U_{eq.1}}\right)^2\right], \quad [11]$$

- electricity supply from first stage to the second one:

$$E_{1,2} = E_{r.1} - \Delta E_1 - E_{d.1} - E_{oc.1}, \ [12]$$

- power losses at the second stage :

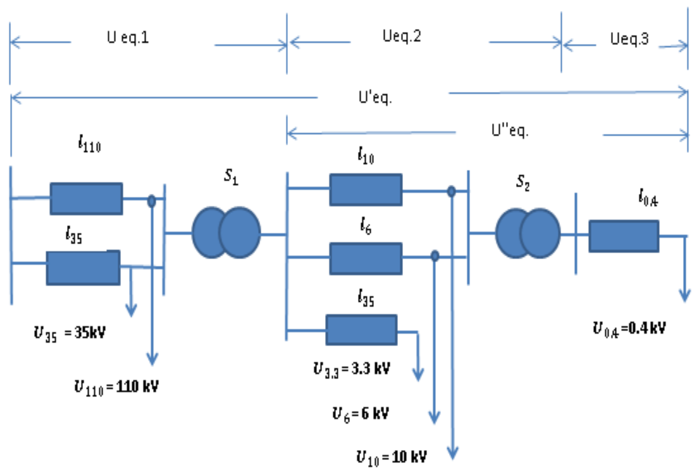
$$\Delta E_2 = (\Delta E_\Sigma - \Delta E_1)\left[0.15 \frac{S_2}{S_\Sigma} + 0.85 \frac{E_{r.2}+E_{1.2}}{E_{r.\Sigma}} \left(\frac{U''_{eq.}}{U_{eq.2}}\right)^2\right], \quad [13]$$

- Power losses at the last (third) stage :

$$\Delta E_3 = \Delta E_\Sigma - \Delta E_1 - \Delta E_2, \ [14]$$

- With other configuration of voltage levels the losses are defined according to similar logic.

- Apriori it is admitted that total actual losses contain two large empirical components – validity of losses of open circuit operation [11and 13] is evaluated as 15%, and load losses as 85%.
- At a certain voltage level (Box 6) open circuit operation losses are defined directly proportional to full transformers capacity at this level, and load losses are directly proportional to load and inversely proportional to the relative amount of square of equivalent voltage level.



Box 7: Defining network parameters

$S_1, S_2, \ldots S_\Sigma$- accordingly full capacity of transformers according to voltage levels and total;
$l_{110}, l_{35}, \ldots l_{0.4}$ – length of lines of certain voltage, km;
$U_{110}, U_{35} \ldots U_{0.4}$ – voltage;

1- level 110-35 кВ;
2- level 10-6-3.3 кВ;
3- level 0.4 кВ

Diagram 9. Calculation scheme for losses allocation according to voltage levels

Box 8: Example of defining equivalent values
(calculation scheme – diagram 9)

Equivalent voltage of losses of first level:

$$u_{eq}^{'} = \sqrt{\frac{U_{110}^2 * l_{110} + \cdots + U_{0,4}^2 * l_{0,4}}{l_{110} + \cdots + l_{0,4}}}, \text{ [15]}$$

Equivalent voltage of first level:

$$u_{eq.1} = \sqrt{\frac{U_{110}^2 * l_{110} + U_{35}^2 * l_{35}}{l_{110} + l_{35}}}, \text{ [16]}$$

Equivalent voltage of losses of second level:

$$u_{eq}^{''} = \sqrt{\frac{U_{10}^2 * l_{10} + \cdots + U_{0,4}^2 * l_{0,4}}{l_{10} + \cdots + l_{0,4}}}, \text{ [17]}$$

Equivalent voltage of second level:

$$u_{eq.2} = \sqrt{\frac{U_{10}^2 * l_{10} + U_6^2 * l_6 + U_{3,3}^2 * l_{3,3}}{l_{10} + l_6 + l_{3,3}}}, \text{ [18]}$$

In diagram 9, there is calculation scheme to define equivalent voltage level of losses and equivalent voltage of levels, calculation formulae of which are presented on box 8.

