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REGULATORY IMPACT ASSESSMENT ON TIME OF USE PRICING FOR HOUSEHOLDS, BUSINESSES AND INDUSTRY

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ACRONYMS

AMI	Advanced Metering Infrastructure
AYPEG	Association of Young Professionals in Energy of Georgia
CAPEX	Capital Expenditures
CAPM	Capital Asset Pricing Model
CBA	Cost-Benefit Analysis
CEER	Council of European Energy Regulators
CNL	Cost of Normative Losses
CNT	Center for Neighborhood Technology
CO_2	Carbon Dioxide
ComEd	Commonwealth Edison
CP	Contracting Party
DSO	Distributions System Operator
EC	European Commission
ECRB	Energy Community Regulatory Board
EnC	Energy Community
EnCT	Energy Community Treaty
ESCO	Electricity System Commercial Operator
EU	European Union
EV	Electric Vehicle
GDP	Gross Domestic Product
GEE	Georgian Energy Exchange
GEL	Georgian Lari
GEOSTAT	National Statistics Office of Georgia
GNERC	Georgian Energy and Water Supply Regulatory Commission
GoG	Government of Georgia
GSE	Georgian State Electrosystem
GWh	Gigawatt Hour
ICT	Information and Communication Technology
IMF	International Monetary Fund
IRENA	International Renewable Energy Agency
JSC	Joint Stock Company
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt Hour
M&E	Monitoring and Evaluation
MEPA	Ministry of Environmental Protection and Agriculture of Georgia
MO	Market Operator
MoESD	Ministry of Economy and Sustainable Development of Georgia
MoF	Ministry of Finance of Georgia
MS	Member State
MW	Megawatt
NPV	Net Present Value
OPEX	Operational Expenditures
PECI	Projects of Energy Community Interest

PMI	Projects for Mutual Interest
RAB	Regulatory Asset Base
RCB	Regulatory Cost Base
RIA	Regulatory Impact Assessment
SDR	Social Discount Rate
ToU	Time of Use
TSO	Transmission System Operator
TWh	Terawatt Hour
US	United States
USAID	United States Agency for International Development
VAT	Value-Added Tax
VRES	Variable Renewable Energy Sources
WACC	Weighted Average Cost of Capital
YTM	Yield to Maturity

CONTENTS

1. EXECUTIVE SUMMARY

In 2017 Georgia became a contracting party of the Energy Community Treaty (EnCT). As a contracting party, Georgia took a commitment to harmonize its electricity market legislation with the European Union (EU) Energy Directives and Acquis Communautaire and conclude electricity market liberalization according to Georgia's accession protocol. These structural changes are expected to contribute to a more efficient functioning and empower customers to actively engage in the electricity market activities.

In 2019, the Parliament of Georgia approved the Law on Energy and Water Supply and the Law on Promotion of the Production and Use of Energy from Renewable Sources and in the beginning of 2020 – Law on Energy Efficiency. It should be also noted that secondary legislation stemming from the abovementioned primary legislation is under preparation.

Ongoing reforms cover all parts of the energy sector supply chain as well as support decentralization of energy markets that strengthens empowerment of final customers to actively participate in the market, enjoy benefits and reduce costs. In this regard, roll-out of smart meters and introduction of Time of Use (ToU) tariff scheme represents worldwide the best example of customer empowerment because such scheme allows final customers to access metering and billing information of their individual electricity consumption, incentivize their behavioral change, enhances energy savings and supports the development of a market for energy services and demand management.

According to international best practice ToU scheme can be mandatory or optional depending on the policy goals. The ToU scheme can be directed to all consumers or only for a selected group of end-users. The optional schemes have higher risk that not enough consumers will participate in ToU pricing model, which will lead to policy failure. However, when selecting mandatory applications of ToU the target group of consumers should be carefully defined based on their ability to vary their consumption pattern in accordance with price signals, otherwise the ToU pricing scheme might bring costs rather than benefits. There are two types of ToU tariff schemes based on its structure:

- ***Static ToU:*** tariffs are defined in advance for different time blocks/zones. The fees are determined based on the predicted peak and off-peak periods and do not change in accordance with the real-time system conditions;
- ***Dynamic ToU:*** It is a concept envisaging the short-notice adjustment of prices to accommodate varying demand for network use and changing network conditions such as grid bottlenecks or congestion. Hence, it is a more flexible design of ToU and allows the prices to change on a daily basis reflecting actual system conditions. The consumers typically receive information on changes in higher peak-period prices on day-ahead or day-off basis.

ToU pricing is a demand-side management tool providing price incentives to redistribute electricity demand from the peak to the off-peak periods (peak shaving). It is an effective option to manage system load by changing consumption behavior of the end-users, incentivizes peak shaving and congestion mitigation which in turn leads to more efficient use of electricity and reduces the investment costs in grid infrastructure. However, implementation of the ToU schemes requires certain preconditions in terms of the regulatory framework, market arrangement and system infrastructure. One of the main components of ToU pricing is the advanced meter which measures electricity consumption in real-time. It allows system operators and suppliers to have more precise information about the consumption pattern of a grid user during winter and summer, night and day, or during any other relevant period pre-set in the advanced meter. Therefore, this technical feature of an advanced meter provides possibility for electricity network operators and suppliers to apply time-differentiated tariffs which in turn allows them to reduce investment costs in the network and reflect wholesale electricity prices in the price paid by final customers.

In order to support decision-making bodies, Association of Young Professionals in Energy of Georgia (AYPEG) conducted a Regulatory Impact Assessment on ToU Pricing for Households, Businesses and Industry. While ToU pricing affects a considerable number of groups such as electricity market stakeholders (Ministry of Economy and Sustainable Development of Georgia (MoESD), Georgian National Energy and Water Supply Regulatory Commission (GNERC), Distribution System Operator (DSOs)/Suppliers) as well as end-user customers, project team conducted consultations and online survey for Household and Commercial Customers' in order to assess all possible impacts and identify potential challenges related to the implementation of the proposed regulatory changes. Details of stakeholder consultation and results of survey is provided in Chapter 5.

Based on the stakeholder consultations, survey results and analyzed problems, the project team identified the main objective of the policy intervention. That is to enhance utilization of energy resources efficiently, which among others, implies efficiency of grid infrastructure by increasing customer participation.

Taking into consideration the Regulatory Impact Assessment (RIA) objective, the project team developed the ToU Tariff Model which incorporates an economic-oriented analysis. The analysis evaluates the costs and benefits of the ToU tariff scheme for household and commercial customers under Mandatory and Voluntary policy alternatives as well as captures externalities such as reduction of CO_2 and electricity loss in the network. It is also important to note that the ToU Tariff Model is based on collected data, experience from other countries and number of assumptions. As any model with a long-term future perspective it can only give an idea and a basic direction but cannot predict the reality. The ToU Tariff Model was constructed only for household and commercial customers for the period 2020 - 2040. The 20-year horizon for Cost-Benefit Analysis (CBA) analysis is based on benchmarking and international experience[1]. At the same time, household and commercial customers were broke down by 5 different groups based on various technological specifics. The project team also elaborated industrial customers but due to their flat load profile characteristics during a day and no incentive and motivation to participate in ToU tariff scheme, they were not included in the analysis.

The ToU Tariff Model was analysed for three policy alternatives:

- *Status Quo (Do nothing):* It assumes that no ToU tariff scheme is implemented and no smart meters are deployed. RIA analysis assesses all other policy alternatives against this scenario;
- *Mandatory for All*: ToU tariff scheme is mandatory for participation for all household and commercial customers. It assumes that smart meter roll-out will be possible within 8 years;
- *Voluntary:* ToU tariff scheme is voluntary for participation for household and commercial customers. It assumes that smart meter roll-out will be possible within 3 years[2].

For Mandatory and Voluntary Policy alternatives roll-out period is based on international experience and consultations with Georgian DSOs. At the same time, these policy alternatives incorporate static ToU tariffs for different periods of time during a day in a following structure:

Table 1: ToU Tariff Structure

Off-peak	Morning Peak	Afternoon Off-peak	Evening Peak
00:00-07:59 AM	08:00 AM -13:59 PM	14:00 PM - 18:59 PM	19:00 PM – 23:59

The results of qualitative and quantitative analysis of policy alternatives under ToU Tariff Model are summarized in the Table 2 which shows net present values of individual cost and benefit categories[3]:

Table 2: Comparisons of Policy Alternatives (GEL)

Descriptions			Mandatory	Voluntary
Costs	System Operators / Suppliers	Smart Meter (SM) Unit Costs	-1,254,543,995	-106,618,756
Costs	System Operators / Suppliers	Smart Meter Installation Costs	-169,633,008	-73,627,411
Costs	System Operators / Suppliers	Communication Infrastructure	-425,439,585	-35,184,190
Costs	System Operators / Suppliers	Operational Expenditure for SM	-151,184,318	-10,661,876
Benefits	System Operators / Suppliers	Avoided Meter Readings	262,590,082	45,343,690
Benefits	System Operators / Suppliers	Reduced Billing Processes	20,293,366	3,504,230
Benefits	System Operators / Suppliers	Reduced Disconnection cost	20,405,129	3,456,012

[1] Network Pricing and Enabling Metering Analysis, ENERGEIA; 2) Advanced Metering Infrastructure Cost/Benefit Analysis, Ameren Illinois
[2] Smart Meter roll-out plan and respective years for Option 1 and Option 2 are based on consultations with Georgian DSOs and GNERC
[3] Benefits and costs are arising from efficiency gains. ToU changes are not impacting revenue collected from other customer classes. Other impacts are arising from outside the industry.

Benefits	System Operators / Suppliers	Reduced Maintenance Costs	6,323,990	1,092,034
Benefits	System Operators / Suppliers	Reductions in Losses	45,837,397	27,502,438
Benefits	Environment (Externalities)	CO_2 Reductions	1,341,916,804	406,508,681
		Total Costs	**-2,000,800,905**	**-226,092,233**
		Total Benefits	**1,697,366,768**	**487,407,085**
		Net Effect	**-303,434,137**	**261,314,853**

Based on the results, following key messages can be identified within this report:

- Benefits derived from Mandatory and Voluntary policy alternatives are straightforward and are calculated for household and commercial customers. For example, reduction in CO_2 emissions and losses in distribution network represents overall benefit which improves efficiency of electricity system and overall environmental conditions. However some other benefits such as reduced billing process and avoided metering costs may affect employment in the sector and even reduction of electricity generation from thermal power plants may cause reduction in CO_2 emissions. It has to be noted that evaluation of indirect effect of ToU tariff scheme on thermal power plants are complex while it has several dimensions such as rate of employment, taxes, CO_2 emissions, imported fuel dependency and etc. At the same time, effect on employment in the sector due to increased operational efficiency of DSOs was not captured while it was beyond the scope of this analysis. Therefore, respective cost and benefit categories indicate direct profit and loss from implementing ToU tariff schemes for household and commercial customers.
- Mandatory policy alternative has significant negative net effect which is mainly caused by considerable investment cost in the smart meter infrastructure and big share of customers (which are characterized with a poor consumption) does not have enough potential to deliver benefits for socio-economic perspectives;
- Voluntary policy alternative has considerable positive net effect. Therefore, the project team recommends this policy alternative to be taken into consideration for implementation of ToU tariff schemes in Georgia;
- Under Voluntary policy alternative about 3.5 bln kWh of electricity is saved for the year of 2040 compared to Status Quo, which is approximately equivalent to not constructing a power plant similar to Enguri hydro power plant with installed capacity of 1,300 MW for next 20 years in total. At the same time customers save about 140 mln Georgian Lari (GEL) for the year of 2040 compared to Status Quo;
- It should be also noted that Voluntary policy alternative also narrows electricity supply-demand gap as well as provides possibility to cover time delay of commissioning planned power plants in Georgia;
- In case of Mandatory policy alternative, it was found out that, massive smart meter roll-out captures effects that are not only associated with ToU tariffs but as well with customer service improvements. This effect is smaller in case of Voluntary policy alternative, due to the fact that there will be smaller share of customers with smart metering and there are two metering systems running in parallel, old and new;
- For successful implementation of ToU Tariff scheme active customer awareness campaign should be conducted in order to induce customers to save electricity by more efficient consumption behaviors.

2. PROBLEM DEFINITION

2.1 BACKGROUND INFORMATION

In 2017 Georgia became a contracting party of the EnCT. As a contracting party, Georgia took a commitment to harmonize its electricity market legislation with the EU Energy Directives and Acquis Communautaire and conclude electricity market liberalization according to Georgia's accession protocol. The deadline of implementation of the EU Energy Directives and Acquis Communautaire according to Georgia's accession protocol to the Energy Community was by the end of 2018[4]. These structural changes are expected to contribute to a more efficient functioning of the electricity market and empower customers to actively engage in the electricity market activities. In this regard one of the most important directives that Georgia has to comply with is Directive 2009/72/EC on common rules for the internal market of electricity. This directive defines the rules related to the organization and functioning of the electricity sector and regulates access to the system and consumer empowerment. Other important directives are Directive 2009/28/EC on the promotion of the use of energy from renewable sources and Directive 2012/27/EU on energy efficiency. Directive 2009/28/EC establishes an overall policy for the production and promotion of energy from renewable sources while 2012/27/EU establishes a common framework of measures for the promotion of energy efficiency as well as making improvements to tap all the existing energy saving potentials, encompassing savings in the energy supply and the end-use sectors. Both directives look at all parts of the energy sector supply chain but also support decentralization of energy markets that strengthens empowerment of final customers to actively participate in the market, enjoy benefits and reduce costs. In this regards, roll-out of smart meters and introduction of ToU tariff scheme represents worldwide the best example of customer empowerment because such scheme allows final customers to access metering and billing information of their individual electricity consumption, incentivize their behavioral change, enhances energy savings and supports the development of a market for energy services and demand management.

In 2019, the Parliament of Georgia approved the Law on Energy and Water Supply (hereafter – New Energy Law) and the Law on Promotion of the Production and Use of Energy from Renewable Sources (hereafter – Renewable Energy Law). Further, Parliament of Georgia approved the Law on Energy Efficiency (hereafter – Energy Efficiency Law) in the beginning of 2020. It should be also noted that secondary legislation stemming from the abovementioned primary legislation is under preparation. Currently, Georgia is working on the energy market reforms in order to harmonize its legislation with the EU Energy Acquis. Implementation of the EU Energy Acquis aims to facilitate establishment of a competitive energy market on wholesale and retail level, increase security of supply, customer participation, incentivize utilization of local renewable energy sources and energy efficiency.

According to Georgia's accession protocol to the Treaty establishing the Energy Community, the deadline of implementation of the abovementioned directives was by the end of 2018. At the same time, as an obligation, Georgia must ensure that based on Directive 2009/72/EC eligible customers comprise all non-household consumers from December 31, 2018 and all consumers from December 31, 2019. That translates as full opening of the retail market and making consumers eligible to choose suppliers and negotiate supply tariffs – by the end of 2019. Despite the fact that deadlines defined in the accession protocol were not met due to the delayed adoption of the New Energy Law, the opening of the Georgian electricity market has already started in 2019. Electricity (Capacity) Market Rules mandated 110-35 kV customers with average monthly consumption no less than 5 million kWh to trade on the wholesale electricity market. Market opening is going to continue as per Electricity Market Concept Design of Georgia until full consumer eligibility requirement will not be satisfied. Wholesale market participants and big consumers' participation in the wholesale market would automatically expose them to hourly electricity prices while for smaller industrial consumers, households and small commercial enterprises there is a big potential to introduce ToU tariffs as they, according to Georgia's commitments, must be eligible to choose suppliers. But it also translates into competition between retail suppliers in offering different sets of tariff contracts to consumers (including ToU options).

Considering the significance of ongoing energy market reforms, obligations undertaken by the Government of Georgia (GoG) are crucial as it will bring overall benefits and welfare to the Georgian

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[4] https://www.energy-community.org/dam/jcr:71db75bd-ba91-4e54-8aa1-16ecb8f68d51/PRO_2016_MC_Georgia.pdf

society. However, along with obligations and requirements from Georgia's accession protocol, final customers should be offered modern schemes and options to incentivize their active engagement in the energy market. This will result in maximized social welfare and final customers fully enjoying the benefits of the competitive and decentralized energy market. Implementation of such modern schemes and options requires comprehensive analysis taking into consideration international experience that will support decision-making from the legal and regulatory point of view.

2.2 REVIEW OF INTERNATIONAL EXPERIENCE IN REGARD TO TOU PRICING

One of the main components of ToU pricing is that advanced meters allow to measure electricity consumption in real-time. It allows electricity system operators and suppliers to have more precise information about the consumption pattern of a grid user during winter and summer, night and day, or during any other relevant period pre-set in the advanced meter. Therefore, this technical feature of an advanced meter provides possibility for electricity system operators and suppliers to apply time-differentiated tariffs which in turn allows them to reduce investment costs in the network and reflect wholesale electricity prices in the price paid by final customers. On the other hand, future electricity network development faces various challenges such as growing number of volatile renewable generation systems which lead to short-term imbalances between supply and demand.

Even without additional generation capacities new demand loads of consumers can cause stress for the electricity grid. One instrument to solve such problems are flexible or variable tariffs for final customers. The main idea is to provide an incentive for customers to shift their loads according to price signals. The extent of the associated savings for final customers mainly depends on the pattern of the aggregated network demand. The more time-differentiated the initial annual load curve, the higher the potential of avoided investments when shifting consumption. It should be also noted that the saving potential depends on the capacity of consumers to shift their consumption, which depends on their use of the network[5].

ToU pricing is a demand-side management tool providing price incentives to redistribute electricity demand from the peak to the off-peak periods (peak shaving). Time of Use schemes send time-varying price signals to final consumers depending on the system conditions, the higher fees are charged during the deficit of supply and lower fees are charged during the surplus periods of supply. Therefore, ToU scheme is an effective option to manage system load by changing consumption behavior of the end-users, incentivizes peak shaving and congestion mitigation. ToU leads to more efficient use of electricity and reduces the investment costs in grid infrastructure. As an example, in 2015 the United States (US) saved 5% of electricity after introduction of the ToU scheme[6], for the whole country. Furthermore, ToU scheme enables higher system flexibility and thus, contributes to the facilitation of integration of renewable energy sources.

ToU schemes are widely adopted in the US and EU countries. The design of ToU differs across countries. The appropriate ToU scheme is selected depending on the enabling technologies, market condition and the policy objectives. Two groups of ToU schemes exist:

- *Static ToU*: tariffs are defined in advance for different time blocks. The fees are determined based on the predicted peak and off-peak periods and do not change in accordance with the real-time system conditions[7];
- *Dynamic ToU:* It is a concept envisaging the short-notice adjustment of prices to accommodate varying demand for network use and changing network conditions such as grid bottlenecks or congestion. Hence, it is a more flexible design of ToU and allows the prices to change on a daily basis reflecting actual system conditions. The consumers typically receive information on changes in higher peak-period prices on day-ahead or day-off basis[8].

Compared to dynamic schemes, the static design of ToU is easy to administer and since the tariffs are defined in advance for different time blocks, implementation of static ToU schemes does not necessarily requires the existence of a liberalized and/or developed wholesale electricity market and highly educated and trained consumers in order to follow peculiarities of hourly pricing (hourly market

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[5] For instance, in France, most of the consumption shifting was due to the automatic setting of electric water boilers, which were programmed to switch on during cheap hours at night and then store hot water during the night
[6] Time of Use Tariffs: Innovation Landscape Brief, International Renewable Energy Agency (IRENA), 2019
[7] Electricity Distribution Network Tariffs: CEER Guidelines for Good Practice, Council of European Energy Regulators (CEER), 2017
[8] Electricity Distribution Network Tariffs: CEER Guidelines for Good Practice, Council of European Energy Regulators (CEER), 2017

drivers). Current status-quo is that Georgia does not have an organized hourly market (day ahead and balancing), there is no self-dispatch model implemented yet, where the Transmission System Operator (TSO) only balance system and conduct congestion management based on the market instruments. Even though it is planned to move to self-dispatch based, hourly market model in future, at the time being there is no real data or at least simulation data available in order to incorporate dynamic pricing arrangement into the modeling ToU, which involves as well:

- Time periods when hydro or renewable energy may be curtailed due to oversupply conditions and amount of energy and/or cost in terms of monetary value associated with such curtailments. It is well known that curtailment in self-dispatch market model, curtailments and/or dispatching (market-based instruments of congestion management) are costs for network operators and not for generators or consumers itself. Despite that, for effective operation of the network, such costs shall be minimized. However, in Georgia such instruments are not in practice, network is not congested so as curtailments may be needed, therefore there is no data available in order to model such situations;
- Risk of price spikes impacting consumers – that takes place in case of dynamic pricing when value of energy in time, including wholesale price spikes are transferred to the retail consumers. As there is no such price reference in Georgia, it is not possible to evaluate market behavior in accurate manner;
- Processes related to forecasting, as the role of forecasting not only for supplier but as well as for consumers are higher in case of dynamic ToU pricing model. It is well known that, good forecasting decreases cost of energy by avoiding purchasing expensive energy close to real time.

Therefore and due to the facts that it is impossible to address above mentioned items in this analysis, it was decided that static ToU pricing design is the most compatible model for the current situation and the market development level in Georgia and it is appropriate to conduct RIA modeling based on this approach.

ToU tariffs can vary by the different geographic locations[9]. The location-specific tariffs allow the system to manage congestion in different system nodes. However, in the case of Georgia, due to the small size of the market location specific tariffs are less relevant. ToU tariffs can be volumetric, capacity-based or a mix of both. Volumetric tariffs charge consumers for the total volume of energy taken from the grid while capacity tariffs depend on contracted grid capacity or used power. The measurement unit for volumetric tariffs is generally $/kWh whereas for capacity tariffs – $/kW (See Table 3).

Table 3: Comparison of Dynamic and Static ToU Schemes

Type of ToU Schemes	Advantage	Disadvantage
Static ToU	• Simple to administer; • Easy to implement; • Can be implemented in regulated electricity markets.	• Tariffs are rigid and do not reflect actual system conditions; • Requires accurate forecasting of on-peak and off-peak periods to set prices accordingly.
Dynamic ToU		
Real Time pricing	• Flexible tariffs allow to adjust demand according to the actual system conditions.	• Requires instalment of smart meters; • Requires existence of the well-established wholesale electricity market; • Relatively difficult to administer and implement.
Variable Peak Pricing	• Flexibility of on-peak prices allows to respond demand to the actual system conditions; • Possible to implement in regulated market; • Simple to administer; • Does not require smart meters.	• Rigid prices in off-peak period does not allow to respond demand with the actual system conditions.
Critical Peak Pricing	• Allows to manage demands in the peak demand days;	• Requires existence of the wholesale market;

[9] Within one market zone, different locational tariffs are applicable only to those systems where locational pricing is in place. Such approach is not compatible to European market model.

Type of ToU Schemes	Advantage	Disadvantage
	• Simple to administer; • Does not require smart meters.	• Prices most of the time are rigid and do not allow to adjust demand to the actual system conditions.

The implementation of ToU schemes requires certain preconditions in terms of the regulatory framework, market arrangement and system infrastructure. Furthermore, the successful implementation of ToU schemes requires strong consumer engagement, therefore, increasing consumers' awareness on the potential benefits of the ToU pricing will facilitate in changing consumers' behavior and make the demand responsive to the price signals. For example, respective study for selected European Union countries showed that main underlying barriers to dynamic pricing in electricity supply tariffs to household consumers are the lack of awareness of consumer benefits, followed by insufficient cost savings (as perceived by consumers) and the lack of policy framework in support of dynamic pricing[10].

Regardless of the fact which design of ToU pricing is selected, the elaboration of tariff setting methodology is the mandatory requirement to facilitate effective and transparent pricing. However, except for the regulatory arrangement, there are several technical requirements for successful introduction of the ToU schemes. The implementation of smart metering mechanisms, for measuring hourly consumption and assigning respective charges is one of the technical prerequisites. Furthermore, the development of the energy management systems and smart technologies enabling automatically adjusted consumption to price signals are additional factors facilitating the success of the ToU schemes[11].

The ToU scheme can be mandatory or optional depending on the policy goals. The ToU scheme can be directed to all consumers or only for a selected group of end-users. The optional schemes have a higher risk that not enough consumers will participate in ToU pricing model which will lead to policy failure. However, when selecting mandatory application of ToU the target group of consumers should be carefully defined based on their ability to vary their consumption pattern in accordance with price signals, otherwise the ToU pricing scheme might bring costs rather than benefits.

The smart metering pilot project in Hungary has shown that the mandatory inclusion of all customer types in ToU schemes does not bring the anticipated high load shifting effects. This is due to the fact that not all types of customers have the incentive and/or potential for load shifting. Several other pilot projects implemented by local DSOs showed similarly negative Net Present Value (NPVs) for the mandatory case [18].

Table 4: Benefits of the ToU Scheme

Stakeholders	Benefits
Consumers	Potential savings on electricity bills due to shifting their consumption patterns according to price signals.
System Operators	• Potential savings of investment costs in network infrastructure; • Improved system efficiency.
Suppliers	Increased benefits from cost-reflective pricing.
Renewable energy producers	• Enhanced integration of Variable Renewable Energy Sources (VRES); • Reduced curtailment of renewable energy production.
Social, Environmental and Economic benefits	• Spillover effect by facilitating development of innovative products; • Job creation; • Reduction of fossil fuel imports; • Reduction of CO_2 emissions; • Increased level of security of supply; • Increased level of energy efficiency.

The EU legislation does not directly define the strict obligation to establish ToU tariffs but it contains provisions on ensuring existence of ToU information and obligations on hourly metering that puts solid background and indications that ToU tariffs must be used where economically justified. Directive 2012/27/EU on Energy Efficiency defines the obligation[12] for the EU Member States that network regulation and tariffs shall not prevent system operators or energy retailers making available system services for demand response measures, demand management and distributed generation in

[10] Time of Use Tariffs: Innovation Landscape Brief, International Renewable Energy Agency (IRENA), 2019
[11] Time of Use Tariffs: Innovation Landscape Brief, International Renewable Energy Agency (IRENA), 2019
[12] Annex XI of the Directive 2012/27/EU

organized electricity markets. Article 9 on metering of the Energy Efficiency Directive obliges EU Member States that intelligent metering systems and smart meter roll-out for natural gas and/or electricity should be implemented in accordance with Directives 2009/72/EC and 2009/73/EC. This obligation should be met where it is technically possible, financially reasonable and proportionate in relation to the potential energy savings and ensure that:

- Metering systems provide information to final customers on actual time of use and the objectives of energy efficiency and benefits for final customers are fully considered when establishing the minimum functionalities of the meters and the obligations imposed on market participants;
- Security of the smart meters and data communication and privacy of final customers is in compliance with relevant Union data protection and privacy legislation;
- Based on final customer's request meter operators guarantee that respective meters account for electricity put into the grid from the final customer's premises;
- Based on final customer's request, metering data on their electricity input and off-take is made available to final customers or to a third party acting on behalf of the final customer in an easily understandable format that they can use to compare deals on a like-for-like basis;
- Appropriate advice and information are given to customers at the time of installation of smart meters, in particular about their full potential with regard to meter reading management and the monitoring of energy consumption.

In the existing legislation it is already possible to include a time-element in distribution tariffs as the Energy Efficiency Directive (ANNEX XI) states that network or retail tariffs may support dynamic pricing for demand response measures by final customers such as:

- Time of Use tariffs;
- Critical peak pricing;
- Real time pricing;
- Peak time rebates.

ToU volumetric tariffs should be applied as a default pricing option that consumer's metering infrastructure enables application of time-based tariffs, thus providing pricing signal for efficient use of network, peak demand reduction and demand side response in general[13].

