ENERGY REGULATORS
REGIONAL ASSOCIATION

STUDY ON

Regulatory Approaches of Electricity TSO & DSO Network Tariff Structures among ERRA Member Organizations

Submitted to ERRA by:

ECONOMIC CONSULTING ASSOCIATES

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Regulatory Approaches of Electricity TSO & DSO Network Tariff Structures among ERRA Member Organizations

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Abbreviations and acronyms

DP	Delivery point
DSO	Distribution system operator
DUoS	Distribution use-of-system
ECA	Economic Consulting Associates
EDZ	Economic development zone
ERRA	Energy Regulators Regional Association
EV	Electric vehicle
HV	High voltage
ICJ	International Court of Justice
IPP	Independent power producer
LMP	Locational marginal pricing
LRAIC	Long-run average incremental cost
LRMC	Long-run marginal cost
LV	Low voltage
MO	Member organisation
MV	Medium voltage
NUG	Non-utility generator
POD	Point of delivery
ToU	Time-of-use
TSO	Transmission system operator
TUoS	Transmission use-of-system
UoS	Use-of-system

Executive summary

The *Regulatory Approaches of Electricity TSO & DSO Network Tariff Structures* study draws on survey data collected from 26 member organisations (MOs) of the Energy Regulators Regional Association (ERRA) to investigate their approaches for regulating and determining the tariff designs of electricity transmission and distribution use-of-system charges and connection charges.

The study examines the following key concepts of tariff design for network use-of-system and connection charges: market structure and the unbundling of network tariffs, regulations and principles for tariff designs, tariff design calculation principles, drivers for grouping customers into categories, the charging of generators versus load, locational signals in the tariff designs, the types of charges used and the relative level of charges among customer categories. In addition, the study covers topics specific to the use-of-system charge including losses and special tariff categories for emerging challenges and technologies, and topics specific to connection charges, including the depth of the charge and the payment approach. A full account of present (as of May 2022) network charges in each country as well as country fact sheets with the information collected through the survey are included in the study.

1 Network use-of-system charges

Network use-of-system (UoS) charges refer to charges for using the transmission and/or distribution network. The use-of-system charge is typically used by Transmission System Operator (TSOs) and Distribution System Operators (DSOs) to collect the allowed revenues (eg revenues that recover efficient costs for developing, operating and maintaining the network).

Regulations and principles

The first part of the analysis for use-of-system charges concerns regulations and principles governing the determination of use-of-system tariff designs. The focus was on four relevant elements: bundling of charges, governance (tariff design regulations and guiding principles for designing tariffs), methodological approach, and frequency of tariff design reviews.

TSOs and DSOs are separate entities in almost all MOs except in Dubai, Bosnia and Herzegovina and Pakistan. In the sample of 26 MOs analysed, most MOs had only one TSO (92%), while most MOs had more than three DSOs (50%).

Use-of-system charges are completely unbundled in all MOs, except in Dubai, Thailand and Algeria, where charges are embedded in the end-user tariff. Although for Thailand the network use-of-system charge is embedded in the end-user tariff, aspects of the transmission use-of-system (TUoS) and distribution use-of-system (DUoS) charge could be identified separately. In Czechia, customers connected to the transmission network have a separate TUoS and those connected to the distribution network have a single, bundled, network use-of-system charge.

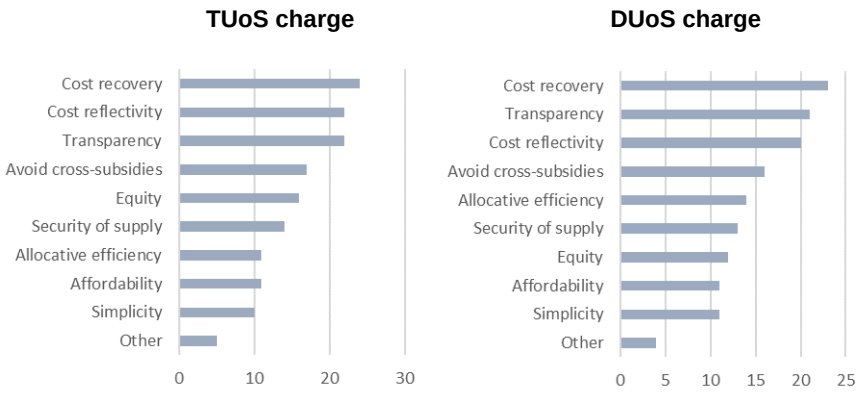
The unbundling of TUoS and DUoS charges in the majority of MOs provides a good basis for the development of cost-reflective charges.

Regarding governance of the regulatory framework, regulators are responsible for approving the tariff designs in all MOs, except in Peru (where DUoS charge design is approved by the

Government). A regulatory framework guiding the tariff design process is in place in all MOs except in Czechia, and in most cases (19 for TUoS and 20 for DUoS) the Regulator is responsible for developing this framework. Regulators in most cases are also responsible for developing the tariff designs for TUoS in 20 MOs (in five MOs the responsibility for the design is with the TSO), and for DUoS in 18 MOs (in seven MOs this responsibility is with the DSO).

The most common guiding principles for the development of network tariff designs are cost recovery, transparency and cost-reflectivity, among several others.

Frequency of guiding principles in tariff design regulations among MOs

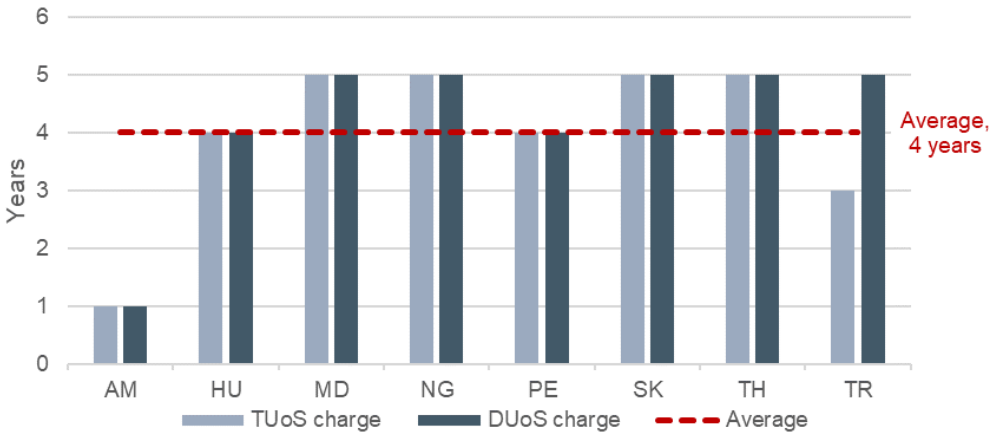


Source: Survey question 1.3.2 (use-of-system sheets)

About half of the MOs engage embedded cost as the methodological approach to determine cost-reflective-tariff design (14 MOs for TUoS and 12 MOs for DUoS), with six MOs applying long-run marginal cost approaches for TUoS and seven for DUoS.

Nine MOs specify the frequency of tariff design reviews in regulations, whereas most (16) MOs allow ad-hoc reviews of the tariff designs. Five years is the preferred period by most MOs for tariff redesigns where the frequency is set by the regulatory framework.