As the test calculations show and compared to actual indicators of company with corresponding system of metering or with calculated according to standard methodology data, adequacy of suggested method is within ±10%.

If in the framework of concrete period of regulation because of change of network structure or loads the amount of actual losses in relation to the normative is +10%, on licensee requirement the regulating commission is authorized to consider the question of revising and adjusting normative of losses within regulated period.

From the point of view of energy efficiency from the side of supply (regulated companies) regulation of network losses at the first stage of energy market development is one of the important measures. The rules developed by us to calculate network losses normative require further trials and development. In particular it is necessary to:

- Analyze the results of network losses regulation in the countries of Black Sea region;
- Create data base on electricity losses to conduct international benchmarking and apply these results when using incentive regulation;
- Conduct study on Back Sea region countries stressing importance of measures of network losses reduction within the general measures of energy efficiency.

6. CASE STUDY ON IMPROVING ENERGY EFFICIENCY IN AZERBAIJAN

Laws and regulations in energy sector:

Although there is no special legislative act on energy efficiency, the existing legal acts in energy sector cover the following issues:

The Law "**On Energy Resources Use**" defines legal, economic and social basis of state policy in the field of using energy resources, as well as the main mechanisms of its implementation, regulates the relations arising in this field among the state, legal persons and physical persons.

The Law "**On energy**" provides regulation in the field of exploration, development, production, processing, storage, transportation, distribution and use of all the "energy materials and products", including gas. In reality the Law "On energy" is a "framework" law in regulation of energy sector.

The Law "**On electric power sector**" defines the legal foundations for production, transportation, distribution, purchase-sale and consumption of electrical and heat energy.

The Law "**On Power Plants and CHP**" sets the legal foundations for designing, construction, operatioon and use of permanent installations (CHP) generating electricity and heat according to legislation of Azerbaijan Republic.

And also according to the order of the Cabinet of Ministers of Azerbaijan the following new rules on energy efficiency were adopted
- "The Rules on improving Energy Saving and Energy Efficiency for Project Construction" 11 March, 2014 # 73

These Rules define the existing requirements on energy saving and improving energy efficiency to design (design and estimate) documents for project construction.

The following rules are not applicable to the project construction:

1. Included in the list of cultural and historical monuments, buildings and facilities, religious buildings;

2. Not more than three times is higher than private residence and resorts;

3. Project construction not requiring permission for construction.

When developing conceptual design documents and (or) design documents (design and estimates) of the building, construction, facility the required energy efficiency class and the requirements on energy saving are recorded in the project assignment. In this project there should be a section on energy saving and energy efficiency improvement.
This section contains the following:

- General energy characteristics of designed building and facility;
- Energy passport of building and facility;
- Energy efficiency class of the building and facility;

- Records on project designs, directed at energy saving and energy efficiency improvement

The form of drafting energy passport of the building: General information, design conditions, geometric values, thermal performance, proxy indicators, specific characteristics, coefficients, composite energy efficiency indicators, energy load of building.

State Committee on Architecture and Urban Planning sets standards for buildings and marking of buildings.

- **"Rules of designing heat supply, natural and artificial lighting, ventilation and acoustics in project construction" 11March, 2014 # 71**

These Rules define the rules of designing heat supply, natural and artificial lighting, ventilation and acoustics in project construction.