According to both, Electricity Directive 72/2009/EC and the recent recast Electricity Directive 2019/944, all consumers should be able to benefit from direct participation in the market by adjusting their consumption according to market signals and in return benefit from lower electricity prices. Therefore, smart meters and dynamic electricity pricing contracts are crucial. Such smart meter products could have many different properties, such as:

- Time of Use products, where the cost of electricity depends on the time of day, or the weekday/weekend, seem to be the most common ones;
- Real-time pricing matches consumer energy prices much more closely to wholesale prices;
- Critical peak prices generally signal peak consumption levels in determining the price of energy;
- Smart meters with remote consumption control functionality are, for example, devices that adapt the operation of specific home appliances, such as heat pumps, to hourly electricity prices, in order to benefit from shifting consumption to lower-price periods.

Currently, electricity consumers in 16 Member States can sign up to Time of Use contracts with intra-day, weekdays or weekend energy price differentiation. In eight Member States, electricity consumers can choose real-time or hourly energy pricing, as shown in Figure 1[14].

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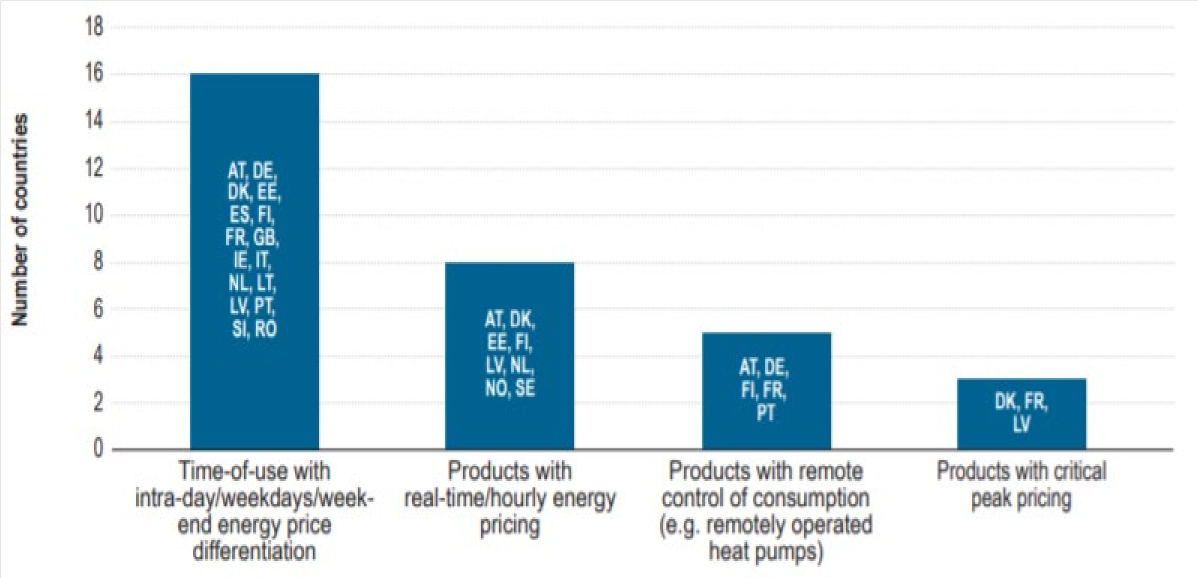
[13] Energy Community's recommendations on Technical Assistance to Develop Policy Guidelines for the Distribution Network Tariffs, 2017

[14] CEER, 2019

Figure 1: Types of Electricity Smart Meter Products Available in EU MSs and Norway, 2018



As for introducing ToU pricing and elaborating regulatory strategy to support smart metering roll-out, Energy Community Contracting Parties (EnC CPs) are obliged to implement the European Union's Acquis (Third Energy Package) on electricity, energy efficiency and renewable energy sources. Provisions on the roll-out of intelligent metering systems are in particular set out by Annex I of Directives 2009/72/EC requiring to install by 2020 intelligent metering systems for electricity consumption for at least 80% of customers where such a roll-out is assessed positively and to prepare a timetable to implement intelligent metering systems within 10 years. In many cases the roll-out of smart metering is driven by the aim to achieve energy savings and to reduce carbon dioxide emissions. In the European Union, this political aim is expressed in the 20-20-20 target[15], finally approved by the European Parliament and Council. According to the definitions by using smart metering, effective consumption feedback including costs of used energy can be provided to the consumer. Additionally, new tariff schemes can easily be adopted. Thus, changes in the consumers' behavior can be triggered. With the Energy Community's decision from October 6, 2011, the Third Package (Directives 2009/72/EC, 2009/73/EC and associated regulations) is to be implemented in the Energy Community's legal framework[16] and are consequently applicable in Georgia.

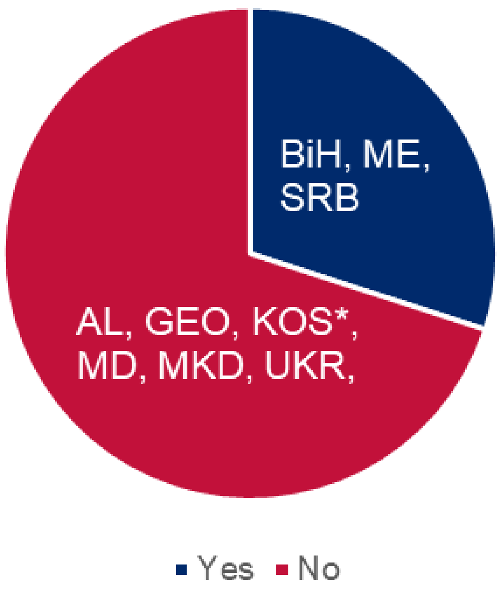
ToU tariffs are not widespread and developed in the CPs. In majority of the CPs, one-time interval volumetric tariffs are in place with capacity component in several countries[17]. ToU tariffs are in place only in 3 CPs (see Figure 2).

[15] 20-20-20 target indicates 20% increase in energy efficiency, 20% reduction of CO_2 emissions and 20% renewables share in energy consumption by 2020 at EU level

[16] Decision of the Ministerial Council of the Energy Community, D/2011/02/MC-EnC: Decision on the implementation of Directive 2009/72/EC, Directive 2009/73/EC, Regulation (EC) No 714/2009, Regulation (EC) No 715/2009 and amending Articles 11 and 59 of the Energy Community Treaty

[17] Distribution tariff methodologies for electricity and gas in the Energy Community, ECRB report, 2019

Figure 2: Application of ToU Tariffs in Energy Community Contracting Parties, 2019



The main obstacle for introducing ToU schemes in EnC CPs is considered to be the absence of real time metering. In addition to the problem of the real time metering system, the incomplete transposition of the Third Energy Package requirements represents a challenging issue at the moment. The only exception is Montenegro which has completely transposed the Third Energy Package into national energy legislation. Hence, Montenegro undertook obligations for roll-out of smart metering stemming from the Annex I of 2009/72/EC Directive and has already started implementing the roll-out project. Such development enabled Montenegro to introduce ToU tariffs in 2019 that is one of the main benefits of the smart (hourly) meter roll-out.

The United States introduced ToU pricing schemes in the 1970s[18]. However, currently the majority of US consumers still pay flat rate tariffs. In the late 2000s several piloting programs of ToU pricing were implemented across the country. The joint experiment of the Commonwealth Edison (ComEd), a large electric utility and the Center for Neighborhood Technology (CNT), a local non-governmental organization which developed optional real-time pricing schemes for consumers in the Chicago area, showed that real-time pricing schemes bring benefits to consumers as well as to the service providers. The consumers enrolled in the real-time pricing schemes received the price alerts and were informed about the price changes day-ahead. The experiment evidenced that consumers were responsive to price signals, particularly when they were informed about the price changes[19].

MONTENEGRO CASE STUDY OF TIME OF USE PRICING

Installation of new, modern meters with remote reading (175,000 meters) in Montenegro began during the regulatory period of 2012-2015, when the Regulatory Agency of Montenegro - REGAGEN approved the first phase of the roll-out of Advanced Metering Management (AMM) system. The AMM project continued through the second phase for the period of 2015-2016 approved by REGAGEN during which the installation of 80,000 meters were planned. In January of 2016, a new Energy Law came into force which obliged DSOs in Montenegro that at least 85% of electricity consumers should be equipped with modern measuring systems until 01.01.2019. After this, REGAGEN approved the third phase of the project for the period 2017 - 2018 which consisted of the procurement of 60,000 meters, of which 45,000 would be installed, and the remaining amount would serve as spare. Through three phases of the project, 300,875 new meters were installed at consumer metering points by the end of 2018.

[18] ToU Rates As If Prices Mattered: Reviving an Industry Standard for Today's Utility Environment, Stuart Schare, Summit Blue Consulting, 2008
[19] https://www.povertyactionlab.org/evaluation/impact-real-time-electricity-pricing-united-states

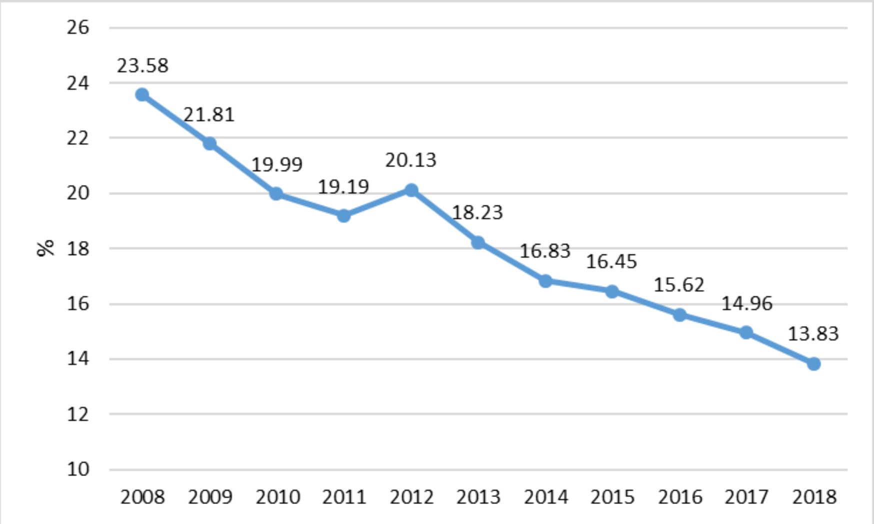
Table 5: Rate of Successfully Disconnected Bad Payers

	Success rate
AMM 2012.	89,23 %
AMM 2013.	94,37 %
AMM 2014.	96,86 %
AMM 2015.	97,42 %
AMM 2016.	93,70%
AMM 2017	94,48%
AMM 2018.	94,59 %

The new meters have the possibility of remote communication which enables more efficient and accurate reading, higher degree and more reliable disconnection of customers who do not meet their obligations within the prescribed period, and consequently higher collections which for the most part of the project exceeds 100%, which means that claims from previous periods are also charged.

The realization of this project, among other investments and interventions, resulted in reduction of losses (technical and commercial) in the distribution system during 2012 - 2018 years and in a higher rate of successfully disconnected bad payers (See Table 5 and Figure 3).

Figure 3: Loss reduction



ToU tariffs that are in place in Montenegro combine both energy and distribution network usage. Therefore, they fully capture the full retail tariff for households and businesses. There are only two-tariff systems working during the day/week under the ToU scheme. First tariff (peak tariff) from 7 AM to 23 PM, for all working days plus Saturday, the second tariff (off-peak tariff) supplements the first tariff. The relation of the first and second tariff is 2 to 1. ToU scheme is applicable for all consumers connected to the distribution network. The ToU scheme is mandatory when a consumer is contracted by a supplier as a two-tariff system customer but as an exception, households and small commercial businesses connected to 0.4 kV voltage and with connection capacity lower than 34.5 kW are allowed to request switching to single tariff system.

The State of California uses static ToU price schemes, the off-peak and on-peak rates are determined in advance and do not change on a daily basis. However, rates are changed seasonally, and consumers are charged at higher rates during the summer season[20]. California adopted a number of pilot programs to evaluate consumers' responsiveness to price signals and assess the overall impact of ToU pricing schemes. Since the piloting of ToU showed promising results in 2015 California made the decision to enroll all consumers in ToU schemes with the possibility to opt-out. The pilot programs showed that such design leads in highest enrollment of consumers, according to the results 90% of

[20] https://www.cpuc.ca.gov/General.aspx?id=12194

the 115,000 consumers participating in pilot programs remained in ToU pricing schemes[21]. In the State of Illinois together with the standard fixed rates, the utilities are required to offer consumers real time pricing options and most of the residential consumers are enrolled in real time pricing programs. As a result, the savings of supply for consumers enrolled in the hourly pricing schemes ranges from between 8-10%. The utilities provide information to consumers about their monthly savings. Furthermore, they consult consumers about enrollment of the hourly pricing schemes and help them decide whether it is a suitable pricing option for them. The results show that real-time pricing schemes are successful to reduce the consumption of electricity as well as the expenses paid by consumers[22].

Observation from the US experience which could be relevant for Georgia and shall be considered during ToU pricing design might be as follows:

- Piloting ToU pricing schemes on small group of consumers before making it country wide;
- Enrolling all consumers in ToU schemes but leaving them option to opt-out will result in higher enrollment rate than making ToU optional initially;
- Increased awareness of consumers about the ToU pricing schemes and their potential benefits will lead to higher demand response rates;

US case study: Mandatory ToU price schemes had moderate impact on total system consumption due to the low engagement of consumers

At the beginning of 2006, the US introduced mandatory ToU pricing for residential consumers with the highest consumption rates. The aim of the program was to increase enrollment of consumers in ToU pricing schemes, since the voluntary ToU pricing schemes adopted before lead to low consumers' engagement and only 12% of consumers selected to be charged ToU basis under voluntary design and had modest effect on system peak consumption. ToU pricing scheme adopted by the US was simple, the consumers were charged at highest rates during on-peak periods and the lowest – during off-peak periods. Both rates changed on seasonal basis and consumers were paying higher rates during summer season. However, the success of the mandatory pricing was also low and the consumers' response to the new pricing design not fully matched the ToU pricing goals. This might be explained by a low awareness of consumers, since there was a little effort made to inform them about the benefits of ToU pricing schemes.

- In case of selecting the Static ToU design the seasonality of changes in on-peak and off-peak periods should be considered.

2.3 REVIEW OF THE ELECTRICITY SECTOR IN GEORGIA

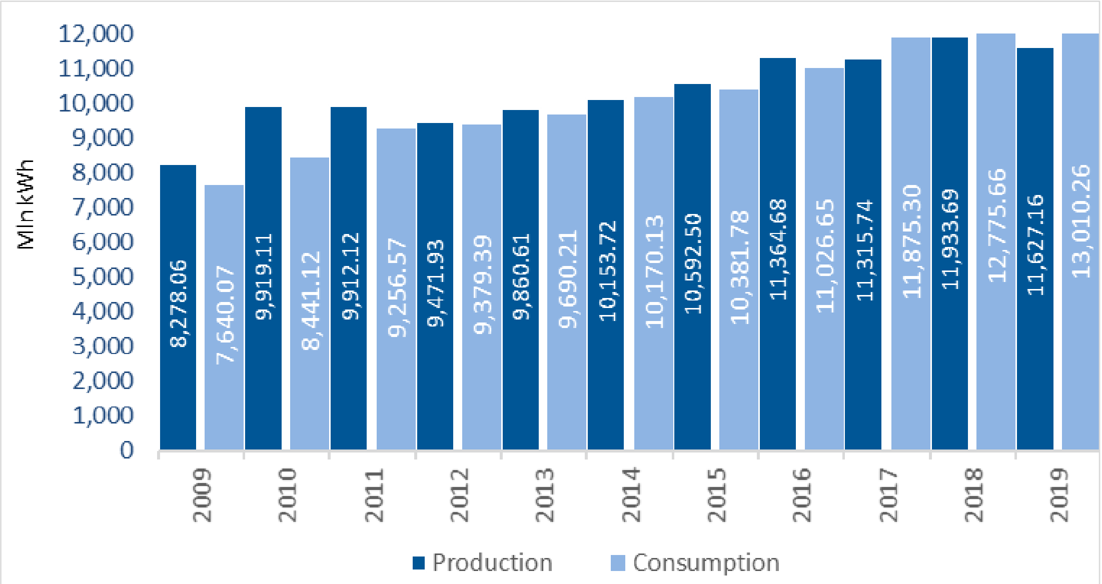
Electricity is one of the main energy sources in Georgia. Its share in the final energy consumption accounted for 23% in 2019 which was increased by 6.5% compared to the previous year. Final electricity consumption by industrial, transport and household sectors accounted for about 80% of total demand in Georgia.

The electricity market of Georgia can be conventionally divided into wholesale and retail markets. Wholesale market participants are electricity producers, direct consumers, exporters, importers, wholesale suppliers and distribution licensees (DSOs) as retail suppliers, as well as TSO, DSOs and Market Operator (MO). Retail electricity market participants are electricity distribution licensees, engaged both in network and supply activities, small power plants and final customers represented by household and non-household customer categories including micro power plants operated on renewable energy sources and owned by retail customers.

In 2019, electricity generation in Georgia was decreased by 2.5%, while electricity consumption increased by 1.8% compared to previous year. Main reasons for electricity production decrease was the worsened hydrology (see Figure 4).

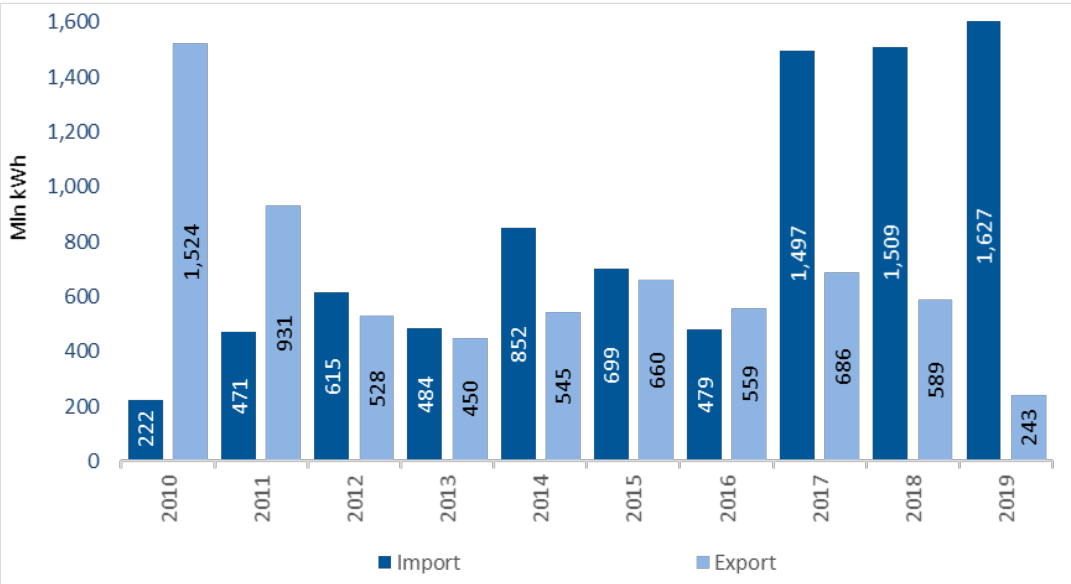
[21] https://www.utilitydive.com/news/california-utilities-prep-nations-biggest-time-of-use-rate-roll-out/543402/
[22] https://www.citizensutilityboard.org/blog/2019/05/10/did-real-time-pricing-help-electricity-customers-save-in-2018/

Figure 4: Annual Electricity Production and Consumption in Georgia



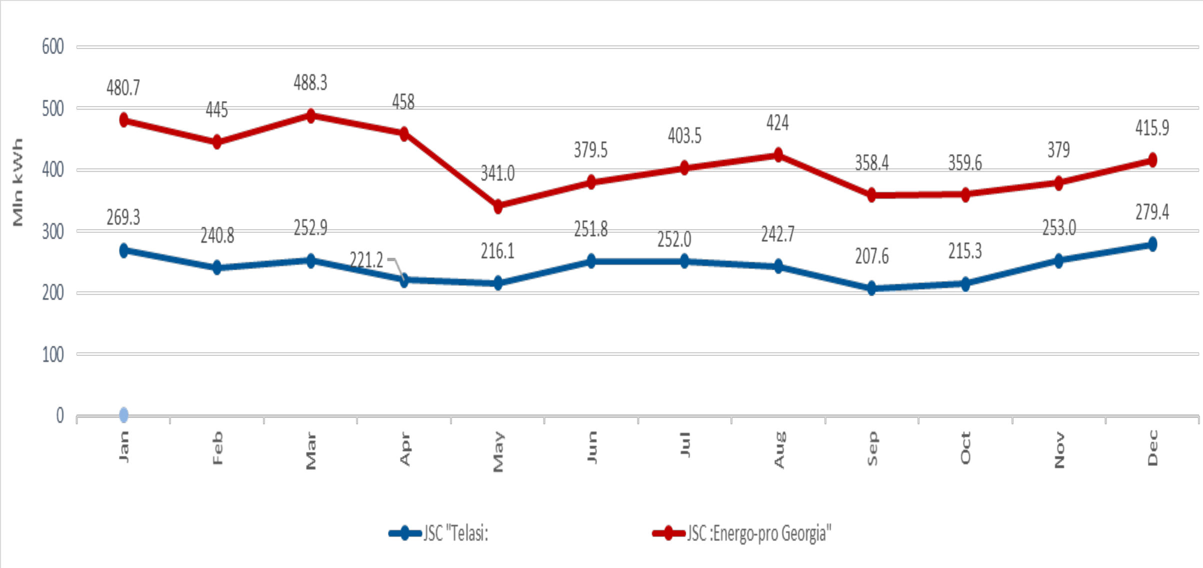
Compared to electricity production and consumption figures, electricity import exceeded import almost 7 times. In 2019, electricity import amounted to 1,627 mln kWh which is 7.8% higher compared to previous year. On the other hand, electricity export amounted to 243 mln kWh which is 2.5 times lower compared to previous year (see figure 5).

Figure 5: Annual Electricity Import and Export in Georgia



At retail level, JSC "Energo-Pro Georgia" owned 63% of the total retail electricity supply and JSC "Telasi" – 37% respectively in 2019 (see Figure 6). On the other hand, in 2018 electricity consumption by household customers in the service area of JSC "Energo-Pro Georgia" amounted to 33% and by non-household customers - 67% respectively. It should be noted that household customers' consumption decreased insignificantly (1%) but non-household customers consumption decreased significantly - by 25%. This mainly was attributed to policy change that enabled some of JSC "Energo-Pro Georgia's" customers to trade on the wholesale market as direct customers (see Figure 7).

Figure 6: Electricity Consumption by Distribution Licensees in 2019



In 2019, electricity consumption by household customers in the service area of JSC “Energo-Pro Georgia” amounted to 36% and by non-household customers - 64% respectively. Household customers’ consumption was decreased insignificantly (0.8%) and non-household customers’ consumption decreased by 1.2% (see Figure 8).

Figure 7: Electricity consumption in JSC "Energo-Pro Georgia" service area by consumer categories

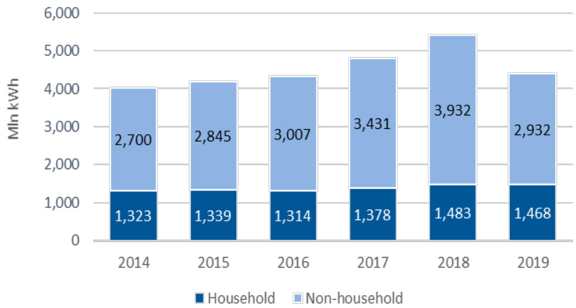
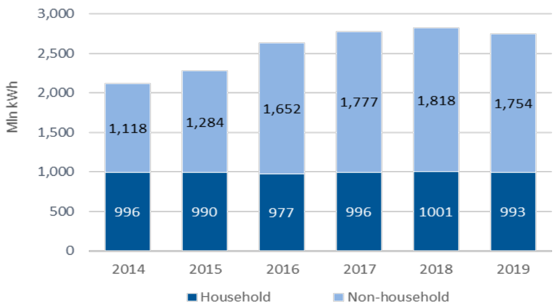


Figure 8: Electricity consumption in JSC "Telasi" service area by consumer categories



Net-Metering regulation in Georgia

Customers’ active participation in the retail market is the modern tendency of the electricity market development. Self-consumption and development of micro-generating energy sources is supported through net metering that has gained popularity in Georgia as well. According to the latest data collected by the GNERC, in total there were over 180 subscribers with installed capacity over 2.2 MW by the end of 2019. Number of subscribers using net-metering has increased significantly in comparison to the previous year. Net-metering enables customers to satisfy their own energy demand, deliver excess energy to the network and make respective settlements. No storage facility requirements are envisaged by the existing net metering regulation. No electronic meters with hourly metering capabilities are required at this moment, though DSOs have to install bi-directional meters that often contain hourly metering capabilities (but such capabilities are not used yet as monthly metering is applied in Georgia).

In 2019, GNERC amended the so-called net-metering regulation and allowed group connection of micro generators as these mostly are in common ownership of a neighborhood. Due to the technical peculiarities, for this scheme of connection, the physical connection of the micro generator grid with the consumer’s grid is now required, therefore separate metering for the micro generator and for consumers using the microgenerator is needed. This requirement converts such connection scheme automatically to “net billing” scheme. The distribution supplier allocates the generated kWh to the respective consumer’s bills according to the allocation formula. These regulation will give an impulse for the wider deployment of micro generators.

Further, the existing net metering regulation has been amended in June 2020 based on the new Law on Energy and Water Supply. Amendments of GNERC regulation envisaged increasing the maximum allowed installed capacity from 100 to 500 kW and abolishing the requirement obliging micro generation and consumption to be at the same physical location (introducing certain elements of so-called “virtual net metering”).

This particular regulation is interesting for the proposed RIA analysis due to the fact that it can allow/incentivize energy storage, load shift possibilities and even energy savings in case of introducing ToU tariffs. Distributed generation might play a key role in load flow optimization in the grid.

Overview of metering system in Georgia

At the time being, individual meters are installed almost at 100% of customers. However, there are different situations about metering requirements when it comes to different types of consumers. The only document that regulates technical standards for meters is the Georgian Grid Code approved by GNERC. Wholesale metering points, as well as consumers connected to the grid with at least 1 kV voltage and higher must satisfy metering standards for wholesale consumers. The Grid Code contains a chapter on wholesale metering points which requires that all such connection points must be equipped with electronic meters with at least half hour metering and data transferring capabilities. In practice, all wholesale consumers and consumers connected at 35 kV voltage are satisfying these requirements. On the other hand, not all big consumers who still are retail consumers of DSOs and are connected to the grid with 1 kV voltage or higher (mostly 6-10 kV consumers), satisfy this requirement. Furthermore, in 2018 GNERC adopted a decision obliging distribution companies and partially big consumers, who own such metering points, to comply with Grid Code requirements not later than the end of 2021. Around 1,800 metering points were identified throughout the country above 1 kV that are still not compliant with the Grid Code. Finalization of modernization works and equipping connection points with electronic meters will allow consumers connected to 1 kV voltage or higher to benefit from ToU application. In addition, it is worthwhile to mention that DSOs run automatic metering systems that gather hourly data from wholesale metering points and partially from industrial consumers and big commercial objects and transfer these data to the Georgian State Electrosystem’s (GSE) high level metering system.

However, for households and small commercial consumers (connected to lower voltage than 1 kV) such obligation and officially adopted decision do not exist whether or not to roll-out electronic meters. Such consumers have so-called “induction” meters with no capabilities of hourly metering and data transferring. The Distribution Grid Code (which is part of the Georgian Grid Code) contains a chapter on metering, specifically on metering systems in the distribution network and also a chapter on smart metering systems. The Distribution Grid Code does not oblige DSOs to deploy such meters but defines technical characteristics of smart meters and the possibility for consumers to request the installation or change of old meters with smart meters with the disclaimer that consumers will compensate the DSO for appropriate costs of such meter change. Even though no such compensation mechanisms, or pre-approved fees are adopted by GNERC. Despite the lack of regulation for introducing electronic meters at low voltage distribution networks , both DSOs started smart metering pilot projects, exposing particular residential areas to smart meters, arranging communication infrastructure and centralized software in headquarters that collects and analyzes hourly consumption data. It will be important input underlying assessment in terms of data analytics and information availability on hourly load profiles of households and their behavior in terms of energy consumption.