Frequency of tariff design reviews mandated by regulation among MOs



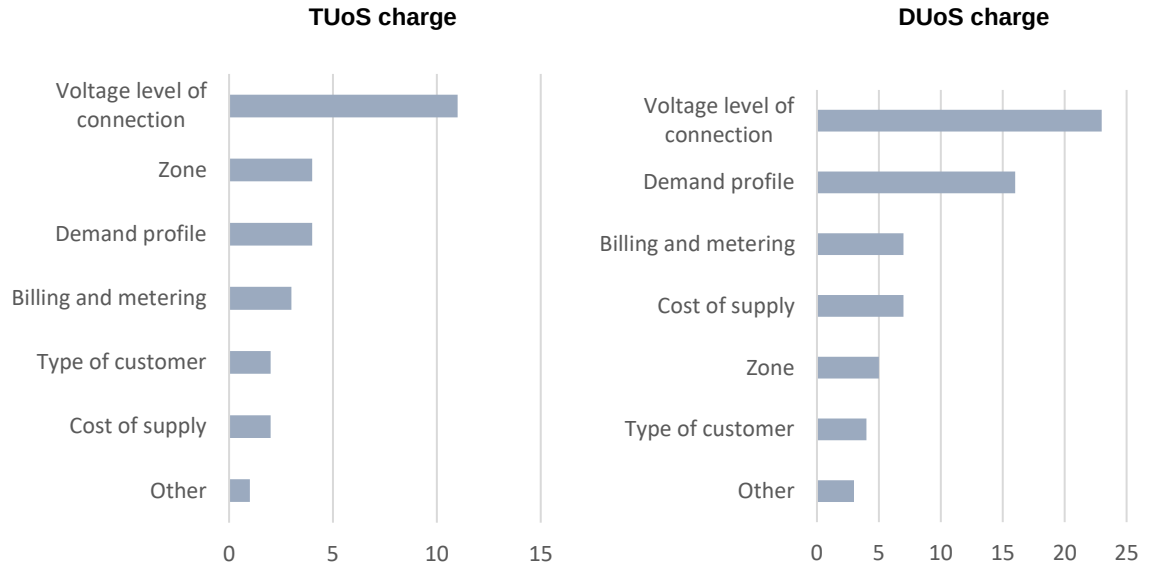
Source: Survey questions 1.5 & 1.5.1 (use-of-system sheets). Key: ✓ (yes), x (no).

Customer categories

The analysis further concerns the design of customer categories for the application of use-of-system network tariffs. The analysis includes a discussion on drivers, metering, and voltage levels.

The separation of charges into distinct customer categories is more common for DUoS charges (in 23 MOs) than for TUoS charges (in 14 MOs). Where customer categories exist, the voltage level of connection is the principal driver for separating charges into customer categories for both the TUoS and DUoS charges. For the DUoS charge, the demand profile is also a key driver, while it is less prominent for the TUoS charge (in 16 MOs versus four MOs, respectively).

Frequency of drivers for separating charges into customer classes among MOs



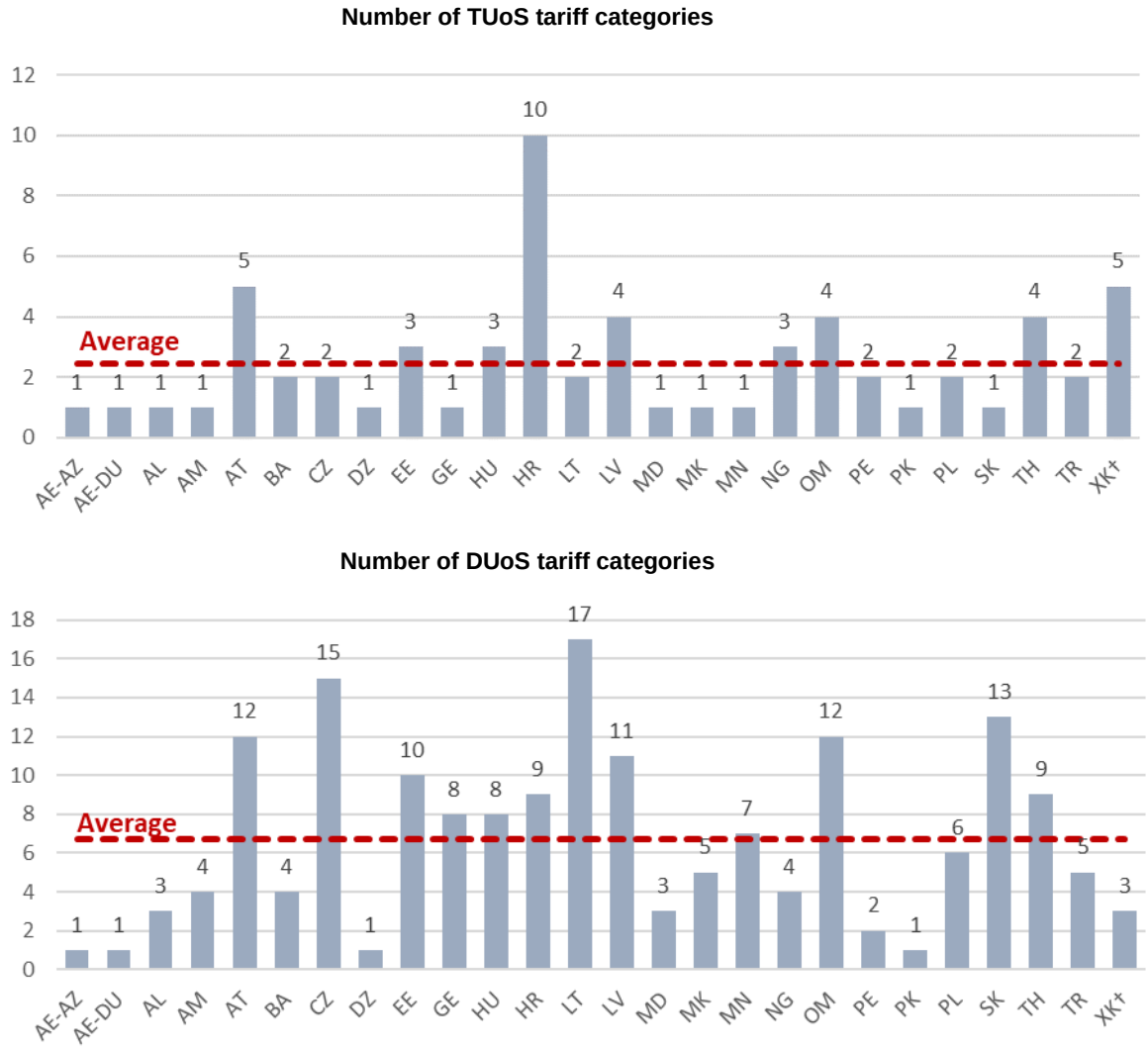
Source: Survey question 2.1 (use-of-system sheets). Key: ✓ (yes), x (no).

The type of meter installed affects what type of charges can be imposed. Electronic meters are more common for most MV- and HV-connected customers (12 MOs each) allowing for the application of more complex and time-of-use tariff designs. MV customers enjoy smart meters in nine MOs and HV customers in 11 MOs. There are still several MOs where electromechanical meters are used for non-LV customers: one for HV customers, and three for MV customers. Electromechanical meters are still more common for LV-connected customers in over a third of MOs. Smart meters for LV-connected customers are only used in four MOs, and the rest are using simple electronic meters.

DSOs operate networks with voltage levels spanning 0.22-132kV, while TSOs operate voltage levels spanning 6-750kV.

In the ERRA sample, the average number of tariff categories for TUoS charges was three. The most typical structure included the following three categories: (1) for the use of the system by DSOs, (2) for the use of the system by generators and (3) for the use of the system by transmission connected industrial customers. The number of DUoS tariff categories was much higher due to the need to recognise the cost of supply for different customer categories. The minimum number of DUoS tariff categories was one, the maximum 17 and the average seven.

Number of tariff categories for network use-of-system charges among MOs



Source: Survey (present charges sheet).

In principle, network charge categories should group different types of customers based on their relative costs of supply. The distinctions of customer categories should be very clear and easily verifiable to avoid the risk of 'gaming' by customers. An excessive number of categories should also be avoided, as it makes it harder for customers to understand, makes it more administratively complex for the operator, and can make it more difficult to verify distinctions. Customer categories are also often used to meet social objectives, for example subsidising residential customers or to deal with new emerging challenges such as the penetration of EVs.

Distinguishing among customer categories would not be required, if charges could be differentiated by time-of-use and voltage of supply, hence the importance of metering to that effect. The current penetration of smart meters in the MOs considered does provide a prospect further rationalisation of charging based on actual time-of-use in most MOs.

Locational signals

The next element reviewed by the study is the provision or not of locational signals through the network use-of-system charges. Most use-of-system tariff designs do not adopt locational pricing (21 MOs for TUoS and 22 MOs for DUoS charges). There are only four MOs where TUoS charges provide locational signals and two MOs provide such signals for DUoS charges. Where locational signals are adopted, zonal pricing is used in all cases. Despite the clear advantage of location reflective rates on economic efficiency, other considerations such as equity and regional development seem to block their use across most of the MOs.