Building and facility should be designed and built in such a way that when a person lives or stays in the building or facility there is no harmful effect on the person as a result of physical, biological, chemical, radiation or other impacts:

1. Heat supply for housing, public and industrial buildings;

2. Ventilation for housing, public and industrial buildings;

3. Natural and artificial room lighting;

4. Noise protection in the rooms of houses and public buildings and in the working areas of industrial buildings and facilities;

Besides draft **"State program on heat supply system development (2014-2018)"** was produced. In the program the following was recorded:

1. The reforms in the sphere of heat supply and formation of legal basis, improvement of existing norms, rules and standards;

2. Implementation of institutional measures in heat supply sector;

3. Tariffs and social protection in heat supply;

4. Technical measures on reconstruction of heat supply system;

5. Use of alternative and renewable energy sources, saving energy and environmental protection;

6. Package of measures in housing and public utilities sector.

To conduct systematic and focused actions to achieve efficient energy resources use a short term (2012-2014) and long term (2015-2017) plan of action was developed "On Efficient Use of Energy" and "On Using Alternative and Renewable Sources of Energy" and fraft laws are being developed **"On Using Alternative and Renewable Sources of Energy" and "On efficient Energy Use"**.

The main reasons for improving energy efficiency are:

- To provide energy security;
- To provide incentive for stable economic development (competitiveness of industry, additional revenue from oil and gas export, release of budget resources) ;
- To improve environment.

Energy system of Azerbaijan includes 15 thermal and 14 hydro power plants. Installed capacity of energy system is more than 7 GW. In 2013 this indicator was 7.1 GW.

In 2001 413g of reference fuel was used to generate 1 kWh, in 2013 this value was reduced to 305g. In 2013 fuel oil was not used to generate electricity.

More than **1000 km of fiber optic cables** was laid between power plants and substations of system–level. Application of these modern technologies provides online supply of data from energy generation and transmission facilities into **SCADA** system of the Central Dispatch Department.

Last year demonstration trail consisting of windmills, solar panels and installation using biogas as fuel was put into operation. As part of the project “Clean city” thermal power plant 37MW capacity, using municipal waste as fuel was put into operation.

Small HPP:

One of the priorities in the regions is construction of small hydropower plants;
A number of HPP average and small capacity was put into operation in 2013, for example:

- Tahta Kerpu – 25 MW;
- Gekchay – 3MW;
- Ismailly – 1,6 MW;
- Arpachay – 20,5 MW;

In 2014 it is planned to complete construction of 7 small HPP more.

Wind energy projects:

- WPP «Pirakushkul» 80 MW,
- WPP «Khizi» 5.3 MW,
- WPP «Khizi» (Shurabad) 48 MW,
- WPP «Yeni Yashma» 50 MW,
- WPP «Mushviq» 8 MW.

Before long a project of wind farm construction on the sea will be developed, and coastal 90 MW wind farm construction started.

Solar projects:

Solar power plants 2.8 MW capacity construction started in 10 regions. Of these “Suraxani“ (1,5 MW) was put into operation on 16.06.2014.

It is planned to put power plant “Pirallahi” into operation until the end of 2014. The rest will be put into operation in 2015.

In 2013, according to the resolution of the Cabinet of Ministers of Azerbaijan Republic in Baku and suburbs and on the territory of Biliasuvarsky district (6 schools and 6 kindergartens) in administrative and socially-oriented buildings together with providing heat and electricity with assistance of solar modules (PV) and energy saving bulbs (LED), and also to provide efficient energy use the works on reconstruction of isolation and buildings heating are finished.

The State Agency on Alternative and Renewable Sources of Energy together with the Ministry of Foreign Affairs of Norway implements the program “Energy efficiency of the buildings in Azerbaijan”.

With financial assistance of Federal Ministry of Economy and Tecnologies of Germany, International Academy of Renewable Sources of Energy conducted training in 2013 on “Energy Efficiency” for 20 experts from various sectors in the country.

7. Energy Efficiency in Moldova

Scope and regulatory environment

The implementation of EE and RES projects in the heating sector in the Republic of Moldova is being supported and promoted through several mechanisms and tools, which involve mainly incentives in form of grants, preferential credits and other financial instruments.