Massive deployment of smart meters would imply considerable investment costs, which on its side will influence distribution tariffs. Therefore, such decisions must be made based on wider cost-benefit analysis that may contain not only benefits of using ToU but also benefits from the improved metering, billing and consumer management processes stemming from the roll-out of intelligent metering systems and communication/IT infrastructure (see Table 6). Table 4 provides a number of connected customers or number of metering points in the distribution system).

Table 6: Number of Connected Customers Metering Points in Distribution System, 2019

Company	Residential	Non-residential	Total
JSC "Telasi"	572,909	39,062	611,971
JSC "Energo-Pro Georgia"	1,125,083	69,419	1,194,502

Overview of the electricity tariff system in Georgia

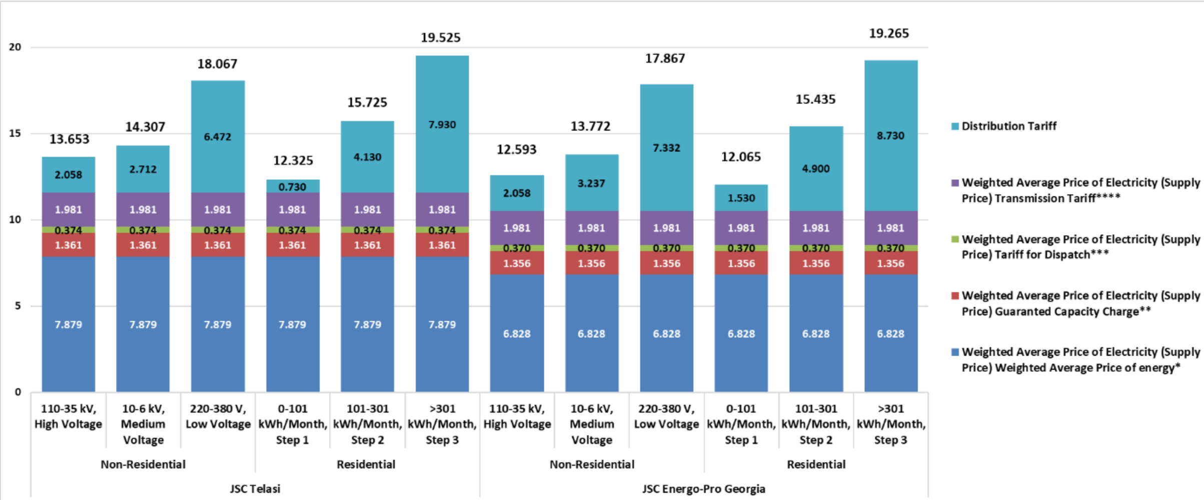
Newly adopted legislation in the energy sector – Law on Energy and Water Supply defined basis for introducing ToU pricing schemes in Georgia, namely article 29 which defines methodological background of the tariff system, provided that tariff may take into account different cost structures associated with different consumer classes and allows GNERC to implement different tariff designs, including tariffs for different time periods (at least peak and off-peak) of electricity consumption. As per the law, in order to achieve this task, innovative approaches and best international practices could be used.

Despite the provisions of the law and the ongoing market opening process, ToU schemes are not defined in the secondary legislation regulating tariff methodologies that is approved by GNERC. Current electricity tariff methodology was prepared under the first twinning project of GNERC with an EU partner, namely the Austrian regulatory authority - E-Control. Existing end-user tariff consists of two components, network and energy components. Allowed revenue is a key element of network-tariffs. GNERC defines DSO's allowed revenue for each regulatory period. Allowed revenue, Regulatory Cost Base (RCB) covers reasonable capital and operational expenditures (CAPEX, OPEX), Cost of Normative Losses (CNL), correction and service quality components. The CAPEX is calculated as the sum of return on Regulatory Asset Base (RAB) and depreciation. The Weighted Average Cost of Capital (WACC) approach is used to calculate the reasonable return on investments. The tariff methodology allows to reflect planned investments in the RAB for the regulatory period in advance and make an adjustment after the regulatory period ends according to the actual figures. This mechanism creates incentives for investments and helps electricity distribution licensees to attract scarce financial resources, which is a major constraint in emerging markets. As for operational expenditures, incentive-based regulation (RPI-X) is introduced. Taking into consideration the above mentioned, it can be concluded that the tariff methodology considers best European practice adjusted to Georgian reality.

The existing retail electricity market of Georgia is characterized by a monopolistic structure where two incumbent companies (JSC "Energo-Pro Georgia" and JSC "Telasi") supply electricity to retail customers. These companies also conduct distribution activities. No competition on retail supply is allowed, distribution companies have no possibilities to offer different sets of tariffs to customers. Retail tariffs are cost reflective and comprise all costs including energy supply and network components. Tariffs in Georgia are "kWh only" based and no capacity (subscription) fees are in place. Existing tariff methodologies do not involve possibilities to set ToU tariffs. Tariffs are set for a 3-year regulatory period for each distribution company based on different voltage levels and type of customers. Last regulatory period when GNERC set retail tariffs was 2018-2020 years which implies that at the end of 2020 tariffs will be recalculated for the next 3-year regulatory period. For small commercial (connection voltage 0.4 kV) and industrial consumers, connected to medium voltage (6-10 kV), tariffs are set by each voltage level while for household consumers, 3 step tariffs exist sorted with the ranges and tariff volumes presented below in Figure 9[23]. The intention of introducing step tariffs, with increasing values according to consumption, was to incentivize energy efficiency/energy savings, as well as to set up a social protection scheme for vulnerable customers.

[23] GNERC's Annual report for 2019 year

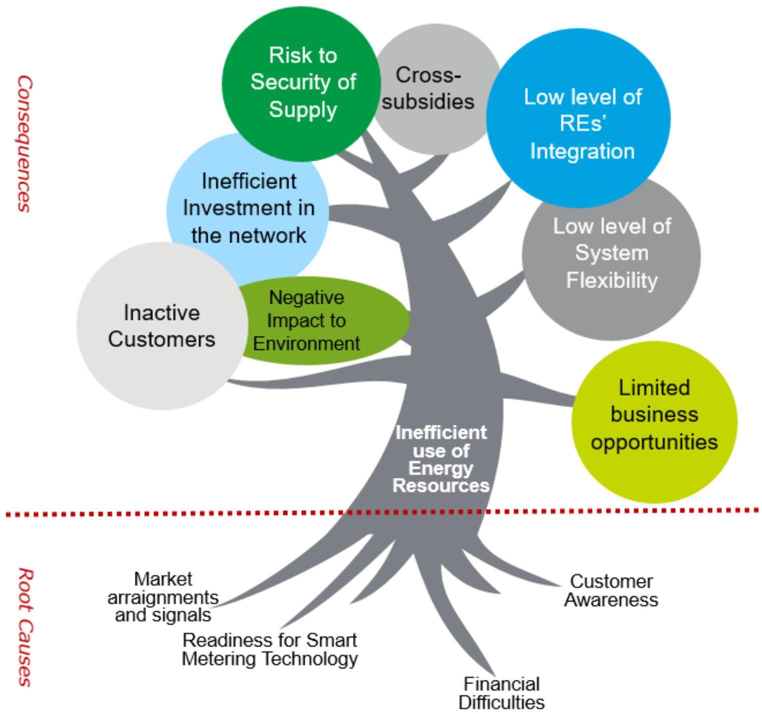
Figure 9: Electricity Final Consumption Tariffs for 2018 - 2020 Regulatory Period (Tetri/kWh)



2.4 PROBLEM DEFINITION

The aim of this chapter is to define the key problem, its causes and consequences. As a member of the Energy Community, Georgia has committed to develop its electricity market in line with EU market organization principles. The main purpose of the new Law on Energy and Water Supply is to introduce competitive wholesale and retail electricity market in Georgia with new market arrangements while existing market structure characterized as a monopolistic where network and retail supply activities are still bundled. Therefore, non-competitive market interlinked with other key root causes resulted in inefficient use of energy resources. Figure 10 provides description of problem tree.

Figure 10. Problem Tree of ToU



As indicated in Figure 10 the key problem is an inefficient use of energy resources. However, there are directly and indirectly associated root causes and consequences to it. Brief description of each root causes and consequences of ToU's problem tree.

Root causes:

- **Market arrangements and signals:** The existing legal and regulatory framework of the Georgian electricity market is characterized by a monopolistic structure where network and supply activities at retail level are still bundled. Currently, JSC “Telasi” operates in the Tbilisi area and JSC “Energo-Pro Georgia” – rest of Georgia. Retail customers are not allowed to change their suppliers and retail electricity supply tariffs are set by GNERC. The ongoing reforms in the Georgian electricity sector of aims to introduce competitive electricity market principles, unbundle network and retail supply activities which enable new market arrangements and signals for retail market participants and consumers.

- **Readiness for Smart Metering Technologies:** This root cause is also interlinked with the market arrangements and signals cause. There are no competitive market principles implemented yet such as competitive retail supply and supplier switching, therefore billing of electricity consumption is on monthly basis. On the other hand, DSOs are not interested and ready to roll-out smart meters at large scale because it requires significant investments in the network. High investment costs will cause the increase of end-user tariffs and consequently result in increased number of vulnerable customers. At the same time, based on previous years’ experience, DSOs implement only an 15-20% average of the approved and planned annual investments.
- **Financial Difficulties:** Taking into consideration the economic situation in Georgia, there are a significant number of customers (about 18.5% of total electricity customers[24]) struggling to pay their electricity bills. Investment in the network in order to efficiently manage electricity consumption requires significant financial resources which at the end should be paid by customers.
- **Customer Awareness:** Majority of existing Georgian retail electricity customers can be characterized as inactive consumers which have less developed consumption technologies and as a consequence experiencing low energy consumption compared to average consumers from developed countries. They do not react to system loading signals and moreover, such signals are absent due to the underdevelopment of infrastructure and the market (no congestion pricing and hourly market settlement). Therefore, they do not have motivation to change their behavior caused by financial difficulties and lack of awareness of possible new technologies/appliances that might reduce their electricity consumption and costs.

As a result, the Georgian electricity system has high seasonality pattern during summer and winter periods as well as considerable difference during peak and off-peak periods within a day (see Figure 11 and Figure 12)[25].

Figure 11: Fraction of Daily Electricity Consumption during Each Hour in Winter Period

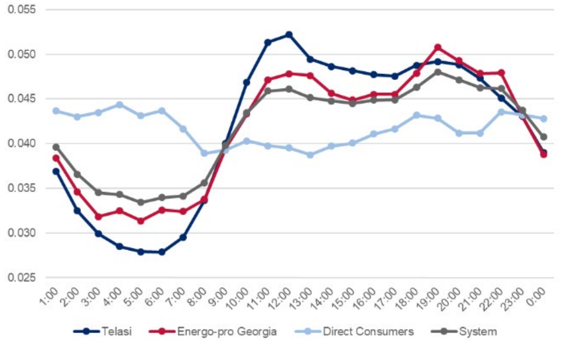
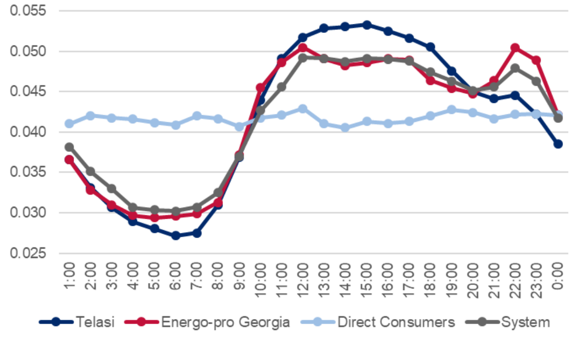


Figure 12: Fraction of Daily Electricity Consumption during Each Hour in Summer Period



It is obvious that peak and off-peak load difference is mostly influenced by distribution load patterns while industrial consumers (direct consumers) have stable and equal consumption and almost have no influence on hourly variation of system load. Hence, as indicated in the Figure 10 **consequences** of the key problem are the following:

- **Inefficient Investments in the Network:** Network developments such as new constructions and extensions, reconstructions and capacity increase are caused mainly by peak load increase in the system. However, such peak periods are only a few hours and they translate

[24] According to data of July, 2020 of Social Service Agency of Georgia, there are 313,455 Georgian households registered under Targeted Social Assistance Program.
[25] Source: Data provided by JSC “Telasi, JSC “Energo-pro Georgia” and JSC “Georgian State Electrosystem”

into investment inefficiencies. Such short period peak load could be avoided and re-allocated to other periods. At the same time, utilization of network assets is also low while peaking capacities are in most hours in idle as well as it increases electricity losses due to unequal load patterns and idle operation networks and transformers. In such cases investment costs also could be avoided that would enhance social-economic benefit.

- **Low level of system flexibility:** Unequally loaded network and generation assets may cause technical problems of voltage and overloading of network elements and as a result energy curtailment that means economic losses for society.
- **Negative Impact to Environment:** Higher losses in the network mean higher generation and therefore CO_2 emissions which could be decreased in case of ToU schemes' presence not only equalizing load and decreasing respective losses but also with energy saving effect which is associated with ToU schemes.
- **Inactive Consumers:** Existing Georgian electricity market legal framework and structure do not allow customers to have real free choice and behavioral changes. Such missed opportunities such as supplier switching as well as participation in demand response programs play an important role for competition and cost optimization both at national and individual customer level.
- **Limited new business opportunities**. Existing Georgian electricity market legal framework and structure is a market entry barrier for new retail suppliers. On the other hand, non-discriminatory treatment of all market participants in regard to network access is a key element for fostering competition on both wholesale and retail level. Hence without unbundling of network and supply activities, new suppliers have less chance to enter the market. In addition, unbundling and generally market and regulatory development create new business opportunities such as trading platforms, price comparison tools, metering, billing, demand side programs such as ToU scheme and etc.
- **Risks to Security of Supply:** System Operators are required to balance system and supply and demand physically. There is significant difference between demand during summer and winter periods as well as hourly peak and off-peaks within a day. System operator may need to import additional power during this period in order to cover peak demand for few hours. This results in the country's dependence on imported electricity and money-drain from the local economy as well as less efficient usage of local energy resources. During 2018-2019 years, electricity import from neighbouring countries has increased significantly and amount to about 10-15% of local demand.
- **Cross-subsidies:** One of the most vivid consequences of bundled electricity systems is cross-subsidy between network and supply activities. Cross-subsidy itself may prevent new entrants in the respective distribution area since incumbent companies have the ability to inflate network access tariffs and thus find reserves to reduce supply prices. In addition, cross-subsidization damages cost efficient operation of a network company and limits transparency.
- **Low level of RES' integration:** As the Georgian electricity system is not flexible enough, there is a low chance to promote VRES integration in the system.

Despite the fact that the key problem has generic roots and consequences, it makes still sense to evaluate the respective target groups in order to tap those potentials effectively that exist at the time being. Such problems for instance are the level of economic development of the country and consequently low technological development of the average consumer (and solvency of consumers) or financial problems of energy utilities. In Georgia, the average consumer consumes 1,450 kWh per year which is around 10 times lower than the average in developed countries. Energy tariffs are also lower compared to developed countries but there are still groups of consumers which are relevant for participating in ToU pricing and the number of such consumers will increase over the time. The development of the new electricity market regulatory framework and structure is one of the priorities for the country and it is an ongoing process at the time being. Therefore, it is expected that inefficient use of local energy resources is going to be mitigated over time as the market development process progresses. In this regard, the implementation of ToU scheme demonstrates to be one of the potential solutions along with the market development process.

3. POLICY OBJECTIVES

In order to conduct RIA on ToU pricing for household, commercial and industrial customers and correctly evaluate potential costs, benefits and regulatory impact on business as usual, it is vital to correctly define and set basic and specific objectives for the successful implementation of ToU schemes.

According to the results of stakeholder consultations and retail consumers' survey as well as taking into consideration international experience and the RIA problem to be addressed, the project team defined the following general, specific, and operational objectives.

General Objective:

Enhancing utilization of energy resources efficiently, which among others, implies efficiency of grid infrastructure by increasing customer participation.

Specific Objectives

Core objectives of ToU scheme implementation in Georgian electricity market are described and summarized below:

- *Improvement of Technical Capabilities: This objective aims at addressing infrastructure underdevelopment which hinders ToU implementation and market development in general. It contains:*

  a. *Hardware*: Advanced metering infrastructure is necessary to enable two-way communication between demand response participants and system operators. Advanced Metering Infrastructure (AMI) will also enable collection and storage of customer consumption profiles on an hourly or sub-hourly basis;
  b. *Software:* Energy management systems that can respond to electricity price signals and automatically adjust consumption according to the customers' preferences, such as during peak price periods;
  c. *Communication protocols:* Development of common interoperable standards to increase the coordination between consumers, system operators and suppliers.

- *Development of Regulatory Environment: This objective is related not only to ToU tariff scheme design but also to technical requirements for system operators, investment incentivization and enabling environment for market development:*

  a. *At Wholesale Level*: Allowing easier and equal access to the wholesale market to all kinds of flexibility service providers. Reveal the value of flexibility by a more granular market time representation;
  b. *At DSO Level:* Incentivize distribution system operators and consumers to adopt smart metering solutions, including innovative AMI and Information and Communications Technology (ICT) infrastructure financing models;
  c. *At Retail Supply Level*: Functioning of competitive retail market could provide innovative products and pricing models for various customer needs. Regulation should set clear roles and responsibilities for all market participants and service providers.

- *Ensuring Stakeholder Involvement: This objective is less costly but can be decisive for successful implementation as proper communication, transparency, data availability and equality are crucial:*

  a. Inform and allow consumers to engage in demand response programs and change to suppliers/retailers offering ToU tariffs;
  b. Data availability - access to consumption data and allowing tools to control and change load patterns greatly support consumer behavior change and turn passive consumers into active participants;
  c. Define customer categories, target groups for cost saving and load shifting potential and involve customers in the design of the ToU tariffs;
  d. Encourage pilot programs and disseminate results publicly.

Based on above mentioned objectives, ToU schemes can generate:

- *Cost-saving potentials for customers:* As electricity demand will increase in the future, electricity will substitute other energy sources and the demand for electricity will increase dramatically – especially for household customers and the service (commercial) sector. ToU tariff schemes represent an instrument that sets incentives to increase flexibility and leads to an optimized interaction between supply and demand. If customers change their consumption behavior due to different price signals throughout a day, they have the possibility to sustainably reduce the electricity costs. ToU tariffs primarily address residential customers. They have a relatively homogenous consumption structure and can easily be reached. Also, a large number of service-sector enterprises are similar to residential customers. Energy intensive sectors and the manufacturing sector are not usual customers that are addressed by standardized ToU models.

- *Positive results for the total economy:* while customers benefit from changing behaviors in the short-run, the entire system benefits from optimization and reduced necessity to invest into the infrastructure in the long-run.

According to results of stakeholder consultations and retail consumers' survey as well as taking into consideration international experience and project findings, ToU pricing scheme is applicable for Georgia but not in the short-term horizon. It requires AMI and ICT technologies to be introduced by DSOs and significant investments in the network respectively. At the same time, the electricity demand is rather low in Georgia compared to western/central European countries. Therefore, the potential for peak-shavings, shifting and saving are low. It should be also noted that as the economy grows in the country, electricity demand will increase in the mid-term and long-run as well as living conditions of Georgian population will relatively increase and they will start to spend more money on new technologies in order to improve living standards and quality of life. However, consumers must be convinced that ToU tariff schemes have a positive impact and that it is worth changing consumption behaviors.

4. BASIC ASSUMPTIONS AND PARAMETERS OF TOU TARIFF MODEL

ToU Tariff Model developed for the Georgian electricity market aims to generate a result whether ToU tariffs have a positive impact or not. This chapter provides an overview of basic assumptions and parameters applied for modeling the impact of ToU tariffs for different customer categories and for the whole electricity system while they have different characteristics and potentials to react on ToU pricing. At the same time, as electricity demand grows and technology develops, new consumer categories will appear in the future with new consumer behavior and response capabilities to price signals. Therefore, such consumer groups should be considered for constructing an adequate ToU model. On the other hand, new primary legislation is intended to support increase share of renewables and the decrease of CO_2 emissions in the country which in turn leads to the introduction of various programs that will boost innovative technologies over the next 20 years. Such technologies will be distributed generation, electric vehicles, heat pumps for heating and cooling, centralized cooling and heating facilities and etc.

4.1. KEY PARAMETERS AND ASSUMPTIONS

ToU Tariff Model incorporates an economic-oriented analysis which evaluates the costs and benefits for household and commercial customers as well as captures externalities such as reduction of CO_2 and electricity loss in the network. The ToU Tariff Model was calculated for household and commercial customers. The model is established on the basis of several key parameters and assumptions:

- Base year of the model is 2019;
- Model was calculated for the period of 20 years, from 2020 to 2040; the 20-year horizon for the CBA analysis is based on benchmarking and international experience;
- Model was calculated for 3 different policy alternatives:

Table 7: List of Policy Alternatives used in the Model

Name of Policy Alternative	Description of Policy Alternative
BAU	Status Quo (Do nothing). It assumes that no ToU tariff scheme is implemented and no smart meters are deployed. Our qualitative analysis assesses all the other policy alternatives against this alternative
Mandatory for All	ToU tariff scheme is mandatory for all household and commercial customers. It assumes that smart meter roll-out will be possible within 8 years
Voluntary	ToU tariff scheme is voluntary for household and commercial customers. It assumes that smart meter roll-out will be possible within 3 years

- Smart Meter roll-out plan and respective years for Mandatory and Voluntary policy alternatives are based on consultations with Georgian DSOs and GNERC;
- Mandatory and Voluntary policy alternatives applies a static ToU tariff scheme which is based on results of consultations with stakeholders and online survey of household and commercial customers as well as its advantages taking into consideration country specifics;
- Mandatory and Voluntary policy alternatives applies ToU tariff scheme for different time periods during a day according to the following structure:

Table 8: ToU Tariff Structure

Off-peak	Morning Peak	Afternoon Off-peak	Evening Peak
			

- In the ToU Tariff Model ToU tariffs were differentiated between green, red and yellow time periods/zones during a day (see Table 8). The green zone has a lower tariff during off-peak-times, the red zone implies higher tariffs during peak-times while the yellow zone as an intermediate time-zone during afternoon has tariff (approximately average) between off-peak and peak tariffs. ToU tariff levels were elaborated with the criteria that aims to minimize risk for DSOs/Suppliers for lost income due to the ToU tariff implementation. Details of the ToU tariff calculation methodology is provided in the Chapter 6 of the report.

4.2. HOUSEHOLD CUSTOMERS

Households represent a very important customer group for ToU tariffs. They have the largest share (see Table 6) in the retail market in terms of number of customers and electricity suppliers have to tailor specific products in order to address households' needs. In general households can be differentiated based on their load profiles while they use different sets of electrical appliances. Different household groups have relatively homogenous load profiles and can be easily targeted with variable tariff-models. One major assumption is that households can shift loads within a day and even reduce it due to their behavioural changes and save energy and costs. Hence, ToU tariff scheme is one of the best instruments to incentivise households to become active participants of the electricity market and to shift their loads from peak-times to off-peak times and reduce load as well. Taking into consideration international organizations'[26] future development trends of the global energy sector, electricity will become a more important source for various energy related services (for example, heating and transport). Therefore, it is necessary to define different types of households.

One important starting point for the definition of different household types is the report "Energy Consumption in Households" by GEOSTAT[27]. The data of GEOSTAT provide a solid overview about the electricity demand of households. The most important key figures of households' electricity consumption can be summarised as follows:

- 6.4% of the households are using electricity for heating;
- Each household has on average 1.09 TVs;
- 94% of the households have a refrigerator/freezer;
- 78% of the households have a washing machine;
- 24% have a microwave oven;
- 59% have a computer;
- 9.1% of the households are using an air conditioner.

Furthermore, the data from GNERC's annual reports were used for the model concerning household customers[28].

- The total electricity demand of households amounted 2.460 TWh[29] in 2019;
- The annual average household consumption was approximately 1,450 kWh[30] in 2019;

Information gathered from GEOSTAT and GNERC show that the electricity consumption per capita in Georgia is rather low compared to central and western European countries[31]. In general, Georgian households are equipped with standard household appliances but it is obvious that electricity is not commonly used for space and water heating and saturation level of cooling devices is rather low. Based on collected data on different consumers included load profiles provided by the DSOs standard load profile of average consumer was calculated that constitutes 3.97 kWh of daily consumption with load profiles for winter and summer seasons based on the data provided by DSOs. Based on hourly fractions of the average household consumer's daily electricity consumption, and winter and summer periods load curves derived the consumption amounted to 3.97 kWh each day on average.

Furthermore, for modelling purposes other household types were also defined due to their use of different technologies and due to the future development of specific technologies. At the same time, hourly load curves for winter and summer periods derived for all different household types. These load curves are the quantitative base for the impact assessment of the ToU tariffs for household

[26] International Energy Agency
[27] „Energy Consumption in Households", National Statistics Office of Georgia, 2017
[28] GNERC's Annual report for 2019 year, https://gnerc.org/files/Annual%20Reports/Reports%20English/2019%20En.pdf
[29] This figure is taken from GNERC's Annual report for 2019 year
[30] Own Calculations
[31] Source: Eurostat, https://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_and_heat_statistics#Consumption_of_electricity_per_capita_in_the_households_sector

customers. For modelling purposes, household customers were divided into 5 types as shown in Table 9.

Table 9. Types of Household Consumers

Types of Household	Standard household appliances	AC cooling (flow based)	Heating (flow based)	Heating/Cooling system with storage	Electric vehicle (EV)
Type I	X				
Type II	X	X			
Type III	X		X		
Type IV	X			X	
Type V	X	X			X

Below basic parameters of those technologies are provided which relate to each type of household consumer and which influence or will influence future consumption patterns of these consumer types. At the same time, the share of household consumers based on their types for the starting point is also provided. Shares of households for Type I, Type II and Type II for the starting point in the Model is based on data from GEOSTAT's report on "Energy Consumption in Households". GEOSTAT's reports provide the percentage of customers using air conditioners for cooling at 9.1% (Type II) and percentage of customers using electricity for heating at 5.7% (Type III). Hence, the rest of households customers are considered to be Type I household customers in 2017 while shares of Type IV and Type V household customers considered to be at 0%. On the other hand, based on international benchmarking as well as on the country specific situation in terms of overall socio-economic conditions and affordability of respective technologies, the Model assumes that the share of Type IV household customers will increase from 2026 (0.03%) and Type V from 2025 (1%). At the same time the Model incorporates projected shares of each household types for 2041 year. Hence, shares of each household types from respective years (2017 in case of Type II and Type III; 2026 for Type IV and 2025 for Type V household customers) linearly decreased and/or increased respectively in order to reach projected shares for 2040. It should be noted that the annual share of Type I household customers is calculated as a difference between total share of household customers (100%) and the sum of shares of Type II, Type III and Type IV household customers (see Table 10).

Household Customer: Type I

Type I household is a typical average household with the following characteristics:

- Standard equipment of household appliances (fridge, washing machine, lighting and IT-equipment);
- They do not use electricity for heating;
- They do not use electricity for cooling;
- They do not use electricity for cooking.

Based on the descriptions above, the Model incorporates that approximately 82.3% of total households are Type I in the base year. Individually a Type I household customer consumes roughly 2.88 kWh daily during both summer and winter periods.

Household Customer: Type II

Type II households use electricity for cooling. In general, these households are equipped like Type I but have an additional load due to cooling. Based on the descriptions above, the Model incorporates that approximately 12.48% of the total households are Type II in the base year. Individual Type II household customer consumes roughly 2.88 kWh daily during winter while 14.5 kWh during summer period.