Except in Turkiye and Peru, where generators and load are each charged with 50% of TUoS costs, in most other cases both TUoS and DUoS charges are applied by 100% to load. Only up to 10% of TUoS and DUoS costs are recovered by generators in four and six MOs, respectively. Charging only load for the use of the network, as in the majority of the MOs, is based on a variety of reasons, including the avoidance of distortions in cross border trade, in connection with the fact that such charges end up being transferred to final customers anyway, the avoidance of negative signals to generators, especially for distributed generation, etc.

Types of charges

On the types of charges applied the discussion spans across analysis of fixed charges, energy charges, reactive power charges, demand and access charges. The following definitions were established for the purpose of this study to create a common basis for the comparison of types of network charges used among MOs.

Definitions used in this study for the types of charges

Charge	Definition
Fixed charges	*A constant sum paid by the customer at pre-determined time intervals (eg per day, month, or year), irrespective of the customer's demand, system peak or other characteristics.*
Energy charges	*A charge paid by the customer for each unit of energy consumed (eg per kWh, per MWh, etc). It may or may not differentiate by time-of-use.*
Demand charges	*A charge paid by customers for use of network capacity. It is based on the metered maximum demand in a given time period (eg kW or kVA per period). It may or may not differentiate by time-of-use.*
Access charges	*A charge paid by customers for contracted capacity or supply capacity per kW or kVA per period. It may or may not differentiate by time-of-use (eg it may be more expensive in some seasons).*
Reactive power charges	*A charge expressed in $/kVArh for reactive power*

Note: The above charges can vary by season and/or time-of-use (ToU). If the charge does not vary according to time-of-use the charge is referred to as flat.

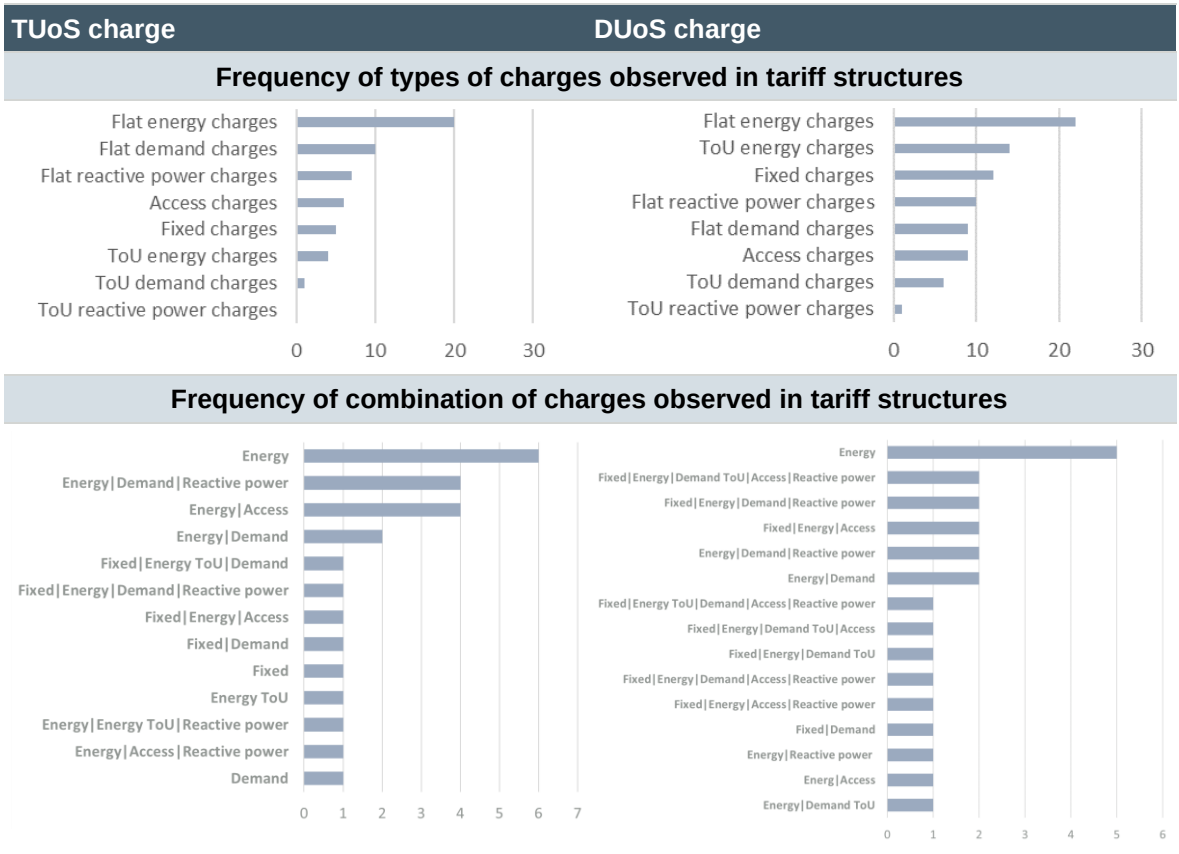
Economically efficient network charges should have (ideally time-varying) energy charges to recover variable costs, plus a demand or access charge to recover fixed costs and a fixed charge per customer to recover cost that change by the number of customers. The cost for the provision of reactive power should also be recovered through an appropriate scheme, either through reactive power penalties that incentivise the improvement of power factors or through reactive power charges.

In practice, there is no unique, single best practice for implementing this theoretical standard, and rates will often deviate from this ideal structure for many reasons, including issues of acceptability, affordability, simplicity, equity and cost of metering relative to the benefits achieved from more complex rate structures and other policy objectives.

Whether charges are applied per kW (or per kVA) or per kWh, to be cost-reflective the charges should ideally be differentiated by time-of-use. Relative lack of time-of-use charges, along with the diversity in the application of fixed, demand and access charges among the MOs, means there is ground for improvement of economic efficiency.

In the ERRA sample, energy charges are more common than any other type of charges for both the transmission and the distribution networks. Furthermore, flat charges are more common than time-of-use charges for TUoS and DUoS. Flat energy charges are simpler (both for customers to understand and for the network operator to apply) and they are typically supported by all types of metering devices. However, they weaken cost-reflectivity.

Types of use-of-system charges applied in each country among MOs



Note: Several MOs also offer Energy ToU or Demand ToU charges instead of the flat charges mentioned above.

Fixed charges are included in the tariff designs of 12 MOs for DUoS charges, and five MOs for TUoS charges. LV residential customers are more likely to have a fixed charge than other tariff categories. Fixed charges are mainly expressed monthly and, in a few cases, they are expressed annually.

Demand and access charges are included in the tariff designs of 16 MOs for TUoS charges, and 18 MOs for DUoS charges. Demand or access charges are frequently used for the recovery of network use-of-system costs as they can reflect the fixed costs of network capacity. Even though demand or access charges can better reflect the fixed costs of capacity for networks, they are less common than energy charges in the ERRA sample for reasons of simplicity and due to metering constraints. The application of demand charges requires the use of suitable metering which is not available for most MOs for smaller customers. Another factor that affects the application of demand or access charges is the ability of customers (especially residential and small commercial customers) to understand this type of charges. For simplicity and practicality demand charges are often avoided for smaller customers.

In the ERRA sample, demand charges are more frequent than access charges for TUoS and DUoS charges. Ten MOs use demand charges, and six MOs use access charges. None use both. For DUoS charges, 14 MOs use demand charges, and nine MOs use access charges. In DUoS charges there are four MOs who use both.

Demand and access charges can be expressed in terms of kVA or kW. Most MOs express these charges using kW.

Time-of-use energy charges typically have within day variation (in all four MOs with time-of-use TUoS charges and in 13 of 14 MOs with time-of-use DUoS charges), and sometimes contain daily or seasonal variation. Within day variation appears in the one time-of-use energy charge and in five of six time-of-use demand charges. Between-day variation appears in one energy charge and seasonal variation appears in one energy charge. Unlike the energy charge, the demand charge is expressed on a much simpler temporal basis with little combination of within day, between-day and seasonal variation.

TUoS apply flat reactive power penalties in seven MOs, and DUoS in ten MOs. The minimum power factor range is 85-99% among MOs for the penalty to apply. Only Bosnia and Herzegovina applies time-of-use reactive power charges in DUoS.