The existing primary legislation (the energy efficiency Law no 142 from 02.07.2010, the Law on heating and promotion of cogeneration no 92 from 29.05.2014) provides also certain administrative and regulatory measures, which complement the existing supporting tools for the development of RES and EE heating projects (e.g. priority purchase of heat produced from RES and support schemes for high efficiency cogeneration). Nevertheless, the role of ANRE in promoting and implementing EE and RES measures in the heating sector according to the primary legislation is quite limited, and includes the application of priority purchase of heat from RES (when the generated heat is injected into the DH system) and other measures applied in the context of calculation and approval of tariffs for heat supplied to final customers (like reduction of losses in heating networks and application of the maximum efficiency at lowest costs).

There are also several documents adopted by the Government, which provide specific measures and actions to be done for the development of RES and EE projects for the heating sector, in particular: the National Energy Efficiency Program for 2011-2020, the National Energy Efficiency Action Plant for 2013-2015 and the National Renewable Energy Action Plan until 2020.

The mentioned primary and secondary legislation provides also certain specific objectives in the field of EE, which act as one of the main drivers for the further development of the EE and RES sector (inclusively for heating). The most important national objectives of targets are the following:

- Reduce the primary energy consumption by 20% until 2020.
- Increase the share of renewable energy sources in the overall energy balance up to 20% in 2020.
- Increase the share of biofuels to at least 10% in the total amount of fuels used in 2020.
- Reduce the GHG emissions by 25% until 2020.

Until now, the most important contribution in the development of the heating sector through EE and RES projects is attributed to the existing financial tools and programs that were implemented in the last couple of years with the support of the financing institutions and donor community. Below are presented the most important projects and facilities available currently in Moldova, with a short description and implementation results (the information was compiled from available data provided on official websites of the described facilities and programs).

Examples and implementation results

1. The energy and biomass project

The Moldova Energy and Biomass Project provides support to public institutions from rural communities to have access to renewable energy sources, ensure energy independence, and community development. This project offers financial support for new modern biomass-fired heating systems as an alternative to the existing ones installed in rural schools, kindergartens, and community centers across the country. The Energy and Biomass Project covers most of the costs related to the installation of alternative heating systems, while the beneficiary communities are expected to contribute with at least 15% of total investment costs.

Each rural public institution from the Republic of Moldova has the opportunity to apply for this support tool and install briquette/pellet fired heating systems, with the financial support granted by the Energy and Biomass Project.

The total budget of the Project amounts for €14.56 million, provided by the European Union (€14 million) and UNDP Moldova (€0.56 million).

By the end of the year 2014, about 144 public institutions (kindergartens, community centers, mayor offices and other) from 127 villages applied and were granted support within this project. A total amount of 127 thermal stations were installed, with a total installed thermal capacity of 29,6 MW (15% based on straw bales; 85% - briquettes/pellets). The full list of implemented projects can be accessed here.
There are also other activities and measures related to EE and RES usage that are promoted within this project, like loans for biomass processing equipment, promotion of efficient biomass heating systems for households, development of studies and researches in the EE and RES field.

2. Moldovan Sustainable Energy Financing Facility

The Moldovan Sustainable Energy Financing Facility (MOSEEFF) is a credit line managed by EBRD, whose main purpose is to offer support for EE and RES projects carried out by Moldovan enterprises.

MOSEEFF provides a credit line of 42 million Euro combined with a 5 to 20% grant component to Moldovan companies through EBRD's partner banks.

Eligible projects must lead to a reduction in primary energy consumption, reduction of CO_2 emissions and in general improve rational energy use in industries, agribusiness and commercial buildings. So The offered grant level depends on the investment of the project, the applied technology, the amount of energy saved and the CO_2 emissions avoided.