Household Customer: Type III

Type III households use electricity for heating. In general, these households are equipped like Type I but have an additional load due to heating. Based on the descriptions above, the Model incorporates that approximately 5.22% of the total households are Type III in the base year. Individual Type III household customer consumes roughly 19.1 kWh daily during winter while 2.88 kWh during summer period.

Household Customer: Type IV

Type IV households use heat pumps with reservoirs in order to accumulate heat or cool air. In general, these households are equipped like Type I but have an additional load due to heating pump operation. Despite that the share of such consumers will not be high, flexibility and therefore value for ToU tariff schemes for such households are significant because of the storage system. Based on the descriptions above, the Model incorporates that there are no Type IV household customers in the base year. Individual Type IV household customer consumes roughly 40.8 kWh daily during winter while 6.7 kWh during summer period.

Household Customer: Type V

Type V households use electric vehicles as well as air conditioning. In general, these households are equipped like Type II but have an additional load due to the charging of electric vehicles. Despite the fact that the share of such consumers will not be high, flexibility and therefore value for ToU tariff schemes for such households are significant. Based on the descriptions above, the Model incorporates that there are no Type V household customers in the base year. Individual Type V household customer consumes roughly 17.88 kWh daily during winter while 29.45 kWh during summer period.

Based on above mentioned different types of household customer types the Model uses following assumptions:

- Different types of households are subject to dynamic development over the time period of the model;
- Different load-curves were developed for all types of households for winter and summer periods;
- Different types of households have different levels of electricity demand and different potentials to shift loads and electricity savings during peak periods throughout a day;
- Higher the difference between peak and off-peak tariffs, the higher is the probability that households shift loads and electricity savings;

In the future, development of households and equipment will depend on different factors:

- Availability of technologies;
- Growing reliability of technologies;
- Economies of scale;
- Price of electricity;
- The decreasing price for equipment and installations;
- Development of real and disposable income of households;
- Policies and subsidy schemes of the government and other institutions.

While the number of household customers increases over years, the average increase between 2014-2019 years was 1.8%. At the same time, according to Geostat's data, the population in Georgia as of 1st of January 2020 is 3,716.9 thousand person. On the other hand, based on the World Bank's database the population in Georgia is going to decrease and by 2040 will reach 3,405 thousand persons[32]. Overall rate of decrease between 2020-2040 years is 8.25%. Therefore, the model is based on the assumption that the population growth rate will relatively decrease over years and in 2040 it will be 1%. On the other hand, the share of household customers will linearly decrease from annual 1.8% to annual 1% over the model's time horizon. As the different types of households imply different demand levels and different potentials for peak-shaving and savings, increase in the number of households is a crucial parameter for the model. The Model also incorporates general redistribution as well as growth rates in order to estimate the development of the different types of households (see Table 10).

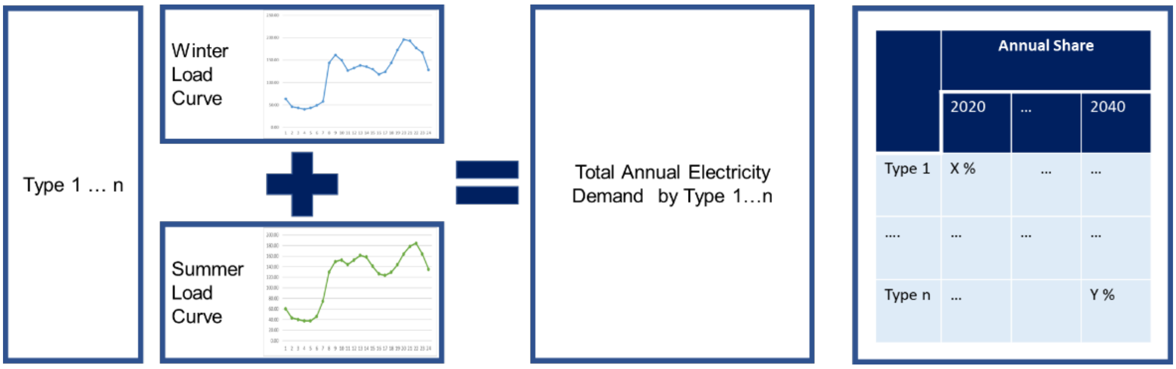
Table 10. Structure of Household Consumers

Types of Household Customers	2020	2025	2030	2035	2040
Number of Household Customers	1,727,556	1,873,501	2,014,198	2,146,695	2,268,047
Type I	82.3%	76.48%	66.10%	55.54%	45%
Type II	12.48%	18.11%	23.74%	29.37%	35%
Type III	5.22%	4.41%	3.61%	2.80%	2%
Type IV	0.00%	0.00%	0.88%	1.94%	3%
Type V	0.00%	1.00%	5.67%	10.33%	15%

[32] Source: World Bank's database: https://databank.worldbank.org/reports.aspx?source=Health%20Nutrition%20and%20Population%20Statistics:%20Population%20estimates%20and%20projections#

The electricity demand of households was calculated based on a bottom-up-approach. As described previously, after defining the number of customers and their shares up to 2040 and individual load curves for winter and summer periods, annual figures were derived for each type of customer. Finally, the annual value of the consumer number was multiplied with the annual consumption of each type of consumer in each individual year. Figure 14 provides a summary of the electricity demand for each year in the Model.

Figure 14: Calculation Process of the Electricity Consumption for Household Customers



The Status Quo and Mandatory policy alternatives reflect the sum of all different types of household consumption where total household electricity demand is driven by the shares of each type of household and the increasing number of metering points or customers. On the other hand, under Voluntary policy alternative not all households participate in a ToU tariff scheme. Unlike Status Quo and Mandatory policy alternatives, the project team used results from stakeholder consultations and adjusted by the project team's judgement. Therefore, Voluntary policy alternative incorporates rates of household customer participation in order to derive consumption of each type of household and the total household electricity demand over the model time horizon. Table 11 provides an overview of participation rates of different types of households. The assumption is that the participation depends on the level of demand and penetration of technologies. Less technologically developed consumers will have less motivation to participate in ToU tariff scheme and vice versa. Those types of households with higher demand (Type IV and Type V) have the highest share.

Table 11. Household Consumers' Rate of Participation in the ToU Tariff Scheme

Types of Household Customers	Consumers agree to participate in ToU Tariff Scheme
Type I	5%
Type II	10%
Type III	20%
Type IV	80%
Type V	80%

For Mandatory and Voluntary policy alternatives, where ToU tariffs are applied in the analysis, household customers reduce load during peak-times. At the same time, based on technology and household characteristics, the Model assumes that part of the reduced load is saved, and another part is shifted from peak-times to off-peak-times. The general assumption is that households with potential "shiftable" loads have the technical requirements and the behavior to do that. Therefore, it is assumed that the following loads can be shifted from peak to off-peak-zones for household customers:

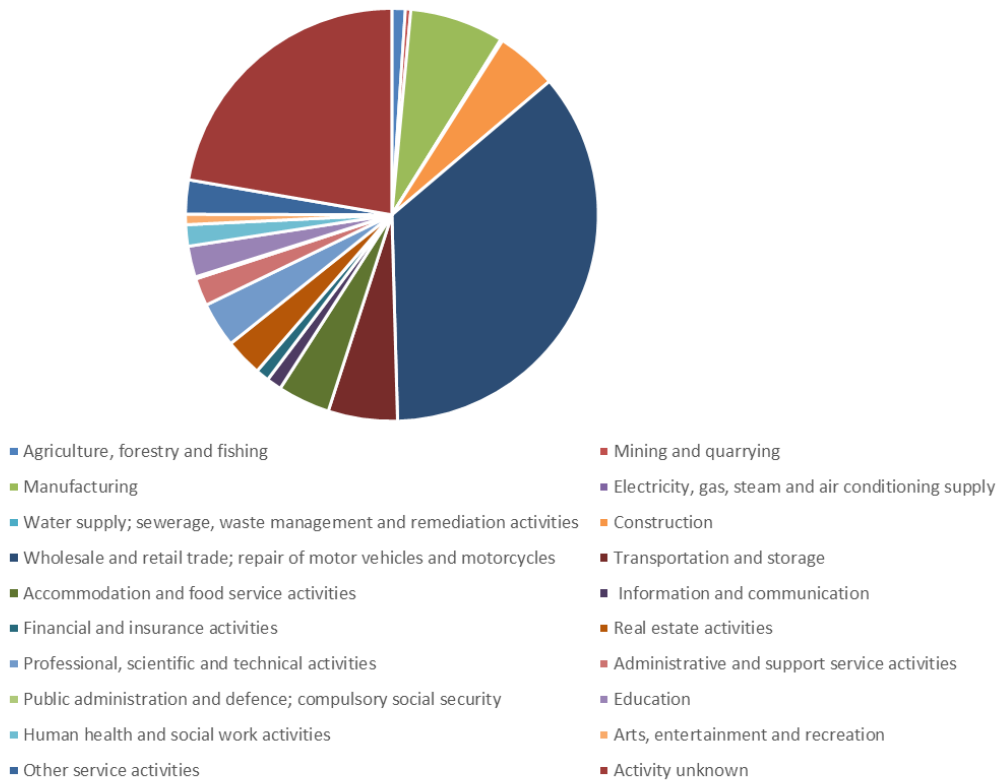
- Washing machines;
- Tumble dryers;
- Dishwashers;
- Heating-systems/Warm-water with boilers;
- Charging of electric vehicles;
- Electrical stove but only to limited extent;

On the other hand, heating systems and air conditioning are assumed to be not shiftable and are rather subject to energy saving. More detailed description of household customers load characteristics is provided in Annex I.

4.3. COMMERCIAL CUSTOMERS

The commercial sector has a very dominating role in the Georgian economy. According to GEOSTAT more than 780,00 enterprises are registered out of which more than 185,000 is active and nearly 500,000 people are employed where most of the active enterprises are rather small with a low number of employees (see Figure 15). Hence, a large number of active enterprises are also relevant for future ToU tariff schemes. In order to estimate the energy demand of different segments appropriate data and/or assumptions are necessary. It is important to note that commercial companies are heterogeneous in the sense of the energy demand. Even in the same segment the energy demand can vary due to different factors such as equipment type, daily working cycle, type of cooling and heating, etc.

Figure 15: Shares of Active Enterprises in the Commercial Sector as of July 1st, 2020



As shown in Figure 15 the commercial sector is dominated by wholesale and retail trade (35.7%) while the rest of activities constitute 64.5% of the commercial sector. Hourly data of electricity consumption were not available for different activities listed in Figure 15, however annual electricity consumption and number of customers were provided by DSOs. For modeling purposes these commercial enterprises were clustered in 5 different groups based on their electricity shares and similarities in the electricity load profiles. Hence, ToU Tariff Model assumes following types of commercial customers for 6/10 and 0.4 kV voltage levels:

- *Type I: Wholesale and Retail trade:* it is rather heterogeneous with a wide range of different branches and different energy demand structures such as supermarkets, shopping malls, fashion stores, grocery shops, bakeries, souvenir stores, drug stores, sport stores, etc. Based on DSOs data 6/10 kV customers consume approximately 1,329.5 kWh and 0.4 kV customers – 50.2 kWh daily.
- *Type II: Hotels and restaurants:* it is very heterogenous and covers a lot of different business types and enterprises such as hotels, guest houses, restaurants, bars and etc. These different types of businesses have different demand structures and different applications in use. Based on DSOs data 6/10 kV customers consume approximately 2,569.9 kWh and 0.4 kV customers – 101.6 kWh daily.
- *Type III: Construction:* Due to the similarity of electricity load profiles as well as missing data this type of commercial customer group is assigned for several sectors such as agriculture, forestry and fishing, mining and quarrying, manufacturing and construction. Based on DSOs

data 6/10 kV customers consume approximately 1,536.2 kWh and 0.4 kV customers – 67.5 kWh daily.

- *Type IV: Office Buildings:* Due to the similarity of electricity load profiles as well as missing data this type of commercial customer group is assigned for several sectors such as electricity, gas, steam and air conditioning supply, information and communication, financial and insurance activities, real estate activities, professional, scientific and technical activities, administrative and support service activities public administration and others. Based on DSOs data 6/10 kV customers consume approximately 1,671.3 kWh and 0.4 kV customers – 42.8 kWh daily.
- *Type V: Transport:* Based on DSOs data 6/10 kV customers consumes roughly 4,023.1 kWh and 0.4 kV customers – 61.29 kWh daily.

Based on above mentioned different types of commercial customers the Model uses following assumptions:

- Different types of commercial customers are subject to dynamic development over the time period of the model;
- Different load-curves were developed for all types of commercial customers for winter and summer periods;
- Different types of commercial customers have different levels of electricity demand and different potentials to shift loads and electricity savings during peak periods throughout a day;
- Higher the difference between peak and off-peak tariffs, the higher is the probability that commercial customers shift loads and electricity savings;

In the future the commercial customers' electricity consumption behavior will depend on various factors:

- Availability of technologies;
- The growing reliability of technologies;
- Economies of scale;
- Electricity prices at retail level;
- Decreasing price for the equipment and the installations;

On average between the years of 2014-2019 the number of commercial customers was increasing by 4.9% for 0.4 kV voltage level and by 3.5% for 6/10 kV voltage level. As the ToU Tariff Model for commercial customers is also based on bottom-up approach, the rate of increase for 0.4 kV voltage level customers will relatively decrease over years and for 2040 year will be 3.5% while for 6/10 kV voltage level customers – 2.5% based on consultations with Georgian DSOs. Similar to household customers, growth rate of the number of commercial customers between 2021-2039 years is linearly decreased. The Model also incorporates growth rates of commercial customer groups to estimate the development of the different types of commercial customers. On the other hand, due to lack of data on the projections of structural changes of Georgia's economy, shares of different types of commercial customers is fixed[33] over the whole period of the analysis (see Table 12 and Table 13).

Table 12.a. Number of Commercial Consumers (0.4 kV)

2020	2025	2030	2035	2040
119,985	150,354	185,634	225,807	270,606

Table 12.b. Structure of Commercial Consumers (0.4 kV)

Types of Commercial Customers	2020 – 2040 Years
Type One	19.40%
Type Two	1.18%
Type Three	2.64%
Type Four	76.24%
Type Five	0.54%

Table 13.a. Number of Commercial Consumers (6/10 kV)

[33] Since there is not officially availably long-term sectoral GDP growth rate, we use shares of commercial customers based on their electricity consumption in the total electricity consumption of commercial customers.

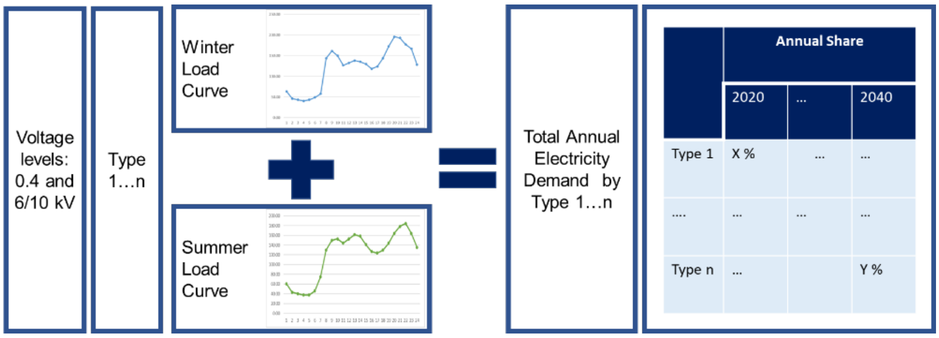
2020	2025	2030	2035	2040
3,246	3,821	4,449	5,123	5,835

Table 13.b. Structure of Commercial Consumers (6/10 kV)

Types of Commercial Customers	2020 – 2040 Years
Type One	11.60%
Type Two	2.20%
Type Three	11.00%
Type Four	71.70%
Type Five	3.50%

Electricity demand for commercial consumers separately for 0.4 kV and 6/10 kV voltage levels was also calculated based on a bottom-up approach similarly to household customers. After defining the number of customers and their shares up to 2040 and individual load curves for winter and summer periods, annual figures were derived for each type of customer. Finally, the annual value of the number of consumers was multiplied by the annual consumption of each type of consumer in each individual year (See Figure 16).

Figure 16: Calculation Process of the Electricity Consumption for Commercial Customers



Status Quo and Mandatory policy alternatives reflect the sum of all different types of commercial customers’ consumption for different voltage levels where total electricity demand is driven by the shares of each type of commercial customers with different voltage levels and the increasing number of metering points or customers.

For calculation of total electricity demand of commercial customers all different types of commercial customers’ consumption for different voltage levels were applied for Voluntary policy alternative. However, under Voluntary policy alternative not all commercial customers participate in a ToU tariff scheme. Unlike Status Quo and Mandatory policy alternatives, project team used results of stakeholder consultations were used and adjusted by project team’s judgement. Therefore, Voluntary policy alternative incorporates rates of participation of commercial customers as well, in order to derive each type of households consumption and total household electricity demand over the model period. Table 14 provides an overview of participation rates of different types of commercial customers under different voltage levels.

Table 14. Commercial Consumers’ Rate of Participation in the ToU Tariff Scheme

Types of Commercial Customers	0.4 kV Consumers agree to participate in ToU Tariff Scheme	6/10 kV Consumers agree to participate in ToU Tariff Scheme
Type One	50%	30%
Type Two	50%	30%
Type Three	50%	30%
Type Four	50%	30%
Type Five	50%	30%

For Mandatory and Voluntary policy alternatives, where ToU tariffs are applied in the analysis, commercial customers reduce load during peak-times. Also, based on technology and commercial customers’ types, the model assumes that part of the reduced load is saved, and another part is shifted from peak-times to off-peak-times. The general assumption is that commercial customers with potential shiftable loads have the technical requirements and the behavior to do that. On the other hand, heating systems and air conditioning are assumed to be not shiftable and are rather subject to energy saving. More detailed description of commercial customers load characteristics is provided in Annex II.

4.4. INDUSTRIAL CUSTOMERS

Before developing the ToU Tariff Model, the project team examined load profiles of customers on different voltage levels. Analysis showed that 35-110 kV voltage consumers in the distribution network, mostly industrial customers, have the same load profiles as consumers who are connected to the transmission network on same or higher voltages. Such consumers in most cases are already participants of the wholesale market and the rest who are not yet, will become wholesale market participants according to the new electricity market concept design of Georgia. In the figure below distribution network connected big consumer's (at 35/110 kV) hourly consumption of random 14 consecutive days in winter and summer periods are shown. Consumption pattern shows almost no peak and off-peak seasonality nor significant daily variations.

Figure 17: Hourly Consumption of 35/110 kV Consumers During Summer Periods

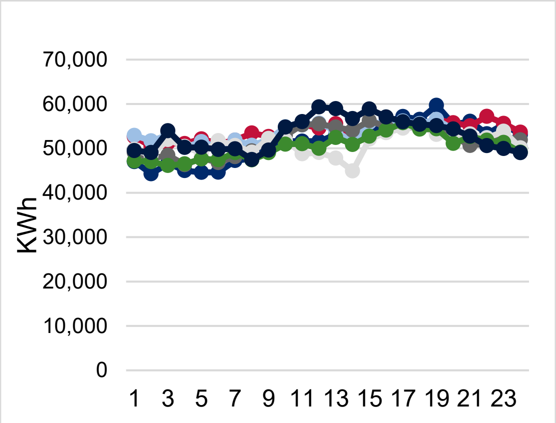
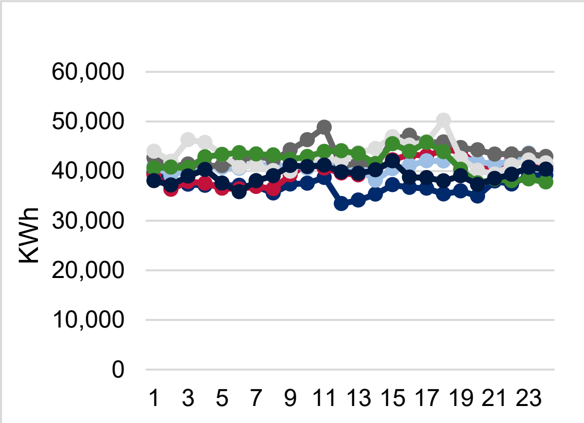


Figure 18: Hourly Consumption of 35/110 kV Consumers During Summer Periods



As analysis revealed, the problem of varying consumption lays down in medium (6/10 kV) and low (0.4 kV) voltage consumption. Unlike higher voltage connection, medium and low voltage consumers are the main target group attractive for ToU tariff schemes. Therefore, due to the above-mentioned facts, industrial consumers connected to the 35/110 kV are not included in the ToU analysis, however, certain small scale industrial consumers who are 6/10 or even 0.4 kV consumers, are envisaged in the analysis of commercial consumers.

5. CONSULTATION PROCESS

Stakeholders' engagement is a crucial part of the RIA process to catch all possible impacts and identify potential challenges related to the implementation of the proposed regulatory changes. The aim of stakeholders' consultations conducted throughout the assignment was to validate assumptions made for the analysis, as well as understand stakeholders' attitude and vision regarding introduction of the ToU pricing system in the retail electricity market of Georgia.

The group of stakeholders that will fall under influence or will have an influence on the introduction of the ToU pricing mechanisms are divided into the following groups:

- *The state agencies involved in the decision-making process*
    - MoESD;
    - GNERC.
- *Electricity Distribution System Operators:*
    - JSC "Energo-Pro Georgia";
    - JSC "Telasi"
- *The private companies providing supporting services such as providing installation services of Smart Meters and data hub management service:*
    - LTD "GIOTI"
- *End-users of electricity:*
    - Large consumers;
    - Commercial consumers;
    - Household consumers.

Different stakeholders were included in the RIA process. The impact of ToU pricing processes on different stakeholders is presented in Table 15 below. The table provides the project teams' assessment of respective stakeholders and their level of impact and influence of the implementation of ToU pricing in Georgia.

Table 15: Stakeholders' Influence / Interest Matrix

Interest/Influence	Low influence	High Influence
Low Interest	Large Consumers	Residential Consumers Commercial Consumers
High Interest	Distribution System Operators: • JSC Energo-Pro Georgia • JSC Telasi Private companies providing supporting services (e.g. importing, producing or providing installation service of the smart meters, microgeneration solar systems, etc.)	MoESD, GNERC

Brief description of main responsibilities of the selected stakeholders in ToU pricing is the following:

- **The Ministry of Economy and Sustainable Development (MoESD)**

The Law of Georgia on Energy and Water Supply entitles MoESD in charge of determining National Energy Policy and Strategy which includes measures supporting integration of smart technologies in the energy transmission and distribution infrastructure, as well as, facilitating energy efficient consumption by applying effective demand-side-management tools. Therefore, MoESD is one of the key stakeholders that has direct power to influence implementation of ToU pricing mechanisms in Georgian electricity market.

- **Georgian Energy and Water Supply Regulatory Commission (GNERC)**

GNERC is responsible for regulating and supervising the electricity, gas and water supply sectors. GNERC is in charge of electricity market monitoring, elaborating tariff setting methodology, as well as setting tariffs for electricity transmission, distribution and supply. GNERC will directly be engaged in the implementation process of the ToU pricing mechanisms in the Georgian electricity market because according to the Law on Energy and Water Supply, GNERC is responsible for developing regulatory strategy for roll-out of smart metering systems as well as designing and implementing ToU pricing schemes. This includes defining the suitable model for ToU pricing schemes compliant with the current conditions and future developments in the Georgian electricity market, as well as setting up ToU tariff schemes for different time periods. Therefore, GNERC is among stakeholders that have higher influence and interest in the introduction of ToU pricing mechanisms in Georgian electricity market.

- **Distribution System Operators (DSO)**

Currently, there are two DSOs operating in the Georgian electricity market: JSC “Telasi” and JSC “Energo Pro Georgia”. They perform electricity supply and distribution activities to the end-users at retail level. However, considering upcoming changes in the electricity market organization in Georgia, the supply and distribution activities will be performed by independent companies and DSOs will perform only electricity distribution activities.

DSOs belong to the group of stakeholders that will fall under direct influence of the introduction of the ToU pricing schemes. The establishment of ToU pricing schemes will influence DSOs in the following way: since the ultimate goal of ToU pricing is to facilitate more efficient consumption of energy and relax the peak load on the system which leads to more efficient performance of the electricity system and lowers investment requirements in the network infrastructure. However, the changed behavior of consumers due to the introduction of the ToU pricing might alter the revenues obtained by DSOs.

Since DSOs will be directly affected by introduction of the ToU pricing mechanisms, they have higher interest regarding the proposed changes. However, they have a little influence on the decision-making process.

- **Supporting Service Providers**

Supporting service providers are companies engaged in importing, producing and installing equipment that assists end-users in accounting and controlling their electricity consumption. Since the ToU pricing scheme facilitates energy-efficient consumption behavior of end-users, the adoption of ToU pricing will gradually increase demand for smart meters, smart appliances, installation and management services, as well as home-based solar systems that help consumers to manage electricity consumption throughout the day.

Currently, there are few companies that provide such types of services, due to low demand. However, with introduction of ToU pricing it is expected that the number of such types of businesses will grew over time. Therefore, such companies have higher interest in implementing ToU pricing mechanisms in Georgia, although their influence on the process is relatively low.

- **End-users of Electricity**

The end-users of electricity are divided into three different groups: Large consumers that are eligible to purchase electricity directly from wholesale markets i.e. from organized market and bilateral contracts market from electricity producers, retail suppliers, traders, commercial and residential consumers that purchase electricity from electricity retail suppliers and receive electricity from the respective DSOs in Georgia.

Currently, there are 16 large consumers on the Georgian electricity market. They represent large-scale industrial manufacturers with rigid load curves. These companies have scheduled production processes and less flexibility to adjust their consumption electricity price changes during the day as it was analyzed in previous chapters. Large consumers already have stable and equal hourly load curves and therefore, they have less interest as well as low power to influence the introduction of ToU pricing mechanisms in Georgia.

The residential and commercial consumers represent one of the influential groups that can contribute to the successful introduction of the ToU pricing mechanism in Georgian electricity market. They have a relatively flexible load curve and have more possibility to adjust their daily consumption to the electricity price changes during the day. However, due to the low awareness of the local population on the benefits of ToU pricing scheme, currently their interest in the new pricing model is very low. Therefore, the success of the ToU pricing scheme also largely depends on the measures applied for increasing awareness of population and small businesses regarding ToU pricing mechanism and potential benefits obtained from this tariff scheme.

Results from Stakeholders’ Consultations

Due to the restrictions imposed under the State of Emergency Situation related to the outbreak of the Covid-19 instead of the face-to-face consultations, the interviews with stakeholders were conducted by using online tools such as e-mails through structured questionnaires. Two separate questionnaires were constructed for each group of stakeholders considering their influence and interest in the implementation of the ToU pricing mechanism in Georgian electricity market. The questions designated for MoESD, GNERC, DSOs and other market players were aimed to understand their attitude and perceptions, as well as capture potential risks related to the implementation of ToU pricing schemes in Georgia. Details of stakeholder consultations is provided in Appendix II of the report.