Special tariffs

No MOs have adopted special tariff designs for the TUoS charge for the categories examined (electric vehicles, smart technologies, self-generators, distributed generation and storage, independent power producers, social tariffs, economic development zones).

Special tariff designs exist for electric vehicles, self-generators and distributed generation and storage for the DUoS charge across six MOs. With the introduction and planned wide penetration of electric vehicles, and electrification of activities such as space heating, not only the provision of signals for timing of consumption becomes critical, but also the expected high rise in prior not existing demand has to be faced, as this may be expected to have a significant impact on electricity system cost, including both transmission and distribution network infrastructure. Hence, MOs are faced with the challenge of structuring network charges to make an efficient use of electricity, optimise the requirements for new investments to cover the increasing demand and enhance economic efficiency.

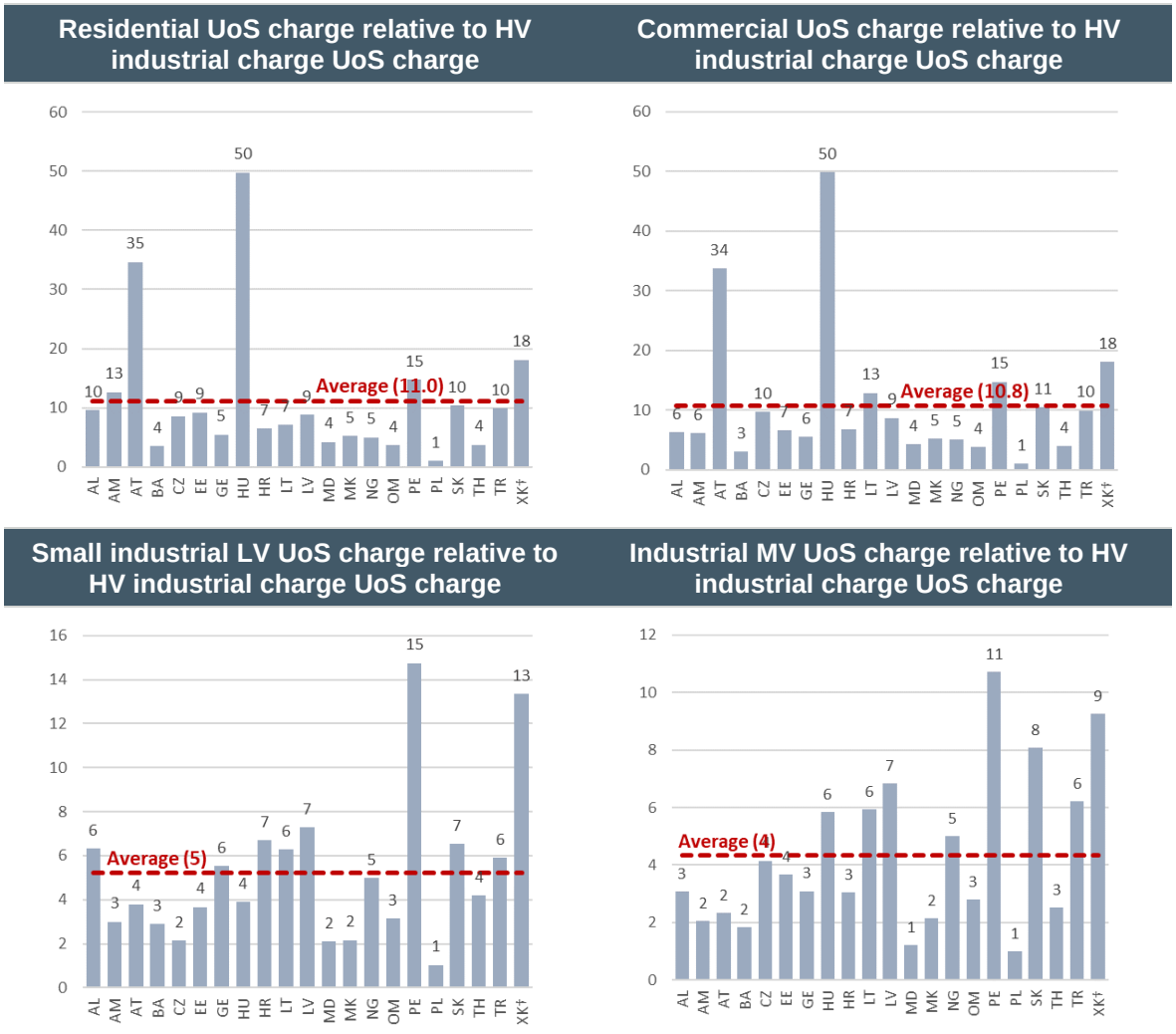
Treatment of losses

Almost all MOs economically account for losses in transmission and distribution (with the exception of Mongolia, where the entire network losses are only accounted for through the DUoS charge). 20 of 24 MOs account for losses by including them in the TUoS charge, and 23 of 25 MOs in the DUoS charge. The remaining MOs account for losses using loss factors.

Relative level of network use-of-system charges among customer categories

The relative level of network use-of-system charges among customer categories is shown in the figure below. The comparison is conducted relative to the HV industrial charge of each country. Residential tariffs are on average 11.0 times higher than HV industrial tariffs. Commercial tariffs are on average 10.8 times higher than HV industrial tariffs. Small industrial LV tariffs are on average five times higher than HV industrial tariffs and MV Industrial tariffs are four times higher than HV industrial tariffs.

Relative level of network use-of-system charges among customer categories among MOs

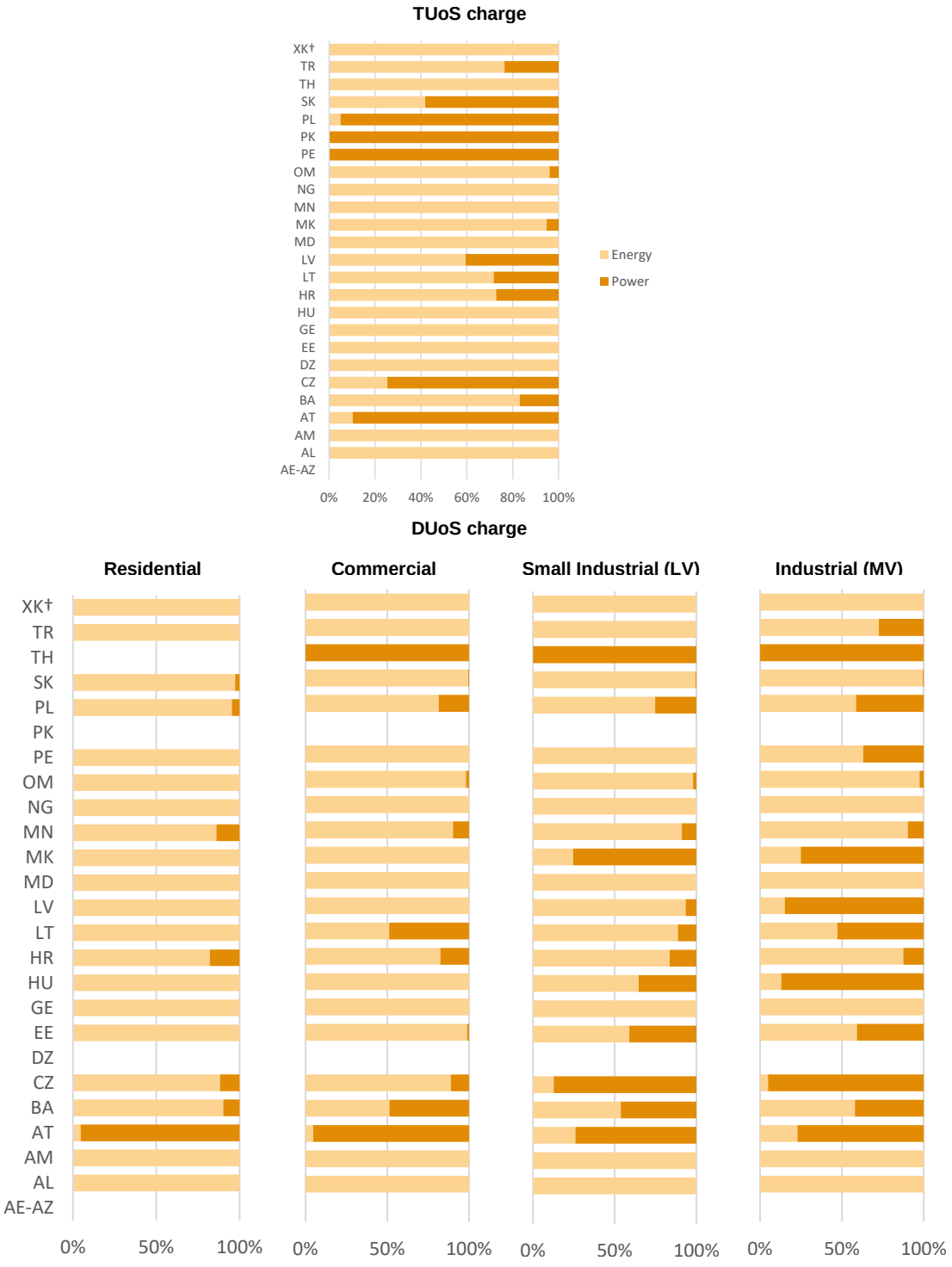


Source: Survey (present charges sheet).