Energy savings of heat, fuel and electricity and CO_2 emission reductions may be achieved by implementing measures and technologies with standard projects such as:

- Rehabilitation and replacement of boilers
- Insulation of steam and hot water pipes
- Switch from electricity heating to fuel based heating
- Installation of energy efficient windows
- Thermal insulation of walls, roofs and floors

- Process improvements (e.g. enhanced control, measurement and metering)
- New furnaces, kilns, ovens, reducing specific fuel consumption
- Installation of heat recovery in air ventilation systems
- Rehabilitation of compressed air systems
- Installation of rolling doors or door lockers
- Plate solar thermal collectors

Projects which apply advanced technologies as follows may be eligible for higher levels of grants:

- Combined heat and power plants and tri-generation
- Condensing gas boilers
- Heat pumps
- Transparent thermal insulation
- Vacuumed solar thermal collectors
- Absorption or evaporative cooling systems
- Installation of new multi-stage operated chillers (compressors)
- Turbo-compressors with inflow choke control
- Variable speed drives on electric motors, fans, pumps and drives
- Energy management systems
- Dynamic balancing of heating and cooling systems

3. Moldovan Residential Energy Efficiency Financing Facility

The Moldovan Residential Energy Efficiency Financing Facility *(*MoREEFF) is a credit line managed by EBRD, complemented with grant funding from the European Union Neighbourhood Investment Facility (EU NIF) and the Swedish International Development Cooperation Agency (SIDA). This program offers support for households, Condominiums/Associations of Apartment Owners, Housing Management Companies, Energy Service Companies or any other eligible service companies providing maintenance, operation, and construction and refurbishment services for the purpose of implementation of eligible EE projects in the residential sector in Moldova.

The MoREEFF loans and investment incentives are available until 30 June 2017. It is anticipated that the total number of energy efficiency home improvement projects to be financed under the MoREEFF facility will be in the range of 8000.

According to MOREEFF statistics, the MOREEFF facility provided 1441 energy efficiency loans with a total of 5,5 mln Euro and incentive grants amounting to about 1,5 mln Euro. More detailed information about loans and savings achieved up to date is provided in the tables below[35]

[35] Information provided on MoREEFF website

Energy Efficiency Home Improvement Measure	Amount of Sub-loans (EUR)	Amount of Investment Incentives (EUR)	Number of Projects	Percentage of Sub-loans
Energy Efficient Windows	**3 006 403**	**798 979**	**1087**	**54.5 %**
Wall Insulations	**710 311**	**188 772**	**26**	**12.9 %**
Roof Insulations	**61 488**	**16 341**	**11**	**1.1 %**
Floor Insulations	**5 185**	**1 378**	**4**	**0.1 %**
Solar Water Systems	**44 387**	**11 796**	**9**	**0.8 %**
Biomass Stoves & Boilers	**393 563**	**104 593**	**177**	**7.1 %**
Hot Water Gas Boilers	**1 227 524**	**326 226**	**191**	**22.3 %**
Heat Pump Systems	**37 192**	**9 884**	**14**	**0.7 %**
Integrated Photovoltaics	**0**	**0**	**0**	**0.0 %**
Central Heating	**30 725**	**8 166**	**1**	**0.0 %**

Energy Efficiency Home Improvement Measure	Energy Savings (MWh/Year)	CO_2 Reduction (Tonne/Year)[1]	Heat Generation Capacity Substituted (MW)[2]	Energy Saved against Annual Heat Use[3]
Energy Efficient Windows	**3 304**	**750**	**1.03**	**0.22 %**
Wall Insulations	**1 673**	**380**	**0.52**	**0.11 %**
Roof Insulations	**145**	**33**	**0.05**	**0.01 %**
Floor Insulations	**12**	**3**	**0.00**	**0.00 %**
Solar Water Systems	**81**	**18**	**0.03**	**0.01 %**
Biomass Stoves & Boilers	**1 946**	**442**	**0.61**	**0.13 %**
Hot Water Gas Boilers	**4 339**	**985**	**1.36**	**0.29 %**
Heat Pump Systems	**249**	**57**	**0.08**	**0.02 %**
Integrated Photovoltaics	**0**	**0**	**0.00**	**0.00 %**
Central Heating	**45**	**10**	**0.01**	**0.00 %**

4. The Energy Efficiency Fund

The main objective of the Energy Efficiency Fund is to attract and manage financial resources to finance and implement energy efficiency and renewable energy projects, in accordance with strategies and programs developed by the Government, by:

- promoting investment projects in energy efficiency and renewable energy sources;

- providing technical assistance for energy efficiency and renewable energy projects development;
- providing financial assistance to the projects;
- direct financial contributions;
- acting as the agent or mediator for other sources of financing;
- providing full or partial guarantees in case of financing by banks;
- providing assistance in identifying optimal combinations for projects funding

The financial resources of the Fund are formed from the following sources:

- financial allocations from the state budget - at least 10% of the Fund needed to achieve the targets related to energy efficiency and renewable energy indicators;
- donations from individuals and businesses from the republic of Moldova and abroad, including from international financial institutions and funds;
- bilateral grants from the states;
- financial income consisting of interest on current accounts or bank deposits of the Fund, and of the interest and fees for financing contracts concluded with the Fund's customers;
- loans and other financial instruments of banks, international financial institutions or investors, used exclusively for furtherance of the Fund's objectives

The Fund shall meet its objectives by promoting and financing economically, technically and environmentally feasible energy projects which will ensure sustainable energy consumption and will lead towards low energy intensity and polluting or greenhouse gas emissions reduction.
Currently, there are 15 RES projects with a total investment cost of 17.6 mln MDL (approx. 1 mln USD) which are in the implementation phase and for which the Energy Efficiency Fund provided financial support. This list of projects includes 12 biomass boilers with a total thermal capacity of 2025 kW and 4 solar thermal units, providing a thermal capacity of 225 kW.

8. DEMAND RESPONSE IN THE TURKISH ELECTRICITY MARKET

Section – I: Turkish Electricity Market Structure

After the issuance of Law No: 4628 Electricity Market Law in 2001, Turkish power market has undergone a dramatic reform towards liberalization of electricity market. First couple of years passed with mainly making the regulatory infrastructure, capacity building and market building issues. The policy makers have envisaged a start-up period and then a transitory market model towards the fully competitive final market structure in which prices are all cost-reflective, market activities are unbundled and supplier switching (i.e. consumer choice) is enabled.