There are following key notes obtained from the consultations' with MoESD, GNERC, DSOs and providers of the supporting services:

- General attitude of stakeholders' regarding the introduction of ToU pricing scheme is positive. All stakeholders (MoESD and GNERC, as well as DSOs) agree that existing tariff scheme are not compliant with European pricing models, it does not serve to mitigate investment costs in distribution network caused by rising peak load in winter and summer periods and that introduction of ToU pricing will contribute to manage peak load in the system and reduce network investment costs;
- None of stakeholders see in ToU pricing missing income risks for DSOs/Suppliers;
- Convergence of stakeholders' opinion, in regard of how much consumer will go for ToU scheme in case it is optional, is around 20%;
- According to decision making stakeholders less than 5-year period will be enough for implementing ToU pricing (including modernization of metering points) and 1-2 year in case ToU tariffs are optional, while DSOs think that more than 7 years will be needed to implement mandatory ToU scheme.
- All stakeholders agree that the introduction of the static ToU pricing model will be a more rational option for the initial period. However, over time gradual transition towards dynamic ToU pricing will contribute to enhance benefits by facilitating adequate responses of the consumption to the actual system condition.
- All stakeholders consider that ToU pricing mechanism is most attractive for residential consumers, as they have more flexibility to respond to changes in electricity tariffs throughout the day.
- All stakeholders think that main technology that will have higher impact on electricity consumption will be electric vehicles, some of the stakeholders think that such technologies also may be heat pumps and electric heating.
- Stakeholders' have different views regarding voluntary or mandatory subscription to ToU price schemes. The supporters of the mandatory schemes argue that under voluntary schemes the adoption rate will not be sufficient enough to relax system load. On the other hand, there are several risks associated with mandatory ToU schemes – mostly related to high investment cost and complexity for implementation. Not in all cases the ToU scheme is effective and acceptable. Without strong communication and awareness raising campaigns, the consumers who are not educated about ToU pricing schemes, might not adjust their demand to the changing prices throughout the day and may finally face higher energy bills. Lastly, vulnerable consumers have also less flexibility to benefit from ToU pricing schemes, therefore, under mandatory schemes, additional measures should be applied to protect vulnerable consumers from increased expenses on their electricity bills.

The separate questionnaire was developed for household and commercial consumers, with the aim to understand current consumption behavior and capture expected response of consumers to the introduction of ToU pricing schemes in Georgia. Due to the COVID-19 situation, end-users interviewing was online based using Google online tool which was disseminated via online channels such as AYPEG's Facebooks page and webpage.

The information derived through the survey greatly contributed to build and validate key assumptions for the RIA. In the survey, more than 300 consumers were engaged, among which 95% were households and 5% businesses. Among households, almost all are permanent dwellers in their living place, as regards to commercial, different sectors were captured, such as warehouses (including cold storage), office, beverages and food production, hotels, restaurants and service sector. Hence, household's influence results of the interview greatly compared to commercial users. Households, as it was understood are from city residents and certain cases, responses are above average observation in the country. Main conclusions that were taken from the interviews are as follows:

- Electricity is not used for heating purposes in majority, but responses gave enough feedback to rely on GEOSTAT's data;
- In case consumers are using electricity heating, they keep switched on heaters in most of the period of a day in November-March period;
- Around 25% of consumers who use electric heaters, regulate temperature automatically. Majority of such consumers do not use control to regulate electric load for heating;
- Most of consumers, who currently do not use electricity for heating, are not going to switch to electricity heating in future (only 7% responded positively to this question);
- Around 60% of households use ACs for cooling[34];
- Most of consumers use ACs in June-September period, and 3-5 hours during daytime;
- More than 55% of consumers do not regulate AC cooling temperature during operation and only 42% set ACs on auto mode;
- 37% of consumers who have no ACs, gave clear answer that they are going to purchase it in next years and 30% is not decided yet;
- 5% of consumers have electric vehicle[35] and 3.5% other type of electric mobiles (bike, scooter);
- Majority of electric vehicle owners connect it to the grid to charge in the period 18:00 – 24:00;
- 47% of consumers, who have no e-vehicles at the time being, are going to own them in next few years;
- More than 40% of consumers cannot control their electricity consumption;
- Majority of interviewees expressed interest and readiness to participate in ToU schemes;
- Basic technologies, in regard to which majority interviewees agreed to save electricity consumption during peak technologies, are conditioning, lightening, electric ovens, dishwashers and electricity heating, while basic technologies, in regard to which majority interviewees agreed to shift electricity load from peak periods to off-peak periods, are electric vehicles, ovens, washing machines.

The survey revealed that electricity loads are not controlled by the consumers due to the lack of interests/incentives and ToU pricing can contribute not only load shaving but also energy efficiency and saving.

[34] That is significant deviation to GEOSTAT data regarding usage of ACs, which equaled 9.1% in 2017. Despite variation, GEOSTAT data was used to model base year but for escalation purposes of different types of consumers using ACs, AYPEG interview results were taken into account in order to model AC penetration up to 2040 year. In comparison to GEOSTAT survey, AYPEG's survey was filled out mainly by residents of Tbilisi and therefore results are overestimated

[35] That is, according to our consideration, a higher value than the average situation in Georgia. If we generalize it for the whole population the number of EVs would be 60,000 while statistics for November 2018 shows only 1,392 EVs.

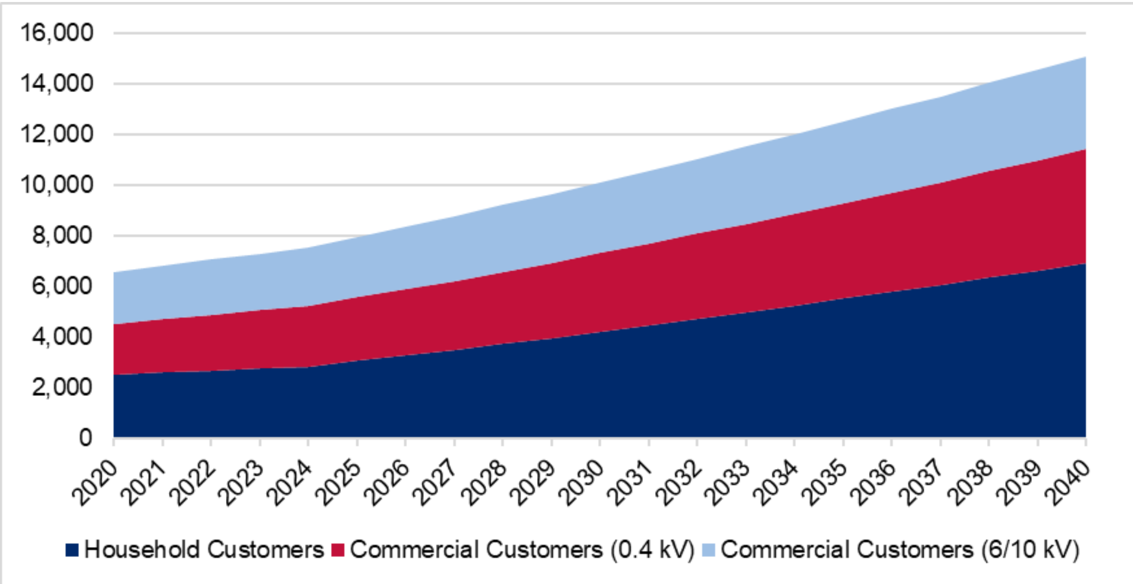
6. POLICY ALTERNATIVES AND SCENARIO ANALYSIS

For addressing the identified problem and policy objectives of proposed RIA, ToU Tariff Model was developed in order to derive economic-oriented analysis which evaluates the costs and benefits for household and commercial customers as well as captures externalities such as reduction of CO_2 and electricity loss in the network. While identified RIA problem is an inefficient use of local energy resources recent level of electricity demand and its future development are fundamental parameters of the ToU-Tariff Model. In general, it can be assumed that the electricity demand will increase in Georgia over the next decades. There are several factors that will drive the future increase:

- GDP and real incomes are increasing;
- Economic activities will grow;
- Household demand will increase due to additional appliances and applications;
- Due to the developments in Europe also in Georgia the use of Electric Vehicles (EV) and the use of electricity for heating and cooling will increase;
- Efficiency increase of electrical appliances will be overcompensated by a higher penetration with equipment.

As the ToU Tariff Model is designed for a period of 20 years and calculated for household and commercial customers using bottom-up approach. Hence, based on calculations in the Model the projected electricity demand[36] of different sectors under Status Quo will increase on average 4.2% and amount to 15,077 GWh by 2040 which is 2.3 times higher compared to 6,570 GWh of electricity consumption in 2020 (see Figure 18). For household customers electricity demand will increase by 5.2% on average annually and amount to 6,904 GWh which is 2.7 times higher compared to 2,533 GWh of electricity consumption in 2020. On the other hand, electricity demand for commercial customers at 0.4 kV voltage levels will increase by 4.2% on average annually and amount to 4,512 GWh which is 2.25 times higher compared to 2,000 GWh of electricity consumption in 2020, while for commercial customers at 0.4 kV voltage levels – by 3% on average annually and amount to 3,660 GWh which is 1.8 times higher compared to 2,036 GWh of electricity consumption in 2020.

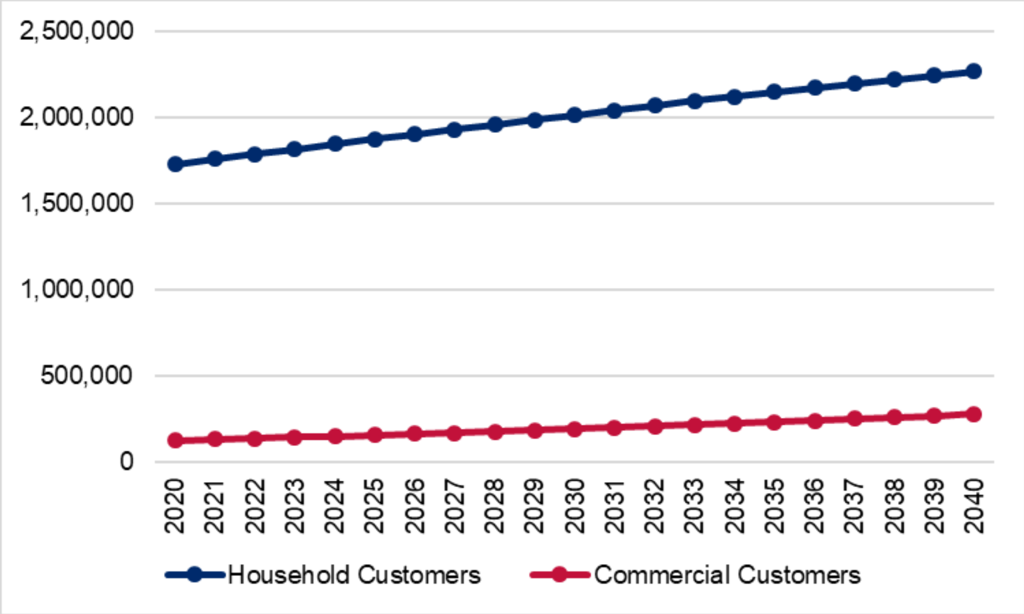
Figure 19: Electricity Demand Projections by Customer Categories under Status Quo in GWh[37]



The increase of electricity demand within different customer categories influenced by increase in number of customers together with other factors described in Chapter 4 of this report.

[36] Policy alternatives are analyzed only for household and commercial (0.4 and 6/10 kV voltage levels) customers and they do not provide projections for electricity demand for whole Georgian electricity system.
[37] Own Calculations

Figure 20: Projected Number of Customers (Metering Points) by Customer Categories[38]



Taking into consideration above mentioned development trends Status Quo policy alternative will require to satisfy increased electricity demand with more expensive electricity sources such as import as well as investing relatively significant amount in network developments which will be reflected in the tariff. However, it should be noted that these actions will not promote efficient electricity consumption as well as optimal development of the network.

Calculation of end-User Tariffs

For the purpose of analyzing ToU tariff impact and effect on customers projected end-user tariffs (separately for transmission, distribution, electricity purchase and other system services) were developed for all policy alternatives taking into consideration GNERC's tariff methodologies. However, for electricity end-user tariff projections in the long-run, reasonable assumptions for the development of the DSOs' capital (CAPEX) and operational (OPEX) expenditures are needed. In addition to this, one of the main parameters is return on investments, which is calculated using the WACC approach and set by GNERC for each regulatory period (3 year). Since return on investments might have significant impact on electricity tariffs, the project team estimated expected WACC development across next regulatory periods based on historical data and past experience.

According to existing electricity tariff methodology[39], CAPEX for respective tariff year, is sum of depreciation/amortization of the RAB for the corresponding tariff year and the return. To estimate RAB and depreciation for the next tariff years, investments of the DSOs' has to be estimated. While the distribution network in Georgia is far from a perfect condition and WACC is one of the highest in the region, investment growth rate is expected to be maintained. Based on the data starting from 2016, investments in distribution networks have been forecasted. At the same time, implementation level of investments in the network in 2020 year were assumed at 20% of average rate (17.14%) of investments' actual implementation during 2017-2019 years in order to capture the COVID-19 effect on the investments.

As it was already mentioned, regarding operational expenditures incentive-based regulation (RPI-X) was introduced by GNERC starting from 2014. The project team followed the same approach to estimate operational expenditures for the next tariff years. On the other hand, OPEX for 2020 (approved by GNERC in 2017), has been taken as starting point for further calculations. Long-term inflation rate forecasts are taken from IMF's and Ministry of Finance of Georgia's prognoses. Efficiency factor (X), is set by GNERC at 1.5% for the next regulatory period. Since it is impossible to maintain current level of efficiency improvement in the long-run, it is expected that the X-factor will be reduced over the next regulatory periods.

[38] Own calculations
[39] GNERC's resolution №14 on Methodology for Calculating Electricity Tariffs adopted in 2014

As for WACC valuation, Capital Asset Pricing Model (CAPM) has been used. To capture country and foreign currency exchange rate risks, yield to maturity on long-term Georgian government bonds was considered as a risk-free rate. Country risk is calculated based on the Georgia's sovereign rating (Moody's sovereign rating)[40]. Market premium has been calculated as a difference between mature capital market return and US long-term treasury bond rates. Finally, there is no evidence or precondition for sectoral risk coefficient (beta coefficient) to deviate from 0.84, which is set by GNERC for electricity sector utilities (2018-2020). Details of main parameters for end-user tariff calculations is provided in the Table 16.

Table 16: Main Parameters Used in Tariff Calculations

Description	2020	2021-2023	2024-2026	2027-2029	2030-2032	2033-2035	2036-2038	2039-2041
Inflation rate	6.0%	3.7%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
X factor	1.5%	1.5%	1.5%	1.0%	1.0%	0.5%	0.5%	0.5%
WACC	16.4%	15.1%	13.8%	13.3%	12.7%	12.5%	11.4%	11.4%

Furthermore, DSOs tariffs which include also supply of electricity were calculated for each voltage levels. At the next step, for Mandatory and Voluntary policy alternatives tariffs at 0.4 and 6/10 kV voltage levels were reallocated within ToU tariff zones based on the following approach:

- <u>*Off-peak tariffs:*</u> Based on benchmarking as well as analyzing the system and each consumer categories' load profiles, electricity consumption during off-peak hours are very low which implies that electricity demand can be satisfied by cheap source of electricity generation. Hence, ToU tariff in this time zone should be also low taking into consideration opportunity of system operators to cover their costs. Therefore, for this time zone ToU tariff equals to the sum of network tariffs (transmission and distribution network) and price of cheap electricity. For calculating price of cheap electricity weighted average annual price of regulated power plants[41] were used adjusted by inflation rate over years.
- <u>*Peak tariffs:*</u> unlike to off-peak tariffs, electricity consumption during peak time zones are very high. Electricity demand in this time zone will be satisfied not only by cheap but also the most expensive sources of electricity generation. Therefore, for this time zone ToU tariff equals to sum of network tariffs (transmission and distribution network) and the price of the most expensive electricity. The most expensive electricity assumed to be import. Hence, weighted average annual price of imported electricity in 2019 year[42] were used adjusted by inflation rate over years.
- Afternoon off-peak tariffs: While electricity consumption in this time zone can be considered as average of peak and off-peak time zones taking into consideration benchmarking, end-user tariffs calculated for 0.4 and 6/10 kV voltage level were applied.

It should also be noted that distribution network tariffs for Mandatory and Voluntary policy alternatives takes into account the respective costs and benefits of the ToU tariff scheme implementation and DSOs CAPEX and OPEX are adjusted respectively. Calculated tariffs for Mandatory and Voluntary policy alternatives over modeling period is provided in the Annex III.

[40] Aswat Damodaran website
[41] Calculation of weighted average prices is based on tariffs set by GNERC for respective regulated power plants as well as their annual electricity generation figures for 2019 year from the ESCO's Electricity Balance for the year of 2019.
[42] Calculation of weighted average prices is based on Geostat's data on total amount of money spent on electricity import in 2018 year as well as figures of imported electricity for 2019 year from ESCO's Electricity Balance for the year of 2019.

7. COMPARISON OF POLICY ALTERNATIVES

As described previously this report applies 2 options for analyzing impact and effect of ToU tariff scheme to household and commercial customers:

- *Mandatory for All:* ToU tariff scheme is mandatory for participation for all household and commercial customers. It assumes that smart meter roll-out will be possible within 8 years;
- *Voluntary:* ToU tariff scheme is voluntary for participation for household and commercial customers. It assumes that smart meter roll-out will be possible within 3 years.

Roll-out plan of smart meters, that is prerequisite for the ToU implementation, is shown in the table below. In case of first option, 8 years for roll-out is considered based on the international practice, as well as feedback from the local DSOs.

Table 17: Roll-Out Plan of Smart Meters

Description	2020	2021	2022	2023	2024	2025	2026	2027 -2040
Mandatory	0%	15%	30%	45%	60%	75%	90%	100%
Voluntary	0%	33%	66%	100%	100%	100%	100%	100%

The ToU Tariff Model and cost-benefit analysis is not constrained to one specific stakeholder group but performs a comprehensive analysis for household and commercial customers and also captures externalities. Therefore, implications for households and commercial customers, system operators, energy suppliers and the environment are taken into account. More specifically, we allocate the cost and benefit categories derived from benchmarking are summarized below (See Table 18).

Table 18: Indicators of Cost and Benefit of ToU Tariff Scheme

Dimension	Indicator	Stakeholder
Costs resulting from the roll-out of smart meters	Smart Meter Unit Costs	System Operators / Suppliers
	Smart Meter Installation Costs	System Operators / Suppliers
	Communication Infrastructure	System Operators / Suppliers
Costs resulting from the operation of smart meters	Operational Expenditure for Smart Meter	System Operators / Suppliers
Operational efficiency gains	Avoided Meter Readings	System Operators / Suppliers
	Reduced Billing Processes	System Operators / Suppliers
	Reduced Disconnection cost	System Operators / Suppliers
	Reduced Maintenance Costs	System Operators / Suppliers
Reductions in network losses	Reductions in Losses	System Operators / Suppliers
Sustainability	CO_2 Reductions	Environment (Externalities)

Furthermore, the Model applies Social Discount Rate (SDR) of 7.6%. In this regard, Yield to Maturity (YTM) on government securities used as a proxy for SDR in order to discount net cash-flows in the model. While Georgian securities market is not sufficiently liquid and government securities are undervalued, it is supposed that the return on Georgian government bonds is higher than risks associated with holding them. Taking into account the above mentioned fact, it is better to assess Georgian risk-free rate based on long-term US treasury bond rates. As a result of global pandemic lockdown, investors try to leave the emerging markets, capital is moving back to the developed markets and return on US Treasury bonds is falling. In order to calculate the risk-free rate in local currency (GEL), Georgian country risk[43] must be added to the YTM of US Treasury bond rate. While sovereign ratings are the same in both, local and foreign currencies and CDS (credit default swap) based country default risk might only partially cover the risk related to the emerging market currency fluctuation (FX risk), it would be reasonable to include inflation differential analysis. Inflation differential of two currencies (GEL, USD) can be easily calculated based on IMF[44] database about consumer price index.

In this chapter, the costs and benefits for different stakeholders as well as the environmental externalities are introduced and quantified. In addition, net present values resulting from Option 1 and Option 2 are presented.

[43] Aswat Damodaran website
[44] IMF World Economic Outlook

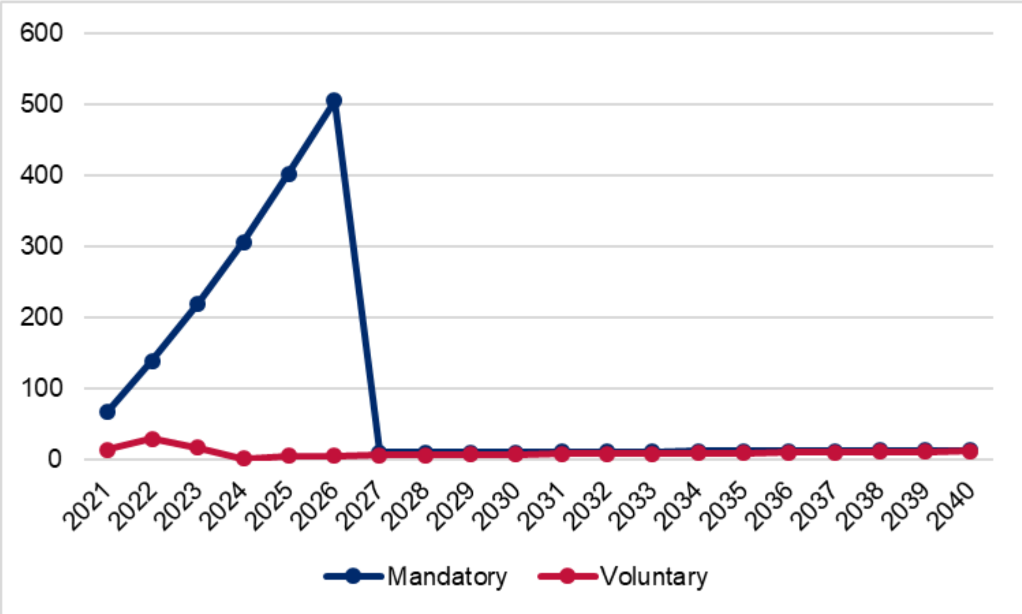
7.1. COSTS FOR THE SYSTEM OPERATORS

In the ToU Tariff Model, following costs for the system operator are analyzed:

- smart meter unit costs;
- smart meter installation costs;
- smart meter communication infrastructure costs;
- smart meter operation costs.

With respect to smart meter unit costs, the project team used data received from the Georgian operators. In order to correctly differentiate costs of smart meters between different policy alternatives, the project team solely considers costs for smart and ordinary meters. Therefore, the Model uses unit cost of smart meter at 228 GEL without Value-Added Tax (VAT) and cost of ordinary meter at 40 GEL which is based on information provided by Georgian DSOs. Furthermore, the unit cost is increased by the inflation rate over the modeling period. Finally, by multiplying this value by the number of meters to be rolled out annually, costs of smart and ordinary meters derive (See Figure 21).

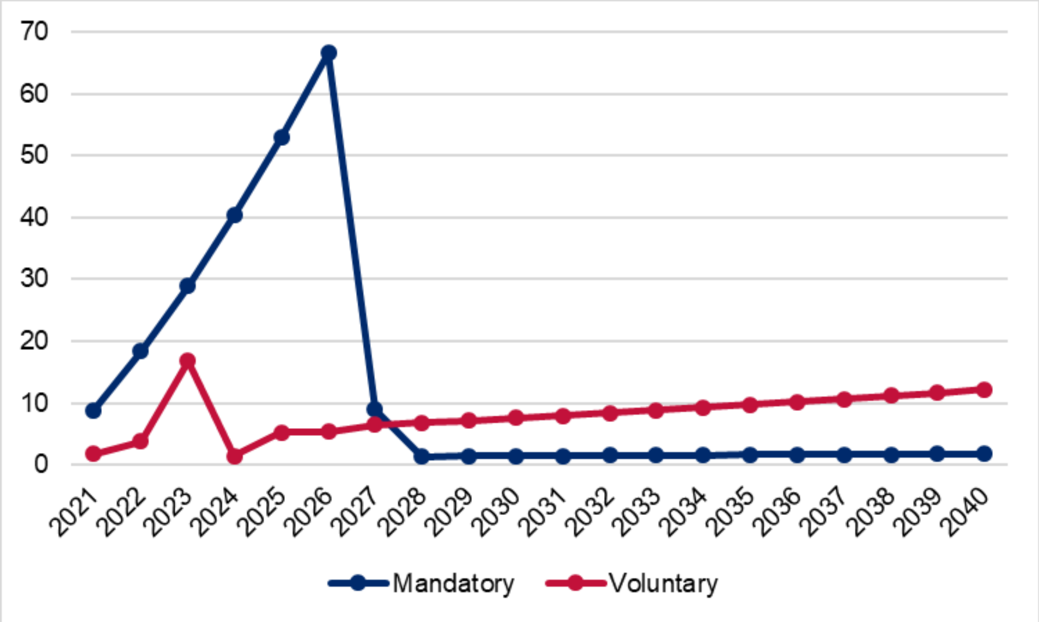
Figure 21: Costs of Roll-out of Smart Meters in mln GEL[45]



At the next step the installation costs for smart meters are calculated. Based on information provided by DSOs the installation cost does not differ from those of ordinary meters. Therefore, installation costs for smart meters is considered at 30 GEL per metering point which is based on information provided by Georgian DSOs (See Figure 22).

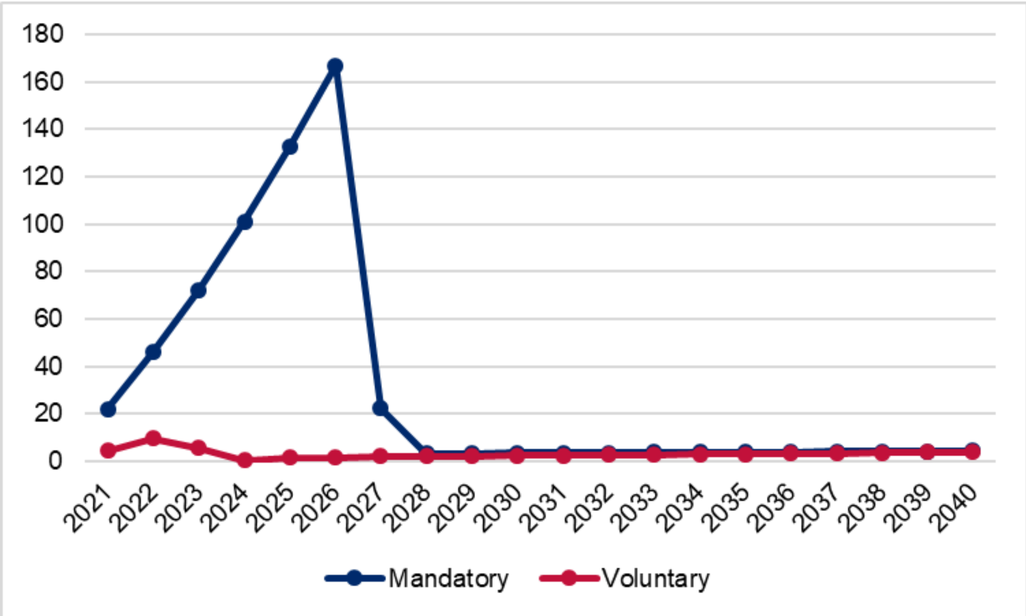
[45] Own Calculations

Figure 22: Costs of Smart Meters Installation in mln GEL[46]



Furthermore, communication infrastructure for smart meters is accounted for at 33% of the smart meter unit price[47]. It should be noted that specific communication infrastructure and the exact technology of data transfer has not yet been determined. Nevertheless, costs for communication infrastructure considers in the model will be able to cover all the costs which will materialize in the future. The costs can be summarized as follows (See Figure 23).