Energy and capacity split of network use-of-system charges

The split between energy and capacity charges for the TUoS charge and the individual categories in the DUoS charge is sown below. Energy charges are the primary means for raising revenue for the TUoS charge and DUoS charges.

Split of energy and power charges in the network tariff designs among MOs



Source: Survey (present charges sheet).

2 Connection charges

Connection charges refer to charges for connecting to the electricity network. The charge is typically used by TSOs and DSOs to pay for the construction and maintenance of assets used to connect the user to the network. In this section, we discuss and evaluate the principles and approaches that are used for designing connection charges.

Regulations and principles

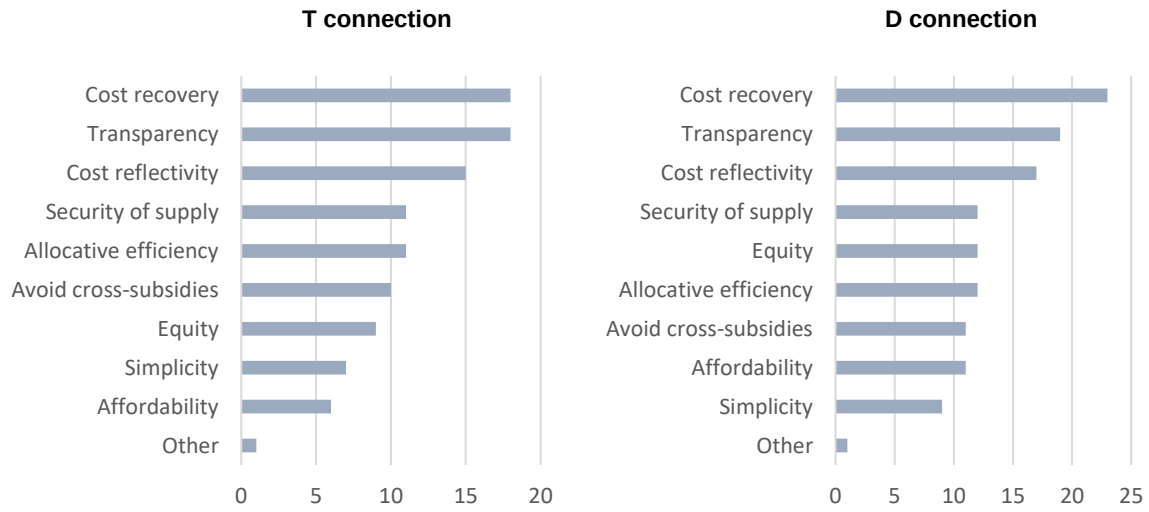
Regulators are mostly responsible for developing the connection charge policy (in 13 MOs for connections to the transmission network and 15 MOs to the distribution network), followed by the TSOs (nine and eight MOs respectively), the Government (two and three MOs, respectively. TSOs and DSOs have a larger role in the design of connection charges than for use-of-system charges.

The connection charge policy approval is done by the regulators in 21 MOs for connections to the transmission network and in 23 MOs for the distribution network. TSOs only approve these policies in two MOs, DSOs in three MOs, and the Government, or another entity account for the remaining cases.

Regulatory frameworks governing connection charges exist in 22 MOs for transmission and 23 MOs for distribution connections. Where they exist, the regulator is mostly responsible for developing them (15 and 21 MOs respectively). In a few MOs, there is a joint role between the regulator, the TSO/DSO, the Government and the parliament.

Cost recovery, transparency and cost-reflectivity are the most frequent guiding principles for the development of regulatory frameworks governing connection charges among others.

Frequency of guiding principles for tariff design of connection charges in regulations among MOs

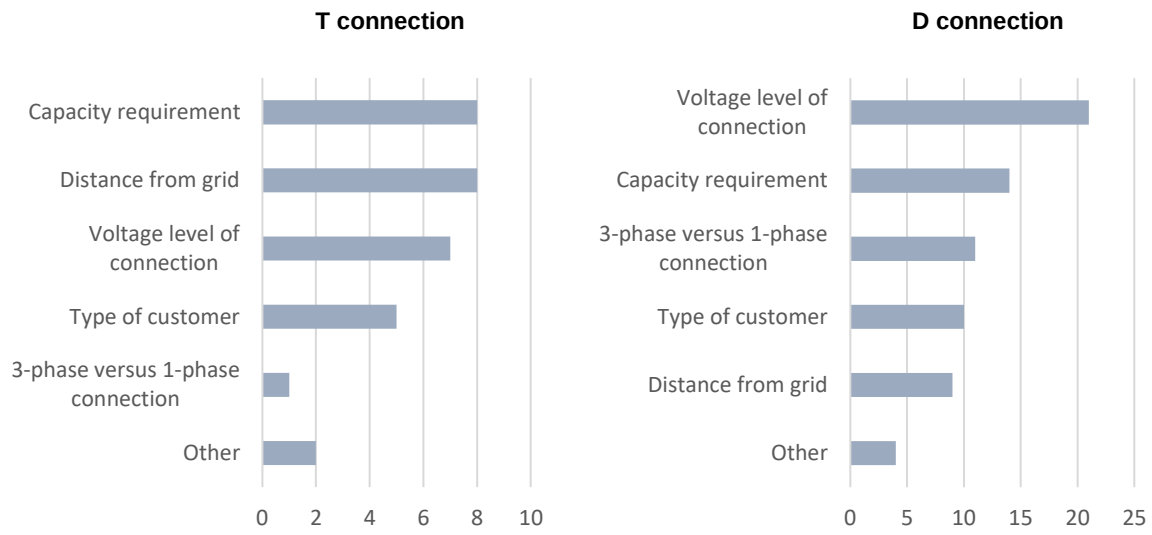


Source: Survey question 1.3.2 (connection sheets).

Customer categories

The key driver for grouping customers for connection charges should be the cost of the connection. Customers with similar costs of connection should be grouped together. Distance from the grid, capacity requirements, three-phase versus single-phase connection and the voltage level of supply are and can be used as proxies for the cost of the connection. The frequency of drivers used among MOs to design customer categories for connection charges is shown below.

Frequency of drivers for separating charges into customer classes among MOs



Source: Survey question 2.1 (connection sheets).

Most MOs in the ERRA sample distinguish multiple customer categories for transmission and distribution network charging. Separation of connection charges into distinct customer categories is more common for distribution (in 23 MOs) than for transmission (in 12 MOs). However, the categorisation of customers using the above drivers does not in itself provide the essential factor regarding the determination of fair and cost-reflective connection charges. The outcome also depends on how costs are calculated, whether connection costs may be shared when multiple users connect to the grid at different points in time, and other factors specific to each particular case.

Depth of charge and payment method

The purpose of connection charges (irrespective of the model chosen) is to recover the initial, non-recurring connection costs that enable users to receive network services. In general terms, and as further discussed below, there are key design choices to be made (‘shallow’ charging, ‘deep’ charging and hybrid), as well as variations within each regarding the payment options (up front, in limited instalments, periodically).