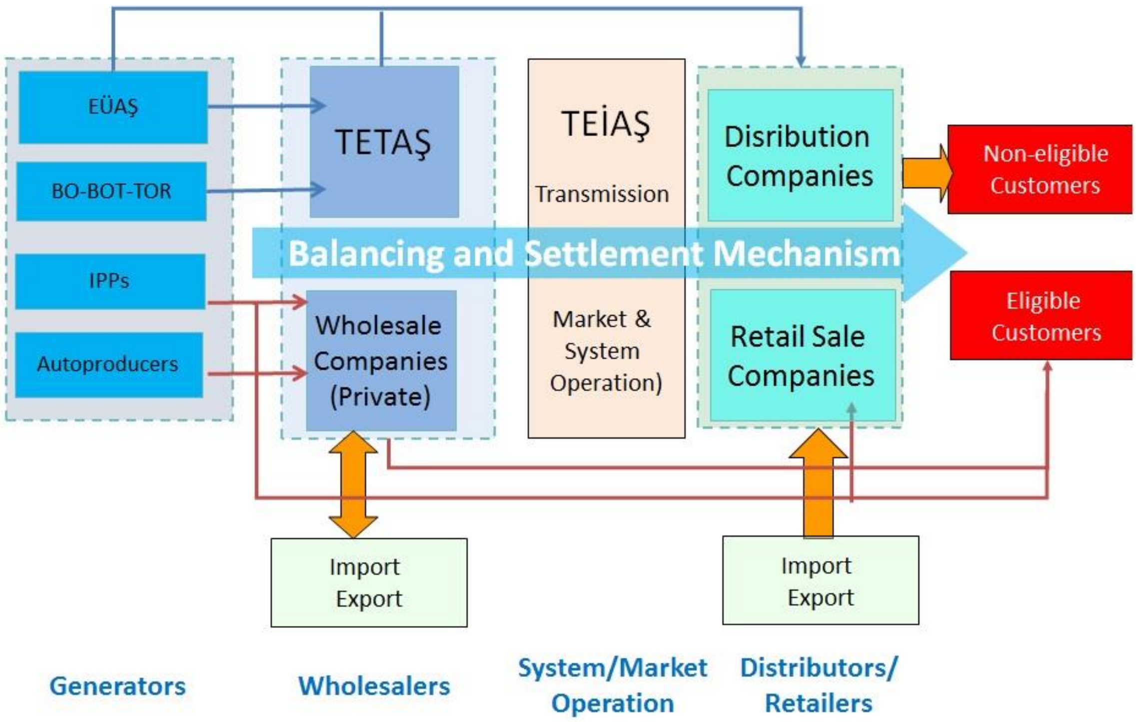


Figure 1: Current Turkish electricity market structure

Since 2001, significant progresses have been achieved about market building and EMRA established strong regulatory infrastructure for a progressive electricity market. During that process, total installed capacity is more than doubled, privatization of all of the distribution and retail sale activities were achieved and generation privatizations are still progress. In this process, the independent regulator (EMRA) was always committed to the liberal market structure and played a significant role, which in turn resulted in increasing involvement of private sector and hence investments. However, some further improvements are still needed, and with supportive policy actions regulatory measures have been proposed to establish fuel mix diversification, regional market integration and consumer choice.
In current electricity market structure, since December 2011, Day Ahead Market and Balancing Market are operating within Balancing and Settlement market. For envisaged market structure, next steps are the incorporation of hourly settlement, demand side participation and market splitting.

Section – II: Importance of Demand Response

Keeping in mind the current electricity market structure, active participation of demand side into electricity market will provide significant benefits in order manage the system efficiently and to handle the challenges such as high demand growth, high prices in critical days and hours. As it can be seen from Table-1 and the Figure-2 below, although there has been significant installed capacity increase during the last 10 year period, still very high system marginal prices can be experience. This mainly because the current market regulations were developed to manage large reliable load from predominately thermal generation and are less well suited to the management of intermittent generation or to facilitate flexible demand. In current market structure, demand side response measures are often under-valued compared to other balancing mechanisms. However, DR programs that is composed of a wide range of tools/ signals which can be used by various market actors can contribute a lot to handle challenges of electricity market.

	Peak MCP (TL/MWh)		**Peak SMP (TL/MWh)**		**Hourly Peak Load (MWh)**	
	Date	**Value**	**Date**	**Value**	**Date**	**Value**
Historical	13/02/2012	2.000,00	13/02/2012	2.000,20	14/08/2014	40.734
Yearly	06/02/2014	499,03	07/02/2014	399,00	14/08/2014	40.734
Monthly	02/09/2014	213,10	01/09/2014	240,00	04/09/2014	39.126