Figure 23: Costs of Smart Meters' Communication Infrastructure in mln GEL[48]



7.2. BENEFITS FOR THE SYSTEM OPERATORS

There are number of benefits for the system operators is associated with the roll-out of smart meters:

- Avoided meter readings costs;
- Avoided billing costs;

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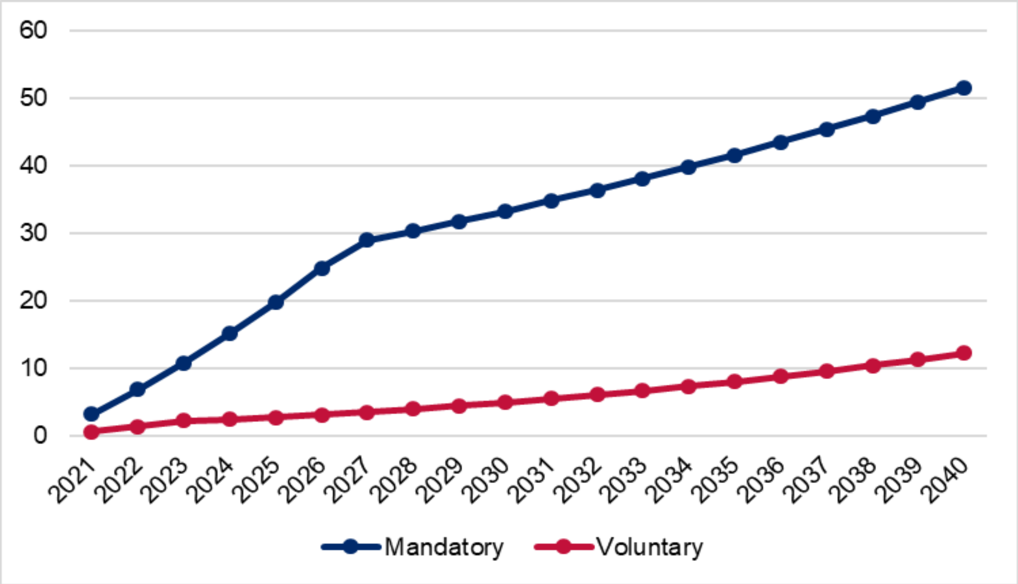
[46] Own Calculations
[47] This assumption is based on European Commission's report on Guidelines for Cost Benefit Analysis of Smart Metering Deployment
[48] Own Calculations

- Avoided disconnection cost;
- Avoided meter maintenance cost.

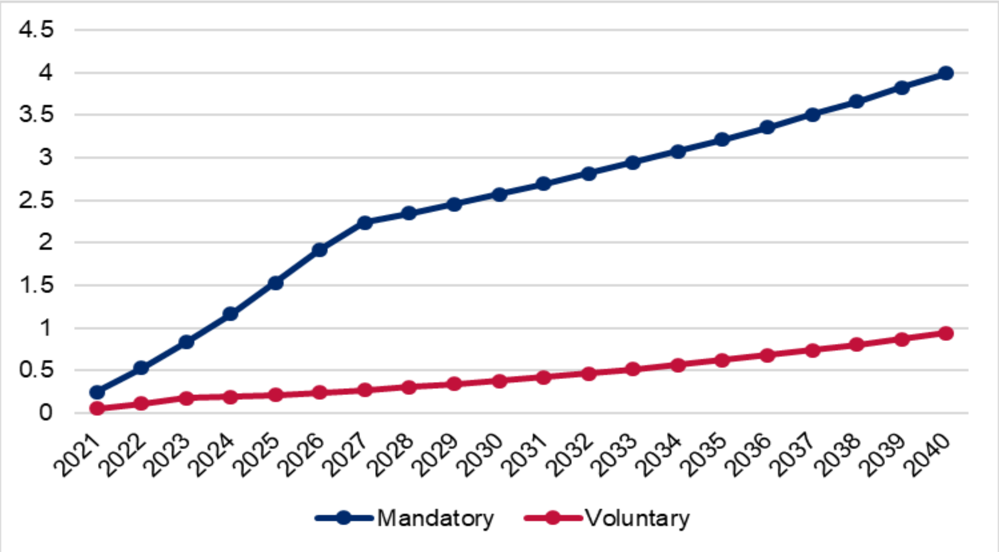
The benefits from avoided meter readings are monetized by multiplying the annual meter reading time[49] with an hourly wage rate[50] and number of metering points taking into consideration the different roll-out plan under Option 1 and Option 2 policy alternatives (see Figure 24).

Figure 24: Avoided Meter Readings Costs in mln GEL[51]



In terms of avoided billing costs, based on data provided by DSOs weighted average for administering billing amounts to around 20 minutes per metering point and year. Therefore, the Model incorporates the potential for billing cost reductions at 50%[52] (see Figure 25).

Figure 25: Avoided Billing Costs in mln GEL[53]



According to data provided by DSOs about 58% of consumers are disconnected annually due to several reasons. On the other hand, cost of disconnection or re-connection to the system is 2 GEL according to existing regulations (see figure 26).

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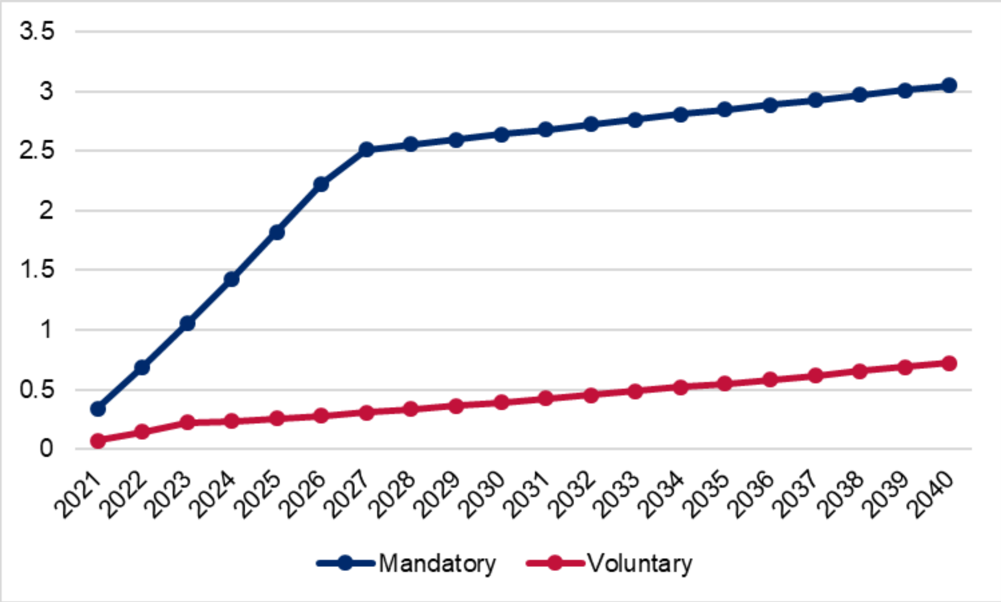
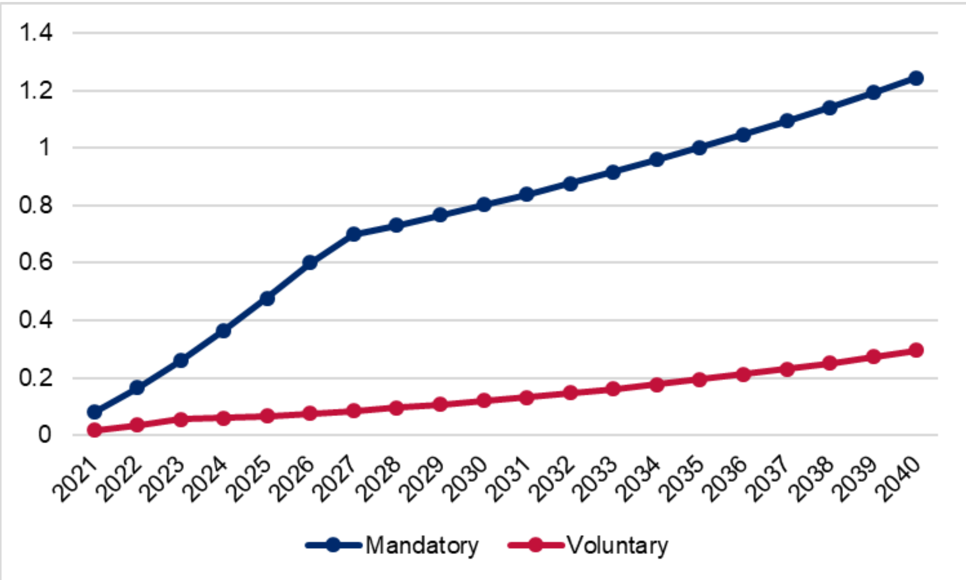
[49] 0.38 hours as a weighted average from the data received from DSO
[50] 4.88 GEL the data received from DSO
[51] Own Calculations
[52] This assumption is based on PWC's report on Study to analyze the cost-benefit of an Austria-wide introduction of smart metering
[53] Own Calculations

Figure 26: Avoided Disconnection Costs in mln GEL[54]



Avoided maintenance costs are considered as follows: Based on Georgian DSOs data ToU Tariff Model inputs that 3.4% of all meters have to be maintained annually. On the other hand, according to consultations with and information provided by Georgian DSOs part of damaged meters can be fixed and another part should be changed with new ones. Hence, based on abovementioned information and data, the Model incorporates that out of 3.4% of damaged meters annually 25% will be fixed under option 1 and 50% under option 2. On the other hand, cost of maintenance is assumed to be 31.4 GEL[55] per meter increased by the annual inflation rate (see Figure 27).

Figure 27: Avoided Disconnection Costs in mln GEL[56]



7.3. ENVIRONMENTAL EFFECTS

The last component which is proposed to be considered within this analysis includes the environmental effects in order to account for externalities. Therefore, price of CO_2 emissions which can be avoided due to electricity savings linked with the roll-out of smart meters and regard the

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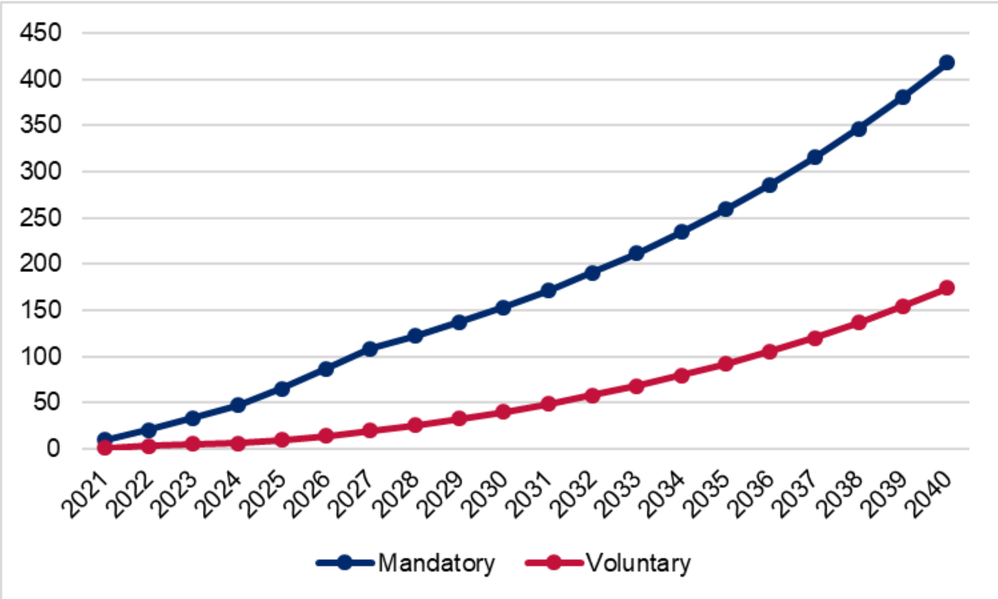
[54] Own Calculations
[55] This figure is also based on information provided by Georgian DSOs
[56] Own Calculations

resulting value as a benefit. In order to calculate the effect, the following data/assumptions were used: CO_2 emission intensity in energy amounts approximately 0.38 kg per kWh for Georgia[57]. According to the seasonality of energy balance of Georgia, only 68% of saved energy can decrease generation at thermal power plants[58]. As regards to the price of CO_2 emission, even though it is obvious and project team agrees that CO_2 emission price does not capture whole range of environmental damage in terms of money value that might be caused by the emission, the value of avoided CO_2 emission was taken from the Cost-Benefit Analysis model of Energy Community Secret elaborated for the identification of candidate Projects of Energy Community Interest (PECI) and candidate Projects for Mutual Interest (PMI). According to the above-mentioned model price for the CO_2 emission for 2020 assumed at 80.3 GEL which increases every year by 5% and reaches 226.3 GEL in 2040[59].

Figure 28: Environmental Effects in mln GEL[60]



7.4. NET BENEFITS AND COSTS

Based on all the assumptions listed, subject to the considerations mentioned above and taking into account the stakeholder groups, we calculate the following effects for Mandatory and Voluntary policy alternatives[61].

Table 19: Comparisons of Policy Alternatives (GEL)

Descriptions			Mandatory	Voluntary
Costs	System Operators / Suppliers	Smart Meter (SM) Unit Costs	-1,254,543,995	-106,618,756
Costs	System Operators / Suppliers	Smart Meter Installation Costs	-169,633,008	-73,627,411
Costs	System Operators / Suppliers	Communication Infrastructure	-425,439,585	-35,184,190
Costs	System Operators / Suppliers	Operational Expenditure for SM	-151,184,318	-10,661,876
Benefits	System Operators / Suppliers	Avoided Meter Readings	262,590,082	45,343,690
Benefits	System Operators / Suppliers	Reduced Billing Processes	20,293,366	3,504,230
Benefits	System Operators / Suppliers	Reduced Disconnection cost	20,405,129	3,456,012
Benefits	System Operators / Suppliers	Reduced Maintenance Costs	6,323,990	1,092,034
Benefits	System Operators / Suppliers	Reductions in Losses	45,837,397	27,502,438
Benefits	Environment (Externalities)	CO_2 Reductions	1,341,916,804	406,508,681
		Total Costs	**-2,000,800,905**	**-226,092,233**

[57] This value was consulted with the MoESD, which is used in case of Georgia in order to estimate CO_2 effect of an energy project, even though this number is not provided any official document.
[58] This is an assumption of the project team based on the energy balance analysis of Georgia. Basic methodology for this assumption is the following: During high hydrology period, there is no thermal generation needed and renewable energy fully satisfies early demand on energy, which in this period amounts around 32%. This methodology was applied to 2019 year and respective numbers were calculated.
[59] Assessment for the identification of candidate Projects of Energy Community Interest (PECI) and candidate Projects for Mutual Interest (PMI), REKK, 2020
[60] Own Calculations
[61] Benefits and costs are arising from efficiency gains. ToU changes are not impacting revenue collected from other customer classes. Other impacts are arising from outside the industry.

Descriptions	Mandatory	Voluntary
Total Benefits	1,697,366,768	487,407,085
Net Effect	-303,434,137	261,314,853

Based on the results, following key messages can be identified within this report:

- Benefits derived from Mandatory and Voluntary policy alternatives are straightforward and are calculated for household and commercial customers. For example, reduction in CO_2 emissions and losses in distribution network represents overall benefit which improves efficiency of electricity system and overall environmental conditions. However some other benefits such as reduced billing process and avoided metering costs may affect employment in the sector and even reduction of electricity generation from thermal power plants may cause reduction in CO_2 emissions. It has to be noted that evaluation of indirect effect of ToU tariff scheme on thermal power plants are complex while it has several dimensions such as rate of employment, taxes, CO_2 emissions, imported fuel dependency and etc. At the same time, effect on employment in the sector due to increased operational efficiency of DSOs was not captured while it was beyond the scope of this analysis. Therefore, respective cost and benefit categories indicate direct profit and loss from implementing ToU tariff schemes for household and commercial customers.
- Mandatory policy alternative has significant negative net effect which is mainly caused by considerable investment cost in the smart meter infrastructure and big share of customers (which are characterized with a poor consumption) has not much potential to deliver benefits for the socio-economic perspectives.
- Voluntary policy alternative has considerable positive net effect. Therefore, project team recommends this policy alternative to be taken into consideration for implementation of ToU tariff schemes in Georgia.
- Under Voluntary policy alternative about 3.5 bln kWh of electricity is saved until 2040 compared to Status Quo, which is approximately equivalent to not constructing a power plant similar to Enguri hydro power plant with installed capacity of 1,300 MW for next 20 years in total. At the same time customers save about 140 mln GEL for the year of 2040 compared to Status Quo.
- It should also be noted that Voluntary policy alternative also narrows electricity supply-demand gap as well as provides possibility to cover time delay of commissioning planned power plants in Georgia.
- In case of Mandatory policy alternative, it was found out that, smart metering massive roll-out captures that are not only associated with ToU tariffs but as well with improvement of customer service improvements. That effect is minor in case of Voluntary policy alternative, due to the fact that there will be smaller share of customers with smart metering and there is two metering systems running in parallel, old and new.
- For successful implementation of ToU Tariff scheme active customer awareness campaign should be conducted in order to induce customers to save electricity by more efficient consumption behaviors.

8. MONITORING AND EVALUATION

Previous chapters of this report provided basic assumptions, parameters and policy alternatives taking into account existing situation. However, it does not mean that assumptions, priorities and indicators used in the assessment will remain the same in the future. The energy markets, at wholesale or retail level, particularly those at the initial stage of development, change very dynamically over a short period of time. Hence, there is a need for constant monitoring of the estimations of the efficiency of the ToU pricing model.

This section provides the Monitoring and Evaluation (M&E) plan for the introduction of ToU pricing model. The M&E plan provides streamlined actions required for successful implementation of ToU pricing model in Georgia.

Table 20: Monitoring and Evaluation

Activity	Timing[62]	Responsible party for preparation	Responsible for approval	Comment
Develop a concept of a ToU pricing model for Georgian Electricity Market	XX years	MoESD, GNERC	GNERC	
Make respective amendments in the regulatory framework (secondary legislation and tariff methodologies)	XX years	GNERC	GNERC	The Law on Energy and Water Supply already provides minimum background for introduction ToU pricing models in Georgia
Develop ToU tariff methodology and set up respective ToU tariffs	XX years	GNERC	GNERC	
Conduct Awareness Raising Campaign regarding ToU pricing mechanisms	XX years	GNERC	GNERC	
Upgrade system infrastructure (smart meters)	XX years	DSOs	GNERC	
Collect and analyze consumption data, evaluate impact of ToU pricing on consumption behavior and make corrective actions when necessary	XX years	DSOs, GNERC	GNERC	
# of smart meters installed	XX years	GNERC, DSOs	GNERC	
# of household customers participating in ToU Scheme	XX years	GNERC, suppliers	GNERC	
# of commercial customers participating in ToU Scheme	XX years	GNERC, suppliers	GNERC	
% in CO_2 reductions	XX years	MoESD, GNERC	MoESD	
# of losses decreases in respective distribution network	XX years	GNERC, DSO	GNERC	

[62] Defining relevant timeline for achieving the objectives is left under the responsible parties

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ANNEX I: CHARACTERISTICS OF HOUSEHOLD CUSTOMERS

According to annual electricity consumption and number of household customers data of the year of 2019, annual average annual and daily electricity consumption of average (typical) household derived which amount to 1,449.4 kWh annually and 3.97 daily respectively. On the other hand, based on the data provide by DSO hourly fractions of daily electricity consumption as well as load profiles for winter and summer period derived (See Figure 29 and Figure 30).

Figure 29: Hourly Fractions of Average Household Consumer's Daily Electricity Consumption

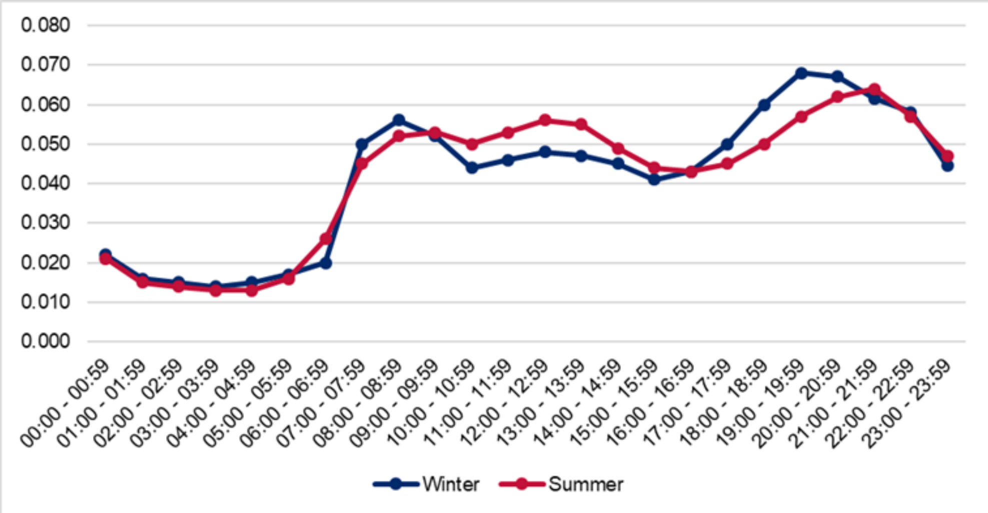
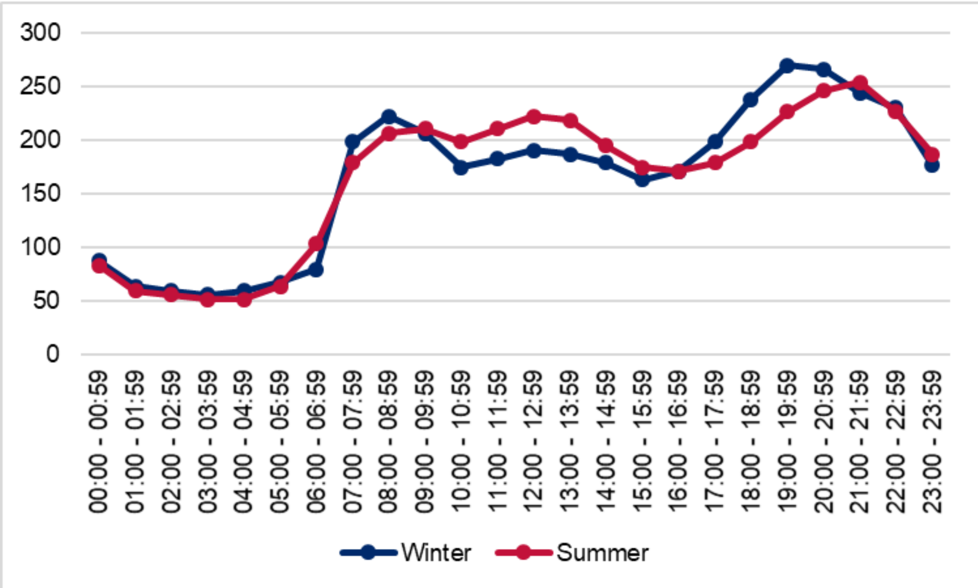


Figure 30: Winter and Summer Load Curves for Average Household Consumer (Watt)



For modeling purposes, different types of household customers were defined based on technologies they use or will use for electricity consumption. In this regard, electricity consumption for cooling, heating, heating/cooling systems and electric vehicles were separated from typical households' consumption which also equated to the electricity consumption of type I household consumers.

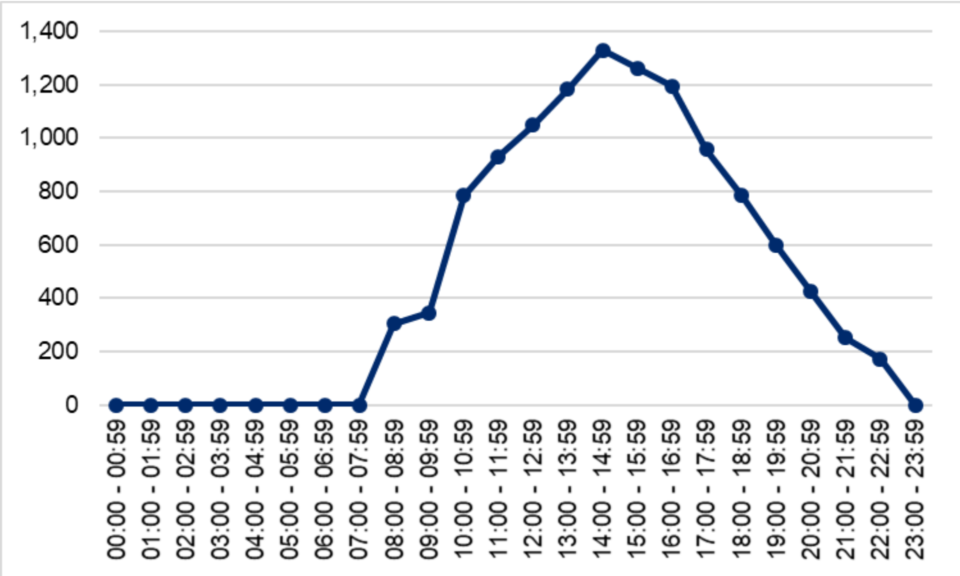
For cooling, project team used data from report on "Energy Consumption in Households" by GEOSTAT which indicated percentage of households used for AC based space size in 2017 year. At the same time according to market research of AC's available in Georgia rated power of AC's applied according to space size in order to calculate daily consumption of AC (See Table 21).

Table 21. Calculation of Daily Electricity Consumption for Cooling

Square meter	% of consumers	Rated power (kW)	Weighted Average power for AC (kW)	Daily Consumption on average customer (kWh)
0-49	4.7%	1.5	2.31	11.57
50-99	4.0%	3		
100-more	0.4%	5		

Furthermore, according to benchmarking as wells as data provided by the Georgian DSOs hourly load profiles derived for cooling (See Figure 31).

Figure 31. Hourly Electricity Consumption for Cooling (watt)



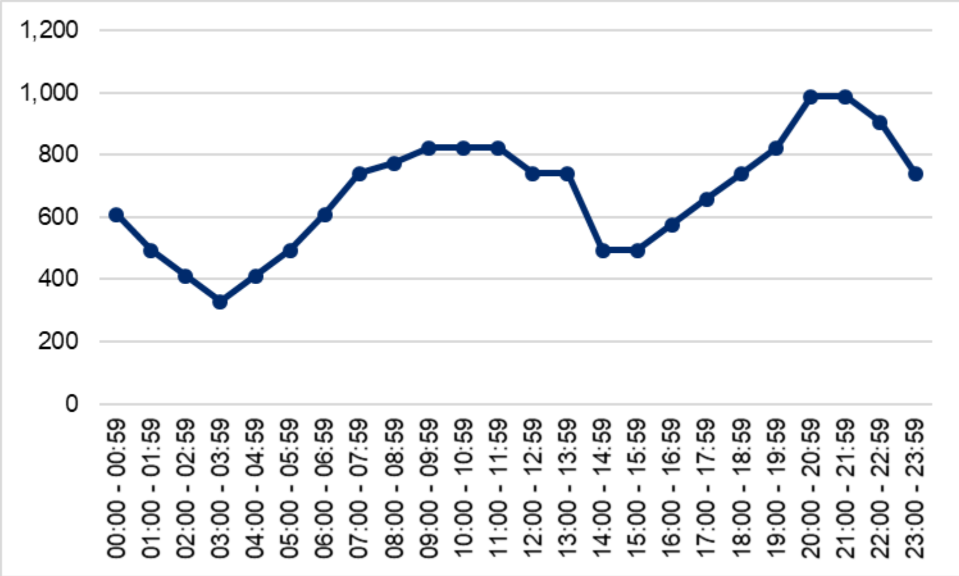
For heating, project team applied to data from report on “Energy Consumption in Households” by GEOSTAT. At the same time according to market research of heating appliances’ available in Georgia rated power of heating appliances’ applied according to space size in order to calculate daily consumption of heating (See Table 22).