Depending on the location of the charging boundary a ’deep’, ’shallow’ or a ’hybrid’ methodology may be developed. The basic variants of the connection charging policies comprise:

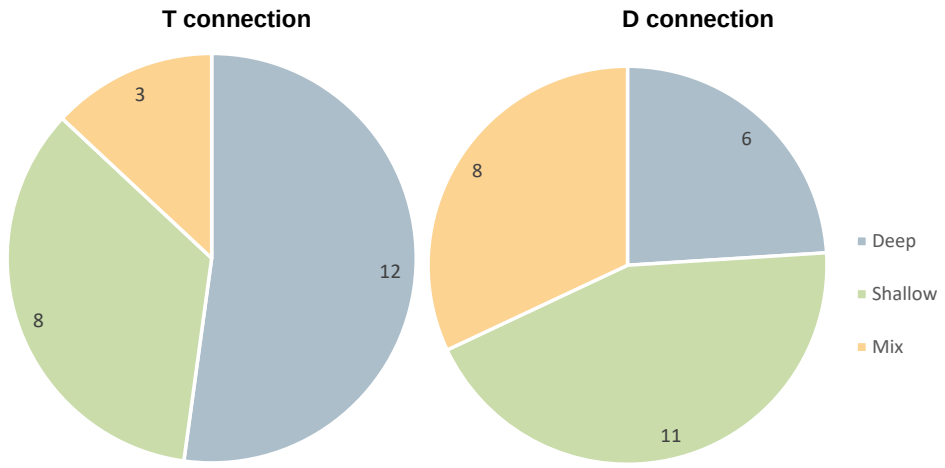
- **Shallow policy –** this does not charge the applicant project for reinforcements to the existing system but charges only for the connection line/cable and other equipment directly or exclusively relating to the connection. All other costs are socialised through the use-of-system charge.

- **Deep policy –** this charges for reinforcements to the existing system as well as the direct connection costs (ie all network costs incurred as a result of the connection). This can include network expansion costs (the cost for expanding the network to the customer's area) and any remote costs (ie upstream costs to the network).

The connection charge policy can be also used to signal location constraints or costs to network users. Deep connection charges provide locational signals regarding the development of new generators and load centres. On the contrary, shallow connection charges cannot provide locational signals regarding the cost of connection to and using the network.

The approach followed by each MO regarding the depth of charge for connection charges is shown below.

Depth of connection charge among MOs



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Transmission connection charge																										
Deep		✓	✓	✓		✓			✓		✓	✓	✓	✓		✓				✓			✓			
Shallow	✓				✓		✓			✓					✓		✓		✓			✓				
Mix								✓										✓								✓
Distribution connection charge																										
Deep		✓	✓	✓							✓		✓							✓	?					
Shallow	✓				✓	✓	✓								✓		✓	✓	✓		?	✓		✓	✓	
Mix								✓	✓	✓		✓		✓		✓					?		✓			✓

Source: Survey question 3.1 (connection sheets). Key: ✓ (yes), ? (no data)

In the ERRA sample, transmission connection charges are mostly deep, but distribution connection charges are mostly shallow. This is a typical approach since customers or generators connecting to the transmission system have higher costs to connect which are solely attributed

to their premises. It is fair to charge these customers the costs of connection through deep connection charges rather than socialise the costs through the use-of-system charge and have other customers pay for their connection costs. At the same time it is simple to have deep connection charges for such customers as their number is limited and the administrative burden to implement individual connection charges through a deep policy is relatively small.

On the other hand, the number of customers connecting to the distribution network is large and applying deep connection charges for smaller customers would impose a high administrative burden for the network operator; either to estimate the actual cost of connection for each individual customer or to approve the cost of connection estimated by the customer. Therefore, for smaller customers shallow approaches are preferred for reasons of simplicity. Shallow approaches undermine cost-reflectivity, and this creates the need of several customer categories with different connection charges to reflect the cost of connecting each group of customers. As it was seen in the customer categories section above, due to the shallow policy for distribution connected customers there is higher need to have several types of connection charge categories.

Shallow charges are sometimes preferred for reasons of social equity. The argument in favour of social equity is that customers in remote areas who have higher costs for connection should not be penalised and should receive equal treatment to those which had the luck to be born in urban centres.

In most cases, ownership of the connection assets is transferred to the TSO/DSO, but there are also several cases where the lines and equipment remain in the ownership of the customer. In most cases, the TSO/DSO pays for maintenance of the line (15 MOs for the transmission connection and 20 MOs for the distribution connection), with the customer paying for maintenance of the assets in the remaining cases.

The connection charge is typically made in one payment (18 MOs for connections to the transmission network and 23 MOs to the distribution network), with the remaining MOs allowing amortisation over time, or a mixed approach. Cost sharing of connection charges is applied in less than half of the MOs (ten MOs for transmission and ten MOs for distribution connections). Cost sharing tends to have a longer time limit for the distribution connection charge than for transmission. Most time limits for sharing of distribution connection costs are above five years, while for transmission less than five years.

The transmission connection charge is calculated on a case-by-case basis in 19 MOs, while the distribution connection charge is pre-determined for customer categories in 18 MOs.

The decision for the depth of charge and the payment methods depends on several factors which are different in each case. There is not one best practice that can fit all cases. Below we have summarised some key benefits and disadvantages of deep against shallow connection charge policies:

Principles	Comment
Cost-reflectivity	Deep connection charges are more cost-reflective in comparison to shallow connection charges and can better provide locational signals.
Cost recovery	Both deep and shallow connection charges can ensure cost recovery given that the cost estimates for the development of the assets is close to the actual cost of the connection. However, shallow charging most typically requires the determination of the connection cost early in advance as a standard payment. If the cost of materials changes rapidly then the standard fee may be inadequate to

Principles	Comment
	cover the actual connection costs. In such cases frequent updates of connection fees are required.
Equity	Deep connection charges are more cost-reflective and fair, but they do not promote social equity.
Simplicity	Deep connection charges for a wide number of customers can become very complex. Shallow connection charges are typically simpler and easier to understand.
Administrative burden	The administrative burden of deep connection charges is higher than shallow connection charges for the same number of customers.
Affordability	Deep connection charges may be unaffordable for some customer categories especially for poor households living in remote areas. Shallow connection charges socialise the costs for reinforcements needed upstream in the network.

1 Introduction

ECA Economics Athens (ECA) has been contracted by the Energy Regulators Regional Association (ERRA) to assist with a *Study on Regulatory Approaches of Electricity TSO & DSO Network Tariff Structures among ERRA Member Organisations (MOs)*. The scope was to collect information from MOs in relation to electricity network tariff designs and connection charges to deliver a study for benchmarking / knowledge sharing of tariff designs and policy developments. A second objective was to deliver an insight for other institutions, such as market participants or customers for further analysis.

At the outset, it is important to recognise the distinction between:

- ***Revenue requirements/average tariff levels -*** calculated by building up allowed costs to determine the level of revenues that are needed to recover efficient operating costs, investment costs and return on assets; and

- ***The structure/design of the tariffs -*** the structure / design of tariffs includes consideration of tariff categories, types of charges, seasonal and daily time-of-use periods and/or dynamic pricing, relativities between charges, charges to implement special policy objectives, etc.

The study draws on survey data collected from 26 MOs of ERRA and covers network use-of-system and connection charges. To collect data for the study ERRA issued a questionnaire to 32 MOs. The questionnaire was prepared by ECA and included questions in relation to the market structure, the regulatory framework for the design of network use-of-system and connection charges and the tariff designs of network use-of-system and connection charges. **Responses from 26 MOs were collected covering 25 countries, resulting in a response rate of 81%.** This compares with ERRA's 48 MOs and 44 countries.

The MO respondents are listed in Table 1 alongside their ISO country codes, which are used throughout the report.

Table 1 Countries surveyed

Regions	Countries	ISO codes
Americas	Peru	PE
Asia	Mongolia, Pakistan, Thailand	MN, PK, TH
Caucasus	Georgia	GE
Europe	Albania, Armenia, Austria, Bosnia and Herzegovina, Czechia, Estonia, Croatia, Hungary, Lithuania, Latvia, Moldova, North Macedonia, Poland, Slovakia, Turkiye, Kosovo*	AL, AM, AT, BA, CZ, EE, HR, HU, LT, LV, MD, MK, PL, SK, TR, XK*
Middle East and North Africa (MENA)	United Arab Emirates (Dubai and Abu Dhabi), Algeria, Oman	AE-AZ, AE-DU, DZ, OM
Sub-Saharan Africa	Nigeria	NG

Note: *This designation is without prejudice to positions on status and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.