Table:1

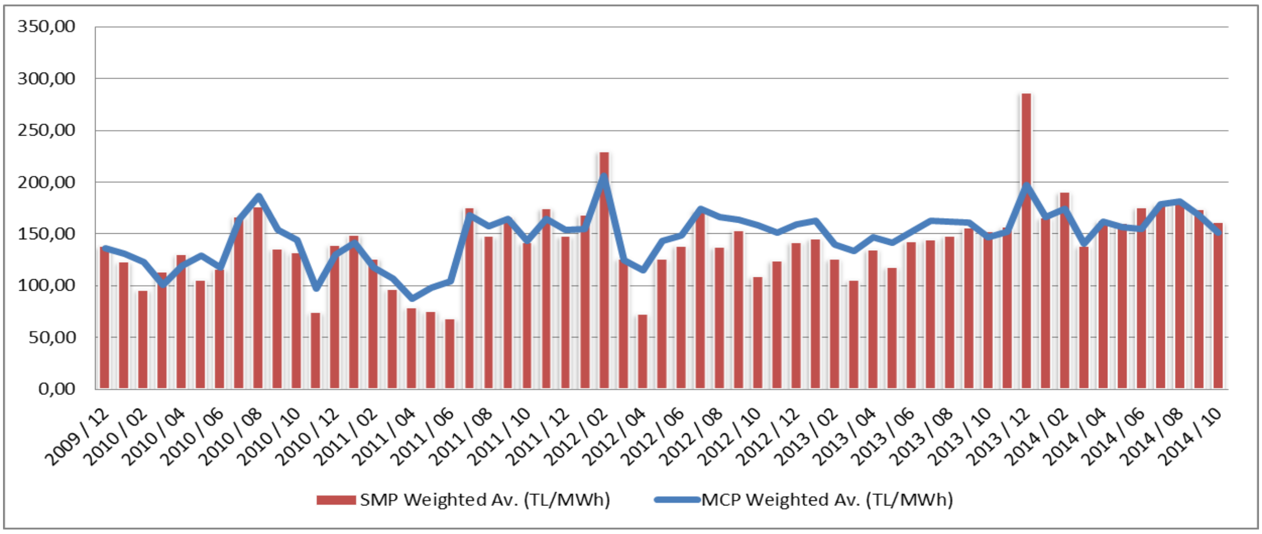


Figure-2:

At this point, policy makers and the regulator should choose the path to follow for further developments of the electricity market. Keeping in mind the natural gas dependency of the electricity generation portfolio, one of the paths is to move on as it is in which the system marginal prices are vulnerable to natural gas supply problems or high natural gas consumption due to weather challenges. The other path is to incorporate demand response into current market structure that will suppress excessive price increases.

Section – III: Propositions for Incorporation of Demand Response into Turkish Electricity Market

In order to fully integrate DR in to electricity markets, it is important to define the legal and regulatory arrangements necessary for DR to emerge and participate/ compete alongside other forms of flexible capacity (generation, storage, interconnection) on a level playing field. Moreover, barriers that are needed to be overcome should be identified and should be eliminated. For fully deployment of DR into electricity market structure, the possible barriers are market access and transparency, lack of an overall legal and regulatory framework, clearly defined roles for market participants and cost recovery.

In current regulatory infrastructure, demand side participation is enabled and power pool is «double-sided». Moreover, load serving entities (i.e. suppliers) can submit bids for their consumption portfolios. However, in practice, there is limited active demand response and the power pool is working as like «single-sided».

Demand response can be utilized through large scale consumers, residential consumers or both. Large scale electricity consumers are often able to provide a significant amount of flexibility with low capital costs but with very high operational costs because of the higher value of the curtailed energy and the impact on their industrial processes. Because of the low capital cost and flexibility, large scale electricity consumers are considered as the initial step for deployment of DR into the market and current regulatory structure allows big electricity consumers to become balancing unit in Turkish electricity market; but, this is not practiced yet.
On the other hand, residential DR is not currently within the Turkish electricity market structure because of the fact that residential DR typically requires significant capital costs to gather small amounts of load flexibility from thousands of customers. However, the operational cost of residential DR is very little once it is deployed. Considering the high capital costs, residential DR was not envisaged in Turkish electricity market structure. However, keeping in mind its potential as different ranges of availability, its responsiveness to reaction times, residential DR is sure going to be utilized to fully achieve the full potential of DR.

For the Turkish electricity market, studies about utilization of load aggregation mechanisms are still carried out. Moreover, comprehensive studies about cost benefit analysis of DR are also studied by DR Working Group that is composed of Ministry, Regulator and TSO. According to draft studies of the DR Working Group, DR response can be available in ancillary service for instantaneous demand control by allowing consumers that are connected to transmission network. Furthermore, utilization of load aggregators are envisaged because of the fact that it is manageable for TSO to deal with service providers instead of individual consumers and also DR services can be paid under ancillary services contracts.

Nonetheless, current approach for incorporation of DR should be complemented with residential DR and also with new tariff methodology for full engagement.