Table 22. Calculation of Daily Electricity Consumption for Heating

Square meter	% of consumers	Rated power (kW)	Weighted Average power for AC (kW)	Daily Consumption on average customer (kWh)
0-49	3.0%	1.5	2.32	16.21
50-99	2.5%	3		
100-more	0.2%	6		

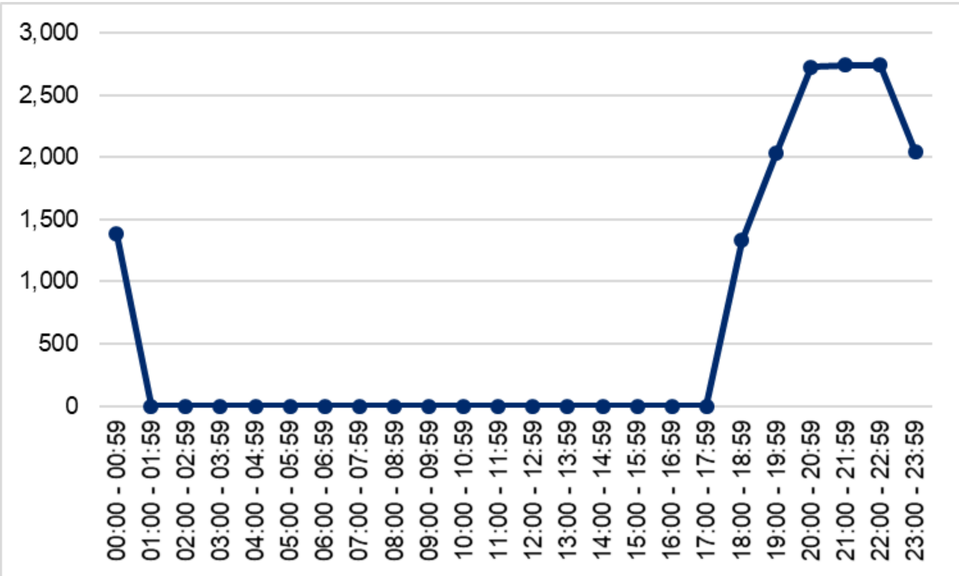
Furthermore, according to benchmarking as wells as data provided by the Georgian DSOs hourly load profiles derived for heating (See Figure 32).

Figure 32: Hourly Electricity Consumption for Heating (watt)



For heating/cooling pumps rated power assumed at 3.3 kW with 11.5 hours of us on average in a day which amounted to 37.95 kWh of daily consumption. For the load profile of heating/cooling pumps individual load profiles for cooling and heating were applied taking into consideration of seasonal usage of heating/cooling pumps. On the other hand, for electric vehicles rated power assumed at 3 kW with 5 hours of usage on average in a day which amounted to 15 kWh of daily consumption. Furthermore, according to benchmarking hourly load profiles derived for heating (See Figure 33).

Figure 33: Hourly Electricity Consumption for Electric Vehicles (watt)



Based on the typical household customers' load profile as well as above mentioned analysis load curves for each type of household customers derived for winter and summer periods.

Figure 34: Hourly Electricity Consumption for Winter and Summer Periods for Type I Household Customer (watt)

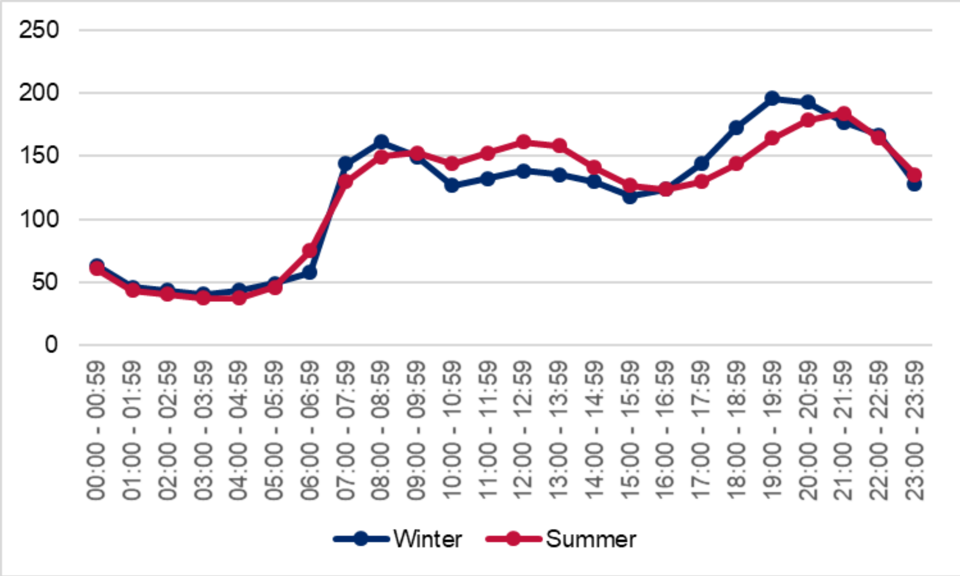


Figure 35: Hourly Electricity Consumption for Winter and Summer Periods for Type II Household Customer (watt)

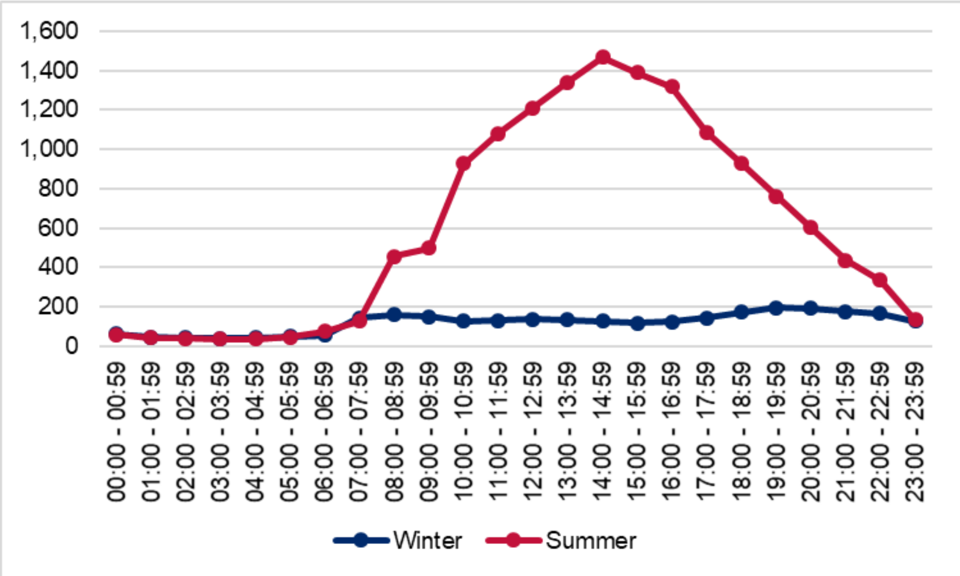


Figure 36: Hourly Electricity Consumption for Winter and Summer Periods for Type III Household Customer (watt)

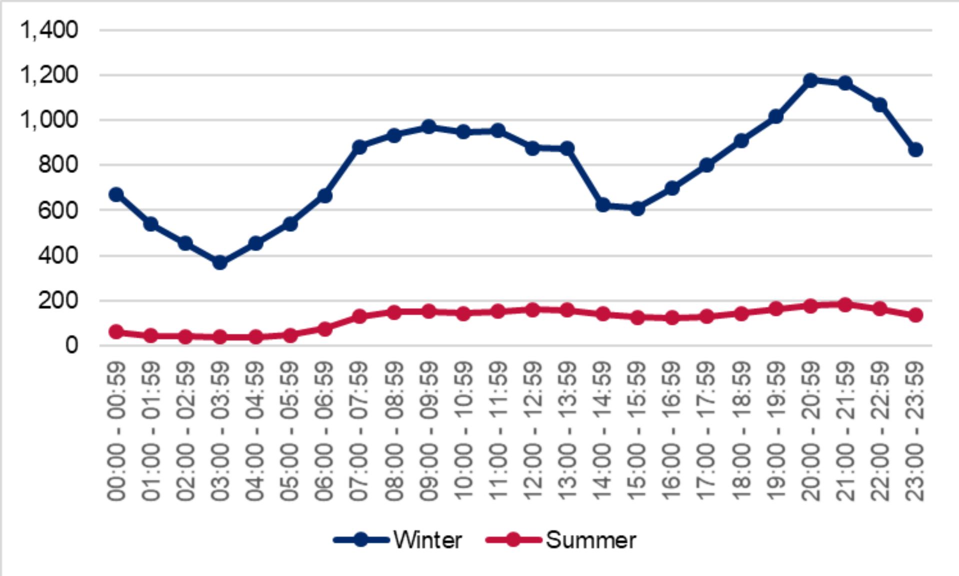


Figure 37: Hourly Electricity Consumption for Winter and Summer Periods for Type IV Household Customer (watt)

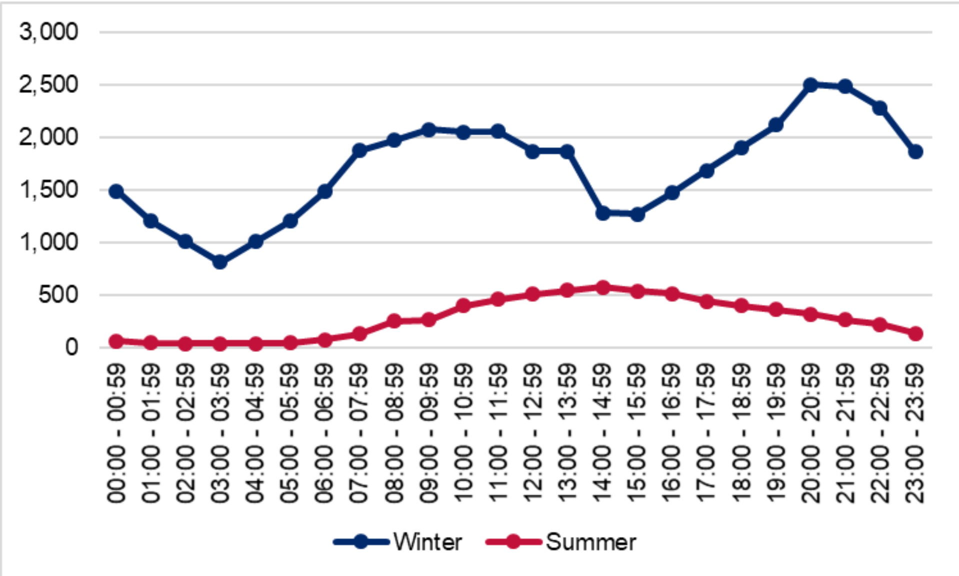
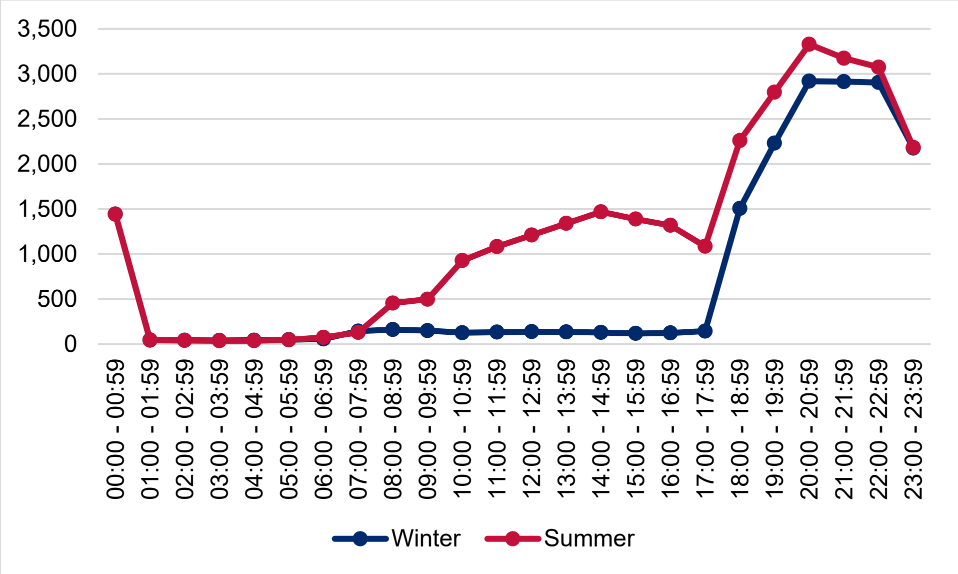


Figure 38: Hourly Electricity Consumption for Winter and Summer Periods for Type V Household Customer (watt)



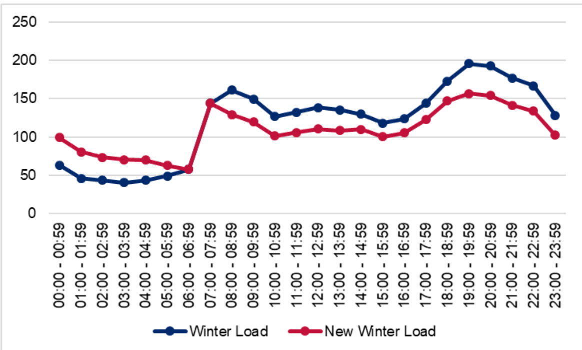
As described previously ToU Tariff Model assumes different rates of load shifting within ToU tariff periods for each types of household customers (See Table 23).

Table 23. Load Shifting and Saving Assumptions for Household Customers

	Type I	Type II	Type III	Type IV	Type V
% of saving during peak hours including shift	20%	20% - winter 35% - summer	20% - winter 20% - summer	35% - winter 40% - summer	30% - winter 35% - summer
% of saving during afternoon off-peak hours (no shift)	15%	15% - winter 20% - summer	15% - winter 15% - summer	15% - winter 20% - summer	20% - winter 25% - summer
shift to off-peak hours from savings during peak	50%	Type II customers shift same load as Type I customer	60% - winter 40% - summer	35% - winter 25% - summer	50% - winter 40% - summer

Results of electricity savings and shift for each types of customers are provide below. New loads after assuming load shifting and/or load saving are elaborated under ToU tariff scheme participation of the customer types for Policy Alternatives Option 1 and Option 2.

Figure 39: Hourly Electricity Consumption for Winter and Summer Periods for Type I Household Customer (watt)



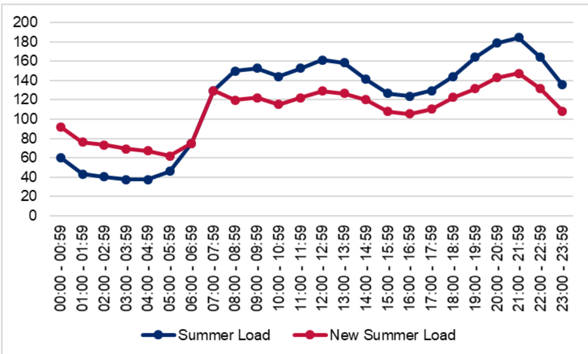
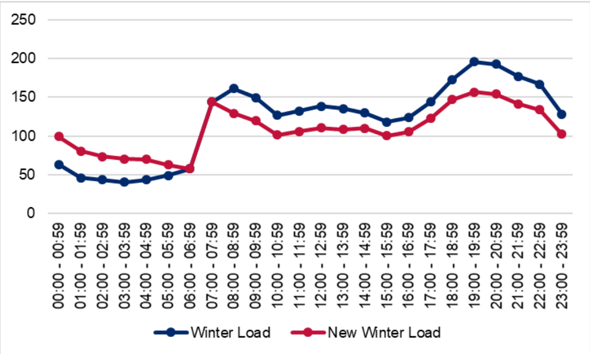


Table 24. Results of Electricity Saving and Shift for Type I Household Customer (watt)

Description	Winter Period			Summer Period		
	Standard Consumption	**ToU Consumption**	**change in load**	**Standard Consumption**	**ToU Consumption**	**change in load**
Off-Peak	486.68	657.17	170.48	469.41	643.92	174.52
Morning Peak	843.78	675.02	-168.76	918.65	734.92	-183.73
Afternoon off-peak	688.27	585.03	-103.24	665.23	565.45	-99.78
Evening Peak	861.06	688.85	-172.21	826.50	661.20	-165.30
Total	**2,879.79**	**2,606.07**	**273.72**	**2,879.79**	**2,605.49**	**274.30**

Figure 40: Hourly Electricity Consumption for Winter and Summer Periods for Type II Household Customer (watt)



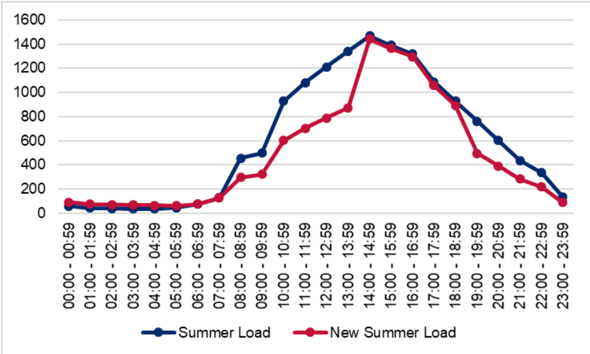
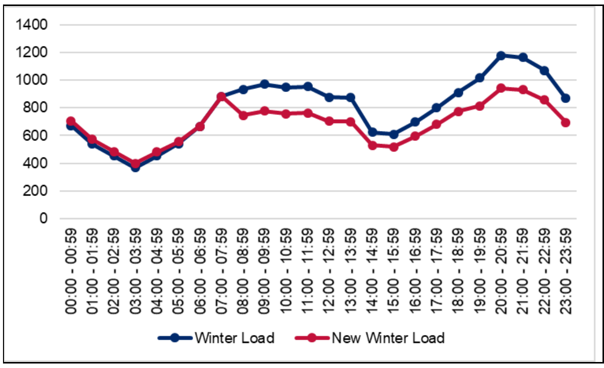


Table 25. Results of Electricity Saving and Shift for Type II Household Customer (watt)

Description	Winter Period			Summer Period		
	Standard Consumption	**ToU Consumption**	**change in load**	**Standard Consumption**	**ToU Consumption**	**change in load**
Off-Peak	486.68	657.17	170.48	469.41	643.92	174.52
Morning Peak	843.78	675.02	-168.76	5,513.16	3,583.55	-1,929.61
Afternoon off-peak	688.27	585.03	-103.24	6,189.26	6,051.61	-137.65
Evening Peak	861.06	688.85	-172.21	2,273.90	1,478.04	-795.87
Total	**2,879.79**	**2,606.07**	**273.72**	**14,445.72**	**11,757.11**	**2,688.61**

Figure 41: Hourly Electricity Consumption for Winter and Summer Periods for Type III Household Customer (watt)



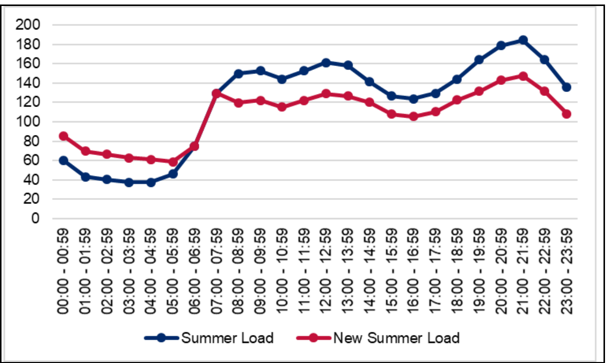
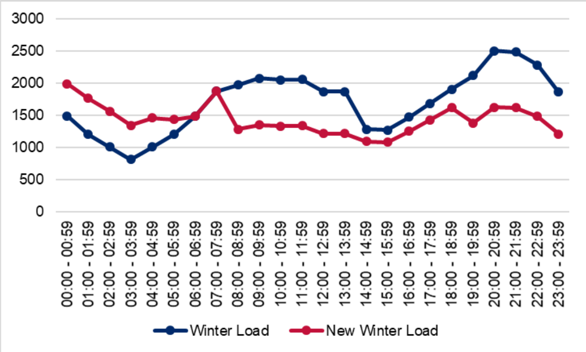


Table 26. Results of Electricity Saving and Shift for Type III Household Customer (watt)

Description	Winter Period			Summer Period		
	Standard Consumption	**ToU Consumption**	**change in load**	**Standard Consumption**	**ToU Consumption**	**change in load**
Off-Peak	4,580.42	4,750.90	170.48	469.41	609.02	139.61

Description	Winter Period			Summer Period		
	Standard Consumption	**ToU Consumption**	**change in load**	**Standard Consumption**	**ToU Consumption**	**change in load**
Morning Peak	5,562.26	4,449.81	-1,112.45	918.65	734.92	-183.73
Afternoon off-peak	3,647.60	3,100.46	-547.14	665.23	565.45	-99.78
Evening Peak	5,300.05	4,240.04	-1,060.01	826.50	661.20	-165.30
Total	**19,090.32**	**16,541.20**	**2,549.12**	**2,879.79**	**2,570.59**	**309.20**

Figure 42: Hourly Electricity Consumption for Winter and Summer Periods for Type IV Household Customer (watt)



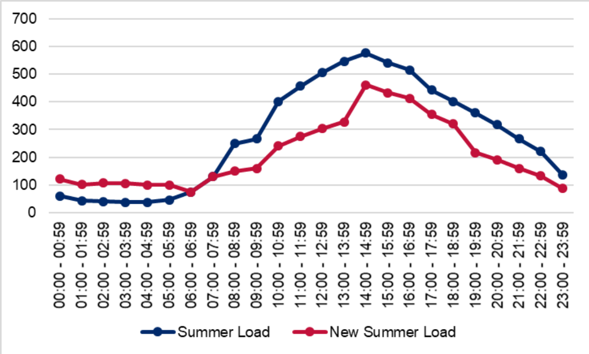
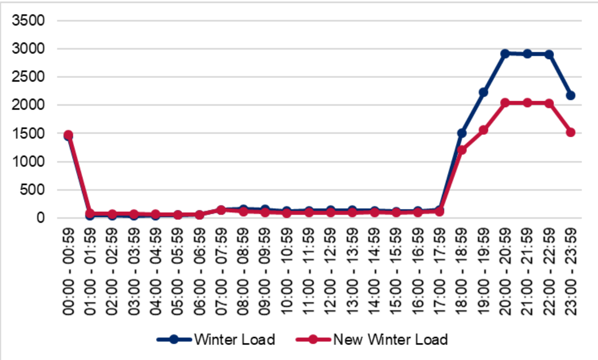


Table 27. Results of Electricity Saving and Shift for Type IV Household Customer (watt)

Description	Winter Period			Summer Period		
	Standard Consumption	**ToU Consumption**	**change in load**	**Standard Consumption**	**ToU Consumption**	**change in load**
Off-Peak	10,070.41	12,905.44	2,835.03	469.41	840.48	371.07
Morning Peak	11,890.08	7,728.55	-4,161.53	2,426.20	1,455.72	-970.48
Afternoon off-peak	7,616.26	6,473.82	-1,142.44	2,477.77	1,982.22	-495.55
Evening Peak	11,253.05	7,314.48	-3,938.57	1,301.42	787.62	-513.80
Total	**40,829.79**	**34,422.29**	**6,407.50**	**6,674.79**	**5,066.03**	**1,608.76**

Figure 43: Hourly Electricity Consumption for Winter and Summer Periods for Type V Household Customer (watt)



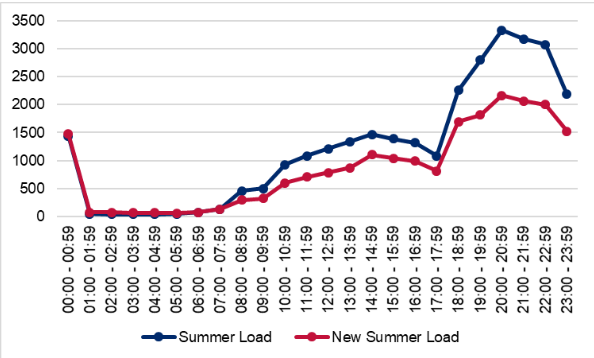


Table 28. Results of Electricity Saving and Shift for Type V Household Customer (watt)

Description	Winter Period			Summer Period		
	Standard Consumption	**ToU Consumption**	**change in load**	**Standard Consumption**	**ToU Consumption**	**change in load**
Off-Peak	1,867.94	2,038.43	170.48	1,850.67	2,025.18	174.52

Description	Winter Period			Summer Period		
	Standard Consumption	**ToU Consumption**	**change in load**	**Standard Consumption**	**ToU Consumption**	**change in load**
Morning Peak	843.78	590.64	-253.13	5,513.16	3,583.55	-1,929.61
Afternoon off-peak	2,021.06	1,616.85	-404.21	7,522.05	5,641.54	-1,880.51
Evening Peak	13,147.00	9,202.90	-3,944.10	14,559.85	9,573.05	-4,986.80
Total	**17,879.79**	**13,448.83**	**4,430.96**	**29,445.72**	**20,823.32**	**8,622.40**

ANNEX II: CHARACTERISTICS OF COMMERCIAL CUSTOMERS

Load profiles for winter and summer periods are assumed to be same for commercial customers.