The remainder of this report collates MO responses to elaborate and compare regulatory principles for setting tariff designs (regulations, principles, methodologies, etc), tariff designs (customer categories, types of charges, locational signals, losses, etc), connection charges (customer categories, types of charges, locational signals, etc) and the impact of energy transition on the tariff structure design among MOs:

- ***Section 2 Use-of-system charges –*** elaborates on tariff designs for network use-of-system charges using the data submitted by 26 MOs, including:
    - Regulations and principles adopted for network use-of-system tariff designs
    - Drivers used for the grouping customers for network use-of-system charges
    - Approach implemented in the tariff designs for the provision of locational signals
    - Treatment of generators versus load in the charging approach
    - Types of charges that are being used (energy, capacity, fixed, time-of-use, etc)
    - Use of special tariff designs for emerging technologies
    - Treatment of losses in the tariff designs and
    - Present level of network use-of-system charges.
- ***Section 3 Connection charges –*** presents the tariff design of connection charges for the 26 MOs and elaborates on:
    - The regulations and principles governing the design of connection charges
    - The grouping of customers to categories for connection charges
    - The depth of charge and the payment method for connection charges
    - Treatment of generators versus load in the charging approach
    - Present level of connection charges
- **Annexes:** (A1) Present charges in each country; (A2) glossary of terms; (A3) the questionnaire issued to participants; (A4) Country fact sheets.

2 Use-of-system charges

Network use-of-system (UoS) charges refer to charges for using the transmission and/or distribution network. The use-of-system charge is typically used by Transmission System Operators (TSOs) and Distribution System Operators (DSOs) to collect the allowed revenues (ie revenues that recover efficient costs for developing, operating and maintaining the network).

This section discusses and evaluates the principles and approaches that are used for designing UoS charges. The discussion was structured across seven subsections:

- **Regulations and principles:** Presents elements regarding the market structure and whether network charges can be identified separately in the tariff designs. Further on it discusses the regulations and principles governing the tariff design (regulatory framework, guiding principles, methodological approach for designing the tariffs, and frequency of tariff design reviews).

- **Customer categories:** Identifies how customers have been grouped for the application of network UoS charges, metering arrangements that may affect the application of tariff designs and key drivers for separating customer to customer categories.

- **Locational signals:** Analyses the presence of locational signals in tariff design and different approaches in the tariff design for the provision of locational signals.

- **Generators versus load:** How use-of-system costs are recovered from generators and load.

- **Special tariff designs:** Tariff designs that exist to address specific policy objectives (such as social tariffs) or special tariffs for new emerging technologies (such as electric vehicles (EVs), distributed generations, smart devices, etc).

- **Types of charges:** The types of use-of-system charges entities use and their characteristics (energy charges, capacity charges, fixed charges, seasonal time-of-use charges, reactive power charges, etc.).

- **Levels of charges:** The existing charges for each MO country in 2022[1].

2.1 Unbundling of network charges in the tariff design

Network UoS charges can be identified in markets where network charges are unbundled from generation, supply and other charges. To ensure a like for like assessment among the tariff designs of MOs, we report below the level of unbundling in each country and if network tariffs could be identified separately in each MO tariff design.

[1] The survey was completed in May 2022 and references to the levels of charges concern the period before the energy price hike of 2022.

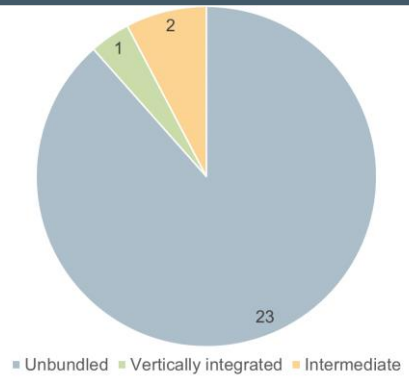
In the ERRA sample, **TSOs and DSOs are separate entities in almost all MOs** (see Table 2). In one case, the TSO and DSO are vertically integrated (Dubai), and in two cases they are intermediate (Bosnia and Herzegovina and Pakistan). In the sample of 26 MOs analysed, most MOs had only one TSO (92%), while most MOs had more than three DSOs (50%).

Regarding the bundling of network tariffs, **charges are completely unbundled in all MOs except in four cases**. In Dubai, Algeria and Thailand use-of-system charges are embedded in the end-user tariff. Thailand was able to unpick aspects of the Transmission use-of-system (TUoS) and Distribution use-of-system (DUoS) charges from the end-user tariff and Algeria was able to unpick the TUoS charge (but not the DUoS charge). For this reason, **in the remainder of this chapter, we do not report data for Dubai or for Algeria's DUoS charge, but we do report information for Thailand**.

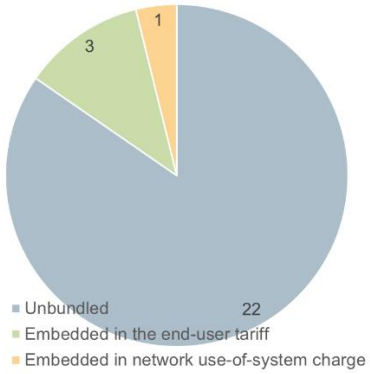
In Czechia, the use-of-system charges for customers connected to the distribution network are embedded in one network use-of-system charge (distinguished from the overall end-user tariff), but customers connected to the transmission network have a separate transmission use-of-system charge. For Czechia, data for the DUoS charge in the remainder of this report refer to the combined network charge, while data for the TUoS charge refer to the use-of-system charge for customers connected directly to the transmission network.

Table 2 Bundling of network use-of-system charges

Transmission and distribution entities vertical integration



Transmission and distribution use-of-system charges unbundling



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Transmission and distribution entities vertical integration																										
Vertically integrated		✓																								
Unbundled	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Intermediate						✓															✓					
Transmission and distribution use-of-system charges unbundling																										
Unbundled	✓		✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Embedded in network UoS charge							✓																			
Embedded in the end-user tariff		✓						✓																✓		

Source: ERRA Survey

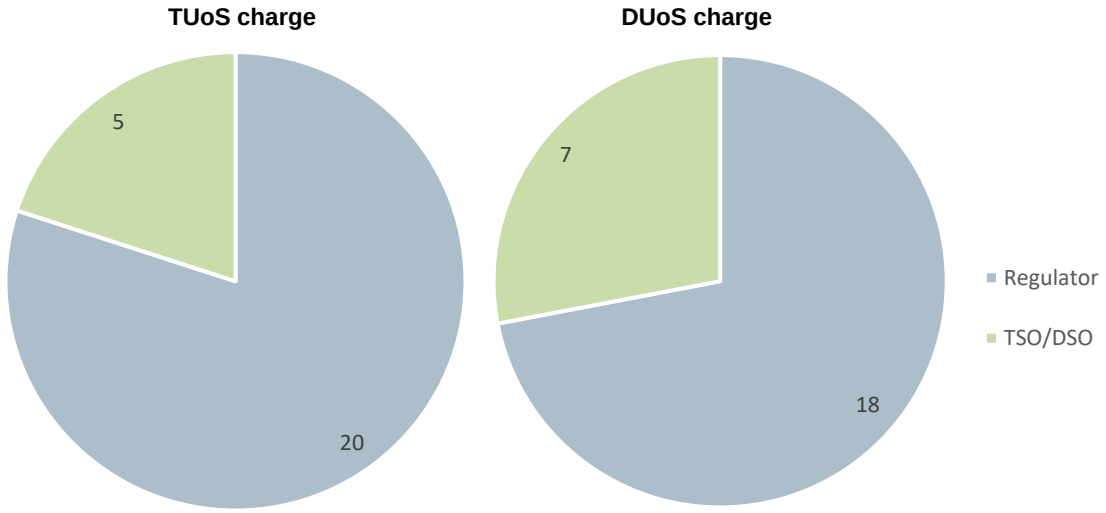
2.2 Regulations and principles for tariff designs

The design of electricity tariffs is typically guided by regulatory principles. In some cases the regulations may clearly define the electricity tariff design or the methodology to derive tariff designs and in other cases the TSO or DSO is responsible to develop the tariff designs subject to regulatory guidance and principles. This sub-section examines the allocation of responsibilities for the development of tariff designs, the entity responsible to approve the tariff designs, the most common methodologies used to derive cost-reflective tariff designs and the guiding principles for the design of network UoS charges.