Figure 44. Hourly Electricity Consumption for Type I Commercial Customer (0.4 kV) (watt)

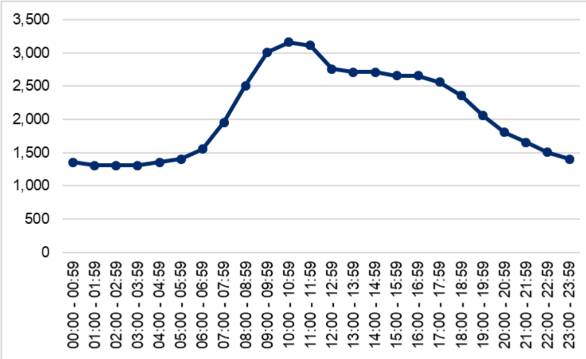


Figure 45. Hourly Electricity Consumption for Type I Commercial Customer (6/10 kV) (watt)

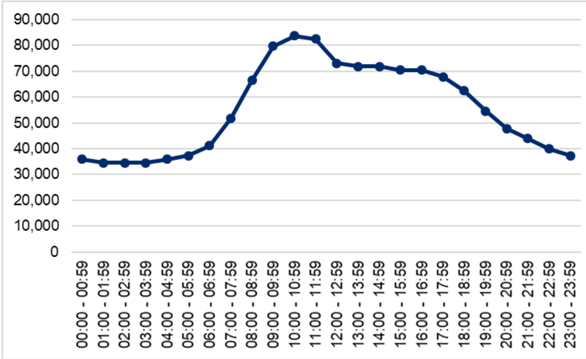


Figure 46. Hourly Electricity Consumption for Type II Commercial Customer (0.4 kV) (watt)

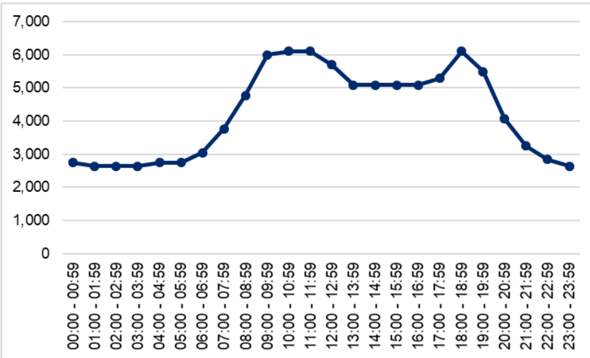


Figure 47. Hourly Electricity Consumption for Type II Commercial Customer (6/10 kV) (watt)

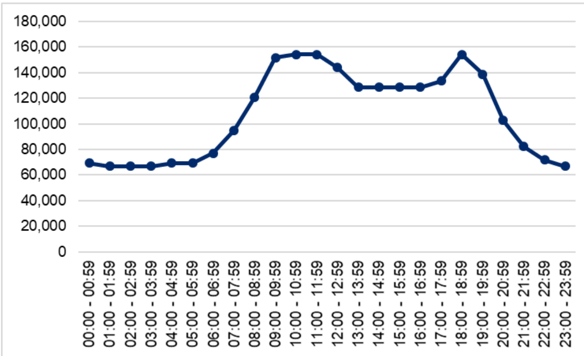


Figure 48. Hourly Electricity Consumption for Type III Commercial Customer (0.4 kV) (watt)

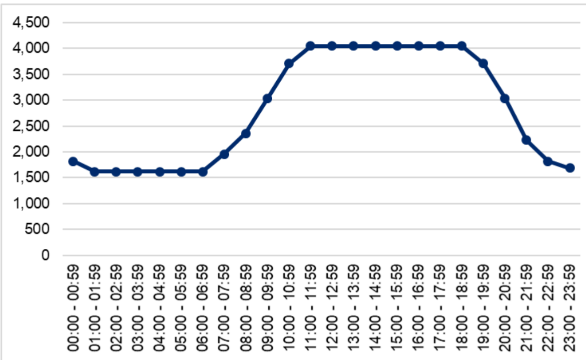


Figure 49. Hourly Electricity Consumption for Type III Commercial Customer (6/10 kV) (watt)

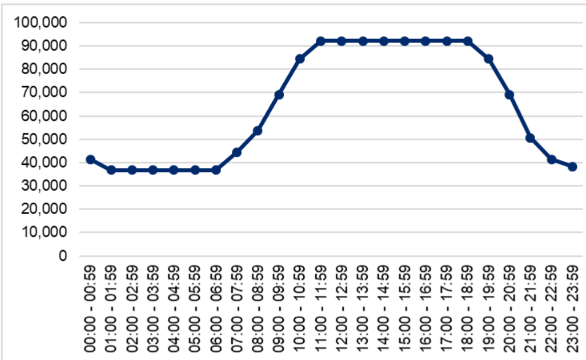


Figure 50. Hourly Electricity Consumption for Type IV Commercial Customer (0.4 kV) (watt)

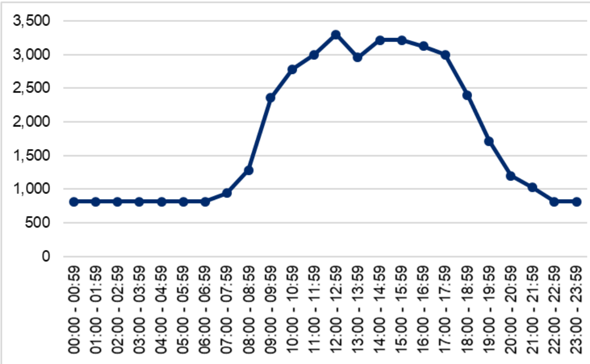


Figure 51. Hourly Electricity Consumption for Type IV Commercial Customer (6/10 kV) (watt)

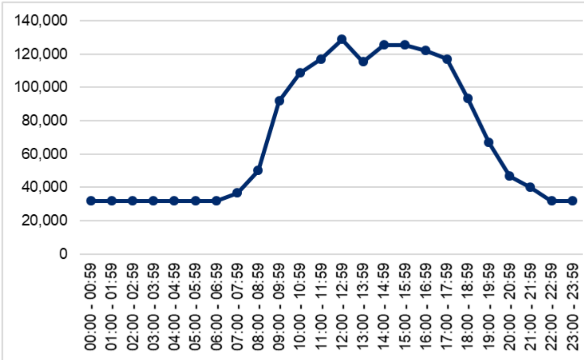


Figure 52. Hourly Electricity Consumption for Type IV Commercial Customer (0.4 kV) (watt)

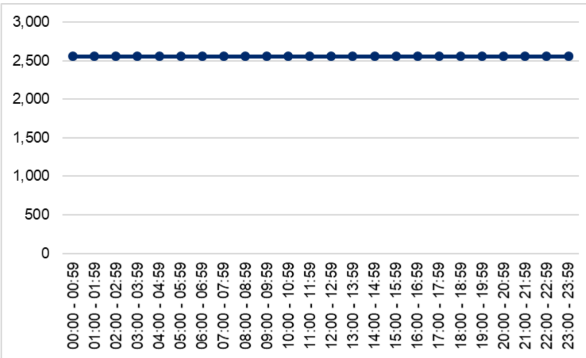
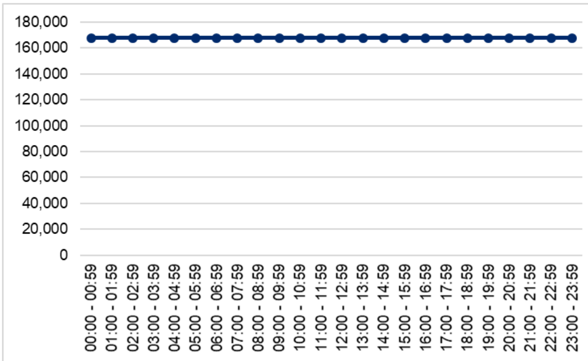


Figure 53. Hourly Electricity Consumption for Type IV Commercial Customer (6/10 kV) (watt)



ANNEX III: TARIFFS APPLIED IN THE TOU TARIFF MODEL

a. Standard tariffs according to existing methodology for Household Consumers in Tetri used for calculations for Status Quo policy alternative

Description	2021-2023	2024-2026	2027-2029	2030-2032	2033-2035	2036-2038	2039-2041
0.4 kV - Household	23.39	24.74	25.87	27.17	28.74	30.22	32.55
0.4 kV - Commercial	23.39	24.74	25.87	27.17	28.74	30.22	32.55
6/10 kV - Commercial	17.24	18.68	20.26	21.96	23.82	25.71	27.95

b. Hourly Tariffs under ToU Tariff Schemes for Household and Commercial Consumers (0.4 kV) in Tetri used for calculations for Mandatory policy alternative

Description	2021-2023	2024-2026	2027-2029	2030-2032	2033-2035	2036-2038	2039-2041
ToU Off-Peak	16.51	22.87	26.47	27.34	28.77	29.66	32.23
ToU Morning Peak	28.90	36.42	41.27	43.51	46.44	48.97	53.33
ToU Afternoon off-peak	25.37	32.55	37.05	38.90	41.40	43.46	47.11
ToU Evening Peak	28.90	36.42	41.27	43.51	46.44	48.97	53.33

c. Hourly Tariffs under ToU Tariff Schemes for Household and Commercial Consumers (6/10 kV) in Tetri used for calculations for Mandatory policy alternative

Description	2021-2023	2024-2026	2027-2029	2030-2032	2033-2035	2036-2038	2039-2041
ToU Off-Peak	8.97	11.36	13.20	14.28	15.59	16.72	18.59
ToU Morning Peak	21.36	24.91	28.00	30.46	33.26	36.03	39.69
ToU Afternoon off-peak	17.83	21.04	23.77	25.84	28.22	30.52	33.47
ToU Evening Peak	21.36	24.91	28.00	30.46	33.26	36.03	39.69

d. Hourly Tariffs under ToU Tariff Schemes for Household and Commercial Consumers (0.4 kV) in Tetri used for calculations for Voluntary policy alternative

Description	2021-2023	2024-2026	2027-2029	2030-2032	2033-2035	2036-2038	2039-2041
ToU Off-Peak	14.95	16.03	16.97	18.21	19.90	21.36	24.23
ToU Morning Peak	27.35	29.57	31.77	34.39	37.57	40.67	45.33
ToU Afternoon off-peak	23.81	25.71	27.55	29.77	32.53	35.16	39.10
ToU Evening Peak	27.35	29.57	31.77	34.39	37.57	40.67	45.33

c. Hourly Tariffs under ToU Tariff Schemes for Household and Commercial Consumers (6/10 kV) in Tetri used for calculations for Voluntary policy alternative

Description	2021-2023	2024-2026	2027-2029	2030-2032	2033-2035	2036-2038	2039-2041
ToU Off-Peak	8.50	9.27	10.17	11.22	12.49	13.71	15.60
ToU Morning Peak	20.90	22.82	24.97	27.40	30.16	33.02	36.70
ToU Afternoon off-peak	17.36	18.95	20.75	22.78	25.12	27.51	30.48
ToU Evening Peak	20.90	22.82	24.97	27.40	30.16	33.02	36.70

ANNEX IV: DATA CATALOGUE

In order to conduct RIA on ToU pricing and correctly evaluate potential costs and benefits, it is vital to identify necessary data items (create comprehensive data catalogue) based on international experience, define data owner institutions and/or appropriate studies with trustable results, carry out consultations with data owners, evaluate data availability and degree of data precision and ensure data gathering in formalized and timely manner. However, when respective data is not available, alternative approaches such as assumptions and/or benchmarking should be used in order to replace data gaps. As the RIA on ToU pricing model for Georgian household, commercial and industrial customers was designed for a period of next 20 years, available data and assumptions were used to set up a forecast for the electricity demand of different sectors/consumer categories. On the other hand, important data items were defined considering international experience and respective studies on related issues.

Taking into consideration main issues necessary for successful implementation of ToU pricing and identified important data items essential for ToU modeling, the following data catalogue was elaborated and discussed with respective stakeholders. It should be also noted that due to the emergency situation in the country and around the world because of COVID-19 disease, we were not able to conduct face-to-face interviews, which was the most preferred option. Therefore, consultations with the stakeholders in regard to data availability was conducted based on phone interviews. The results of consultation are provided in the Table 29 below. As per data availability check, based on stakeholder consultations and overview of data sources (such are public information on websites and in annual reports or other material), it can be concluded that at least 80% of requested information is available and for the rest 20% missing data, assumption/benchmarking approach were applied in order to conduct RIA appropriately.

Table 29: Data Catalogue and Consultations with Data Owners for Data Availability

№	Data Description	Data Category	Potential Source	Data availability (yes/no/comment)
1	**Standard Load profiles in Distribution: Working days/day-offs urban and rural**			
1.1	Residential	Annual load data	DSO / GEOSTAT	yes
1.2	Small Commercials	Annual load data	DSO / GEOSTAT	yes
1.3	Office Buildings	Annual load data	DSO / GEOSTAT	yes
1.4	Industry	Annual load data	DSO / GEOSTAT	yes
1.5	Agricultural	Annual load data	DSO / GEOSTAT	yes
1.6	Distribution grid (aggregated) load profile	Annual load data	DSO / GEOSTAT	yes
2	**Transmission system Load profile**			
2.1	Seasonal	Hourly load data	TSO	yes
2.2	Working days/day offs/holidays	Hourly load data	TSO	yes
2.3	Transmission system peak hours	Hourly load data	TSO	yes
3	**Distribution Grid Losses**			
3.1	Statistics on grid losses in distribution	Annual data	DSO/GNERC	yes
3.2	Forecast on grid losses in distribution	Annual data	DSO	yes
4	**Distribution Demand**			
4.1	Demand statistics for each category of consumers	Annual/hourly data	DSO / Suppliers	Annual and monthly data exist for category of consumers for which GNERC sets tariffs. Hourly data will be based on assumptions and benchmarking
4.2	Demand forecast for each category of consumers	Annual/hourly data	DSO	No data is available. Hence it will be based on assumptions and benchmarking
4.3	Distribution system peak hours	Hourly / Daily / Monthly Data	DSO	yes
5	**Electricity prices/tariffs**			

№	Data Description	Data Category	Potential Source	Data availability (yes/no/comment)
5.1	Tariffs for each categories of consumers	Annual data	GNERC	yes
5.2	Existing wholesale market price	Annual data	GNERC / ESCO	No data is available. Hence it will be based on assumptions and benchmarking
5.3	Forecast of wholesale market price	Annual/hourly data	GNERC / GSE / ESCO	No data is available. Hence it will be based on assumptions and benchmarking
5.4	Electricity retail tariffs	Annual data	GNERC	yes
6	**Meters**			
6.1	Factual number of meters for each category of consumers	Annual data	DSO	yes
6.2	Forecast of increase in number of meters for each category of consumers	Annual data	DSO	yes
6.3	Categorization into % of old, medium age and new meters	%	DSO	yes
6.4	% of electronic (smart) meters into each consumer category	%	DSO	yes
6.5	Average service time period (exploitation) for ordinary meters	Single data	DSO	yes
6.6	Average Service time period (exploitation) for smart meters	Single data	DSO	yes
6.7	Calibration time periodicity for each type of meter	Single data	DSO	yes
6.8	Average installation costs for single phase and three phase ordinary meters	Single data	DSO	yes
6.9	Average installation costs for single phase and three phase smart meters	Single data	DSO	yes
6.10	Average market price for single and three phase smart meters and communication elements	Single data	DSO / International sources / Private companies	yes
6.11	Average market price for single and three phase ordinary meters	Single data	DSO	yes
6.12	Average cost of modernization of ordinary meter into smart meter (for single and three phase meters)	Single data	DSO / Private companies	yes
6.13	Average operation cost for smart/ordinary meters	Single data	DSO	yes
6.14	Average annual number of damaged (taken out of service) ordinary meters	Single data	DSO	yes
6.15	Average annual costs for replacing/repairing damaged ordinary meters	Single data	DSO	yes
6.16	Information about other benefits of hourly electronic (smart) metering	information	DSO / GNERC / International sources	yes
7	**Meter reading and billing information**			
7.1	Average salary of meter reader	Single data	DSO	yes
7.2	Number of meter reader/invoices in a company	Single data	DSO	yes

№	Data Description	Data Category	Potential Source	Data availability (yes/no/comment)
7.3	Information (observation) from pilot projects of hourly metering resulting in consumer behavior change or grid congestion relieve in those areas	Single data	DSO	yes
8	**Information on emerging technologies**			
8.1	Existing Demand (in kWh) for electric vehicle charging	Annual data	DSO / Private Companies	Partially available
8.2	Demand forecast (in kWh) for electric vehicle charging	Annual data	DSO / Private Companies	No data is available. Hence it will be based on assumptions and benchmarking
8.3	Number of existing charging points	Annual data	DSO / Private Companies	yes
8.4	Forecast (or plans) to increase charging points	Annual data	DSO / Private Companies	No data is available. Hence it will be based on assumptions and benchmarking
8.5	Number of consumers participating in the "net metering" (amongst which residential and non-residential)	Annual data	MoESD / GNERC / DSO	yes
8.6	Forecast of consumer number participating in the "net metering" (amongst which residential and non-residential)	Annual data	GNERC / DSO	No data is available. Hence it will be based on assumptions and benchmarking
8.7	Electricity generated and consumed by the consumers participating in the "net metering"	Annual data	GNERC / DSO	No data is available. Hence it will be based on assumptions and benchmarking
8.8	Average capacity of micro generator participating in "net metering" for residential and non-residential consumers	Annual data	GNERC / DSO	yes
8.9	Information of cases of curtailment of distributed renewable energy sources due to the grid congestion	Annual data	GNERC / DSO	No data is available. Hence it will be based on assumptions and benchmarking
8.10	Information of cases of denial of connection to the grid of distributed renewable energy sources due to the grid congestion	Annual data	GNERC / DSO	yes
8.11	Information on other types of technologies or automation necessary/useful for consumers to enable participation in ToU price schemes	information	DSO / GNERC / International sources	No data is available. Hence it will be based on assumptions and benchmarking
8.12	Information about other type of technologies (other than chargers or solar/wind/hydro) to be developed at consumer side effecting on ToU participation (such as heat pumps, batteries and etc.)	information	DSO / GNERC / International sources	yes
8.13	Consumption of electricity in heating and cooling	Annual data	GEOSTAT / MoESD / USAID/AYPEG	Partially available. It will be used together with assumptions and benchmarking

№	Data Description	Data Category	Potential Source	Data availability (yes/no/comment)
8.14	Forecast of consumption of electricity in heating and cooling	Annual data	MoESD / USAID / AYPEG	No data is available. Hence it will be based on assumptions and benchmarking
9	**Greenhouse Gas Emissions**			
9.1	Information about existing levels of greenhouse gas emissions from energy sector	Annual data	MoESD / Ministry of Environmental Protection and Agriculture of Georgia (MEPA) / GEOSTAT	yes
9.2	Information on forecasts, or plans or long-term commitments of Georgia to decrease greenhouse gas emissions	Annual data	MoESD / MEPA	yes
9.3	Emission factors for Georgia	Annual data	MoESD / MEPA	yes
9.4	Emission prices	Annual data	MoESD / MEPA / International Sources	yes
10	**Economic Parameters**			
10.1	Gross Domestic Product (GDP)	Annual data	GEOSTAT	yes
10.2	Forecast of GDP growth	Annual data	MoESD / AYPEG / IMF	Yes, up to 2025, assumptions and benchmarking will be used for later years
10.3	Commercial discount rate	Single data	USAID / AYPEG / Ministry of Finance (MoF) National bank	yes
10.4	Social discount rate	Single data	USAID / AYPEG / MoF National bank	yes
10.5	WACC	Annual data	GNERC	yes
10.6	CAPEX in distribution system (on energy infrastructure)	Annual data	GNERC	yes
10.7	CAPEX in transmission system (on energy infrastructure)	Annual data	GNERC	yes
10.8	Planned CAPEX in distribution system (on energy infrastructure)	Annual data	GNERC	yes
10.9	Planned CAPEX in transmission system (on energy infrastructure)	Annual data	GNERC	yes
10.10	OPEX in distribution system (on energy infrastructure)	Annual data	GNERC	yes
10.11	Planned OPEX in distribution system (on energy infrastructure)	Annual data	GNERC	yes
10.12	Other economic parameters		MoESD / IMF / National Bank	Yes, as well as assumptions and benchmarking will be used if necessary

ANNEX V: QUESTIONNAIRE FOR STAKEHOLDER INTERVIEWS

USAID ენერგეტიკის პროგრამა
USAID Energy Program

საქართველოს ახალგაზრდა ენერგეტიკოსთა ასოციაცია
Association of Young Professionals in Energy of Georgia

Sir/Madam,

Thank you for participating in this survey. The survey is being conducted as part of a project aiming to assess the impact of Time-of-Use tariff (ToU) regulation on electricity retail consumption. The project is implemented by the AYPEG within the framework of the USAID Energy Program.

As you may know, Article 29 of the Law of Georgia on Energy and Water Supply stipulates that tariffs may reflect peak values, average weighted and marginal values, seasonality of total consumption and daily changes in consumption. Innovative tariff methodologies to be used to determine retail tariffs, in case such methodologies are within the interests of enterprises and consumers.

We analyze regulatory impact assessment of introduction of ToU based on advanced tariff methodologies (for household and non-household). The purpose of this questionnaire is to gather additional information to improve the qualitative and quantitative analysis of the research.

Example

ToU tariffs allow customers to adjust their electricity consumption, reduce the load or shift it to the period of a day when it is cheaper, and therefore save on electricity bills. In case of a standard tariff, electricity tariff is constant during the day and night, which does not motivate customers to change or save electricity consumption. According to international experience, different tariff level can be set at different times of a day and night according to the ToU tariff scheme.

Periods of Day and Night	Name of Periods	Time of Use Tariffs	Standard Tariff
00:00 – 08:00	Night	Lower than Standard Tariff	Do not change during day and night periods and it is constant
08:00 – 14:00	Peak	Higher than Standard Tariff	
14:00 – 19:00	Day	Lower than Standard Tariff	
19:00 – 24:00	Peak	Higher than Standard Tariff	

1. **In your opinion, what are the main challenges facing the existing tariff system at this stage of electricity market reform?**

2. **How necessary do you consider the introduction of ToU tariffs in Georgia?**

□ I consider it necessary □ no such needs □ Difficult to answer

3. **In your opinion, which ToU Tariff Model is more acceptable for the Georgian market?**

□ Static model (fixed rates for a specified period of day and night)

□ Dynamic model (variable tariffs for a given period of day and night depending on the state of the system/market)

Please explain the reason for your choice

4. **For which category of users are ToU tariffs attractive?**

□ Household □ Commercial □ Industry

□ Other (please specify) ________________________

5. **Does ToU tariff scheme contain lost revenue risk for the distribution companies?**

□ Yes □ No □ I cannot answer

6. **Should participation in ToU tariff scheme be voluntary or mandatory?**

□ Voluntary □ Mandatory □ I cannot answer

7. **[If answer of the 6th question is "mandatory"] In your opinion, how many years will it take for the full introduction of ToU scheme (introduction includes adaptation to the hourly metering)?**

□ 1-2 years □ 3-4 years □ 5-6 years □ 7 and more years

8. **[If answer of the 6th question is "voluntary": Suppose that every 10th customer has expressed a desire to participate in the ToU scheme] In your opinion, how many years it will take for the full introduction of ToU scheme (introduction includes adaptation to the hourly metering)?**

□ 1-2 years □ 3-4 years □ 5-6 years □ 7 and more years

9. **In case of ToU tariffs will be introduced, what number of users will express interest to be involved in it.**

□ 10% less than □ 10% to 20% □ 20% to 50% □More than 50%

□ Enter another number ________________________

10. **What risks do you see if the application of ToU tariff scheme is mandatory?**

11. **What risks do you see if the application of ToU tariff scheme is voluntary?**

12. **Do you think that the introduction of ToU tariffs for commercial customers will reduce the peak load in the distribution network?**

□ Yes □ No □ I cannot answer

13. **Do you think that the introduction of ToU tariffs for household customers will reduce the peak load in the distribution network?**

□ Yes □ No □ I cannot answer

14. **Tick technologies that will contribute to household electricity consumption in the future (by 2040)?**

□ Energy accumulator □ Electric car

□ Heat pump □ electricity-based heating system

□ Other _

15.Do you agree with the opinion that ToU tariffs will cause not only electricity load shift from peak periods to non-peak periods, but also energy saving as well?

□ Yes □ No □ I cannot answer

ANNEX VI: QUESTIONNAIRE FOR HOUSEHOLD AND COMMERCIAL CUSTOMER INTERVIEWS

USAID
FROM THE AMERICAN PEOPLE

USAID ენერგეტიკის პროგრამა
USAID Energy Program

AYPEG

საქართველოს ახალგაზრდა ენერგეტიკოსთა ასოციაცია
Association of Young Professionals in Energy of Georgia

Survey of Retail Consumers about Electrical Appliances and Time of Use Tariffs

The survey is being conducted as part of a project aiming to assess the impact of Time-of-Use tariff (ToU) regulation on electricity retail consumption. The project is implemented by the Association of Young Professionals in Energy of Georgia (AYPEG) within the framework of the USAID Energy Program.

* Required

1. What type of customer are you? [If you are both types of customer, please select one of them and answer the following questions for the selected consumer type] *

□ Household □ Commercial

2. In the first question if you selected a commercial consumer type, please tell us what type of commercial activities do you execute?

_ _

3. At what time of year is your space occupied? *

□ All year
□ Only in summer
□ Only in winter
□ I do not know
□ Other: _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

4. Which electrical appliances do you mainly use to heat the space? *

□ Cooling-heating mode air conditioner (so-called winter-summer air conditioner)
□ Electric heater
□ Central heating working on electricity
□ I do not use electrical appliances to heat the space
□ Other: _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

5. According to following months, on average how many hours do you use above mentioned appliance during the day and night to heat the space? * [Please answer this question if you selected any appliance in Question 4]

	1-3 hours	3-5 hours	5-10 hours	More than 10 hours	I do not use
October	□	□	□	□	□
November	□	□	□	□	□
December	□	□	□	□	□
January	□	□	□	□	□

February	□	□	□	□	□
March	□	□	□	□	□
April	□	□	□	□	□

6. According to following periods, on average how many hours do you use above mentioned appliance to heat the space? *

	1-3 hours	3-5 hours	Whole period	I do not use
00:00 to 08:00	□	□	□	□
From 08:00 to 18:00	□	□	□	□
From 18:00 to 24:00	□	□	□	□

7. Which of the following statements best describes your control over space heating? *

□ Set the selected (one) temperature and leave it for most of the time

□ Manually adjust the temperature (e.g. turn it off at night or when no one is in the area/space)

□ The device has an automatic temperature regulation function

□ I have no control over the device

8. If you do not use electrical an appliance to heat the space now, are you going to buy it and when? [Please answer this question if you selected answer "I do not use electrical appliances to heat the space" in Question 4]

□ Next year

□ After 2-3 years

□ After 3 or more years

□ I am not going to buy

□ I do not know

9. Basically, what type of electrical appliances do you use for space cooling?

□ Cooling-heating mode air conditioner (so-called winter-summer air conditioner)

□ Old window air conditioner

□ Portable conditioner

□ I do not use electrical appliances for space cooling

□ Other:_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

10. According to following months, on average how many hours do you use above mentioned appliance during the day and night for space cooling?* [Please answer this question if you selected any appliance in Question 9]

	1-3 hours	3-5 hours	5-10 hours	More than 10 hours	I do not use
May	□	□	□	□	□
June	□	□	□	□	□
July	□	□	□	□	□
August	□	□	□	□	□
September	□	□	□	□	□

11. According to following periods, on average how many hours do you use above mentioned appliance for space cooling? *

	1-3 hours	3-5 hours	Whole period	I do not use
00:00 to 08:00	□	□	□	□
From 08:00 to 18:00	□	□	□	□
From 18:00 to 24:00	□	□	□	□

12. Which of the following statements best describes your control over space cooling? *

- □ Manually adjust the temperature (e.g. turn it off at night or when no one is in the area/space)
- □ The device has an automatic temperature regulation function
- □ I have no control over the device

13. If you do not use electrical appliance space cooling, are you going to buy it and when? [Please answer this question if you selected answer "I do not use electrical appliances to heat the space" in Question 9]

- □ Next year
- □ After 2-3 years
- □ After 3 or more years
- □ I am not going to buy
- □ I do not know

14. Which electric vehicle do you own? *

- □ 1. Electric car
- □ 2. Electric Scooter
- □ 3. Electric bicycle
- □ 1 and 2 together
- □ 2 and 3 together
- □ 1 and 3 together
- □ All 3 together
- □ None of above

15. According to following periods, on average during a typical day how many hours do you charge above mentioned electric vehicle? *

	1-3 hours	3-6 hours	Whole period	I do not use
00:00 to 08:00	□	□	□	□
From 08:00 to 18:00	□	□	□	□
From 18:00 to 24:00	□	□	□	□

16. If you do not use an electric vehicle, are you going to buy it and when? [Please answer this question if you selected answer "I do not use electrical appliances to heat the space" in Question 14]

- □ Next year
- □ After 2-3 years
- □ After 3 or more years
- □ I am not going to buy
- □ I do not know

17. How would you rate the following statement: I largely cannot/do not control amount of money spent on space heating *

	1	2	3	4	5	
Fully Disagree						Fully Disagree
	□	□	□	□	□	

18. How would you rate the following statement: Despite my desire, it is difficult to reduce the electricity bill *

	1	2	3	4	5	
Fully Disagree						Fully Disagree
	□	□	□	□	□	

19. How would you rate the following statement: Despite my desire, it is difficult to reduce the electricity bill *

	1	2	3	4	5	
Fully Disagree						Fully Disagree
	□	□	□	□	□	

ToU tariffs allow customers to adjust their electricity consumption, reduce the load or shift it to the period of a day when it is cheaper, and therefore save on electricity bills. In case of a standard tariff, electricity tariff is constant during the day and night, which does not motivate customers to change or save electricity consumption. According to international experience, different tariff levels can be set at different times of day and night according to the ToU tariff scheme.

Periods of Day and Night	Name of Periods	Time of Use Tariffs	Standard Tariff
00:00 – 08:00	Night	Lower than Standard Tariff	Do not change during day and night periods and it is constant
08:00 – 14:00	Peak	Higher than Standard Tariff	
14:00 – 19:00	Day	Lower than Standard Tariff	
19:00 – 24:00	Peak	Higher than Standard Tariff	

20. Given this definition, how would you rate the following statement: Time of Use Tariff scheme is simple, easy to understand and usable *

	1	2	3	4	5	
Fully Disagree						Fully Disagree
	□	□	□	□	□	

21. Given this definition, would you like to be willing to participate in Time of Use Tariff scheme if it is implemented in Georgia? *

□ Yes

□ No

22. In the case of Time of Use Tariff scheme, would you save on electricity during the peak period on the following devices? *

	Yes	No	I do not have
Cooling / conditioning	□	□	□
Heating	□	□	□
Electric Vehicles	□	□	□
Lighting	□	□	□
electric oven	□	□	□

Washing machine/Dryer	◻	◻	◻

23. In the case of Time of Use Tariff scheme, would you shift electricity consumption from the peak period to the non-peak period partially and / or fully on the following devices? *

	Yes	No	I do not have
Cooling / conditioning	◻	◻	◻
Heating	◻	◻	◻
Electric Vehicles	◻	◻	◻
Lighting	◻	◻	◻
electric oven	◻	◻	◻
Washing machine/Dryer	◻	◻	◻

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