2.2.1 Governance of the tariff design process

In the ERRA sample, **regulators are mostly responsible for approving and developing the tariff designs** (see Table 3 and Table 4). **While some TSOs and DSOs develop the use-of-system charge, none approve it.** Approval is overwhelmingly the responsibility of regulators (and, in one case, of the Government). Thus, MOs tend to place the final decision with regulators, which implies that customer interests are protected wherever the regulator is independent.

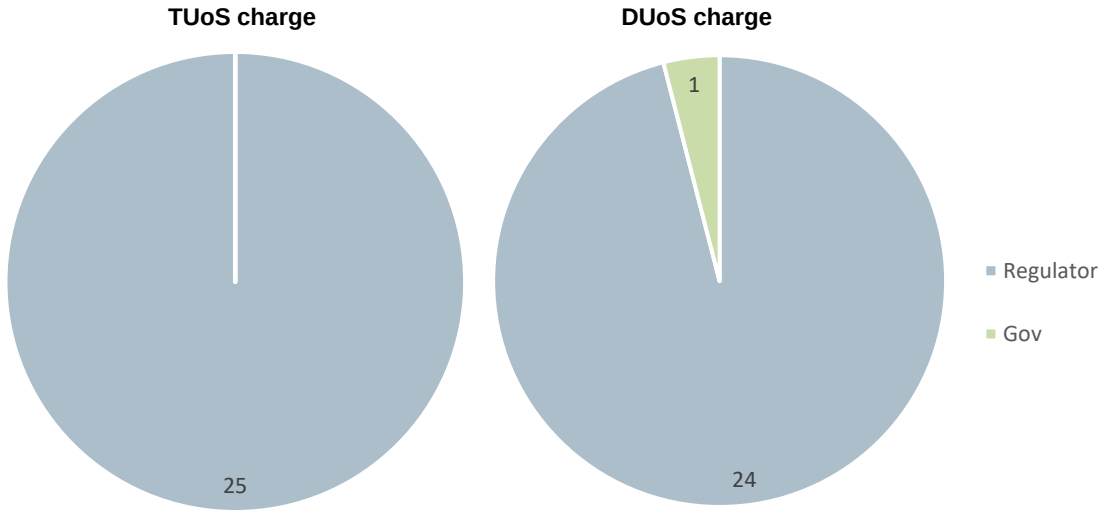
Table 3 Entity responsible for developing the use-of-system charge design



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
TUoS charge																										
TSO	✓								✓				✓											✓		✓
Reg			✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
DUoS charge																										
DSO	✓								✓				✓	✓				✓						✓		✓
Reg			✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓		✓	✓	✓	✓	✓		✓	

Source: Survey question 1.2 (use-of-system sheets). In Poland, the tariff design is set in law, but the regulator has the final decision.

Table 4 Entity responsible for approving the use-of-system charge design

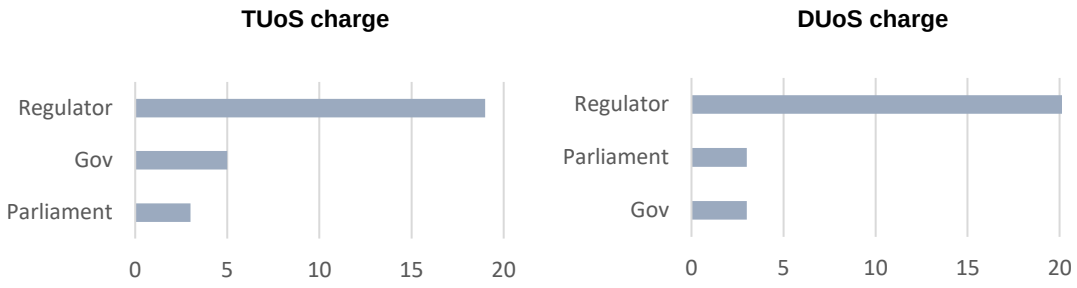


	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
TUoS charge																										
Regulator	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
DUoS charge																										
Regulator	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Government																				✓						

Source: Survey question 1.1 (use-of-system sheets).

Regulatory frameworks can be used to guide the tariff design process. A regulatory framework is a document outlining a regulatory approach or methodology for the design of network use-of-system charges. In the ERRA sample, **regulatory frameworks are in place in most settings** (see Table 5). The **regulator is the responsible entity to develop the regulations for the tariff designs in most MOs**. However, unlike allowed revenue frameworks (which specify how to calculate the allowed revenue), tariff design frameworks (which specify or guide how to design the tariff structure) tend to be looser and allow more freedom in approach. The regulator typically sets boundaries using a regulatory framework while regulated entities may develop the tariff design under the boundaries set by the framework.

Table 5 Entity responsible for developing regulations on tariff designs



Source: Survey question 1.1 (use-of-system sheets).

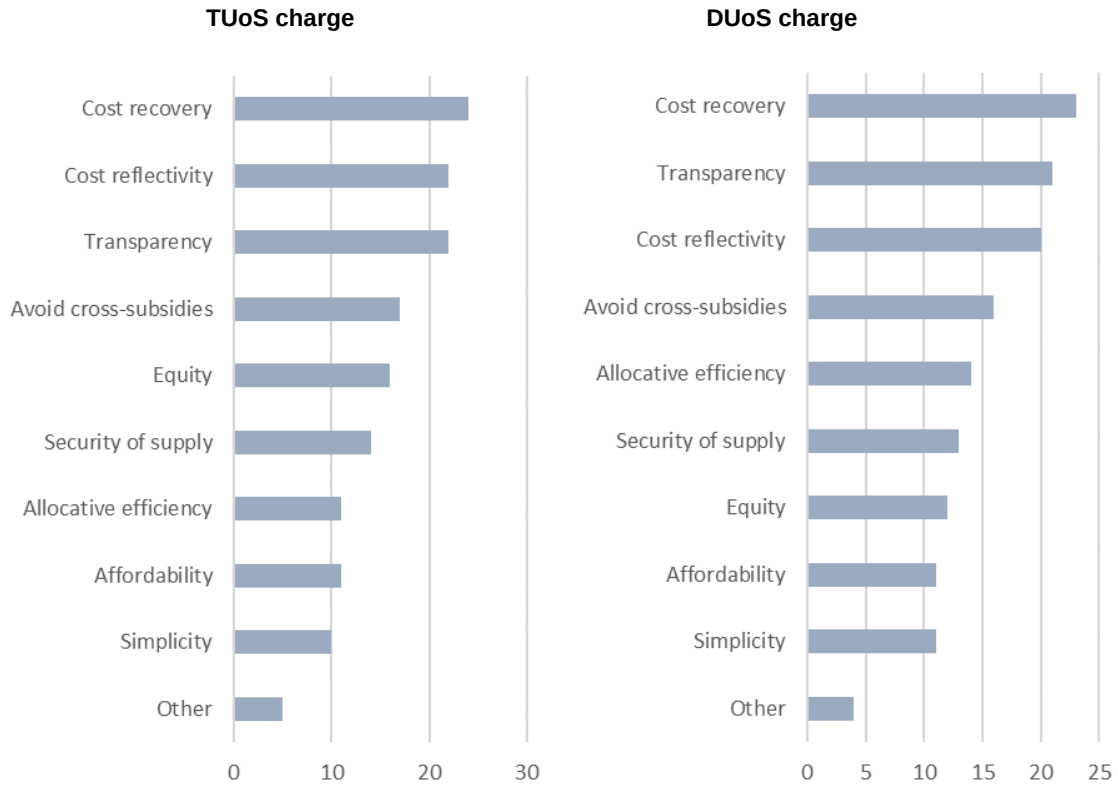
2.2.2 Guiding principles for the design of network UoS charges

Regulatory principles are typically determined to guide the design of electricity tariffs. The principles are set to protect both consumers' and suppliers' interests. In many cases there may be conflicting objectives and the tariff design process becomes a complex exercise to balance these conflicting objectives.

In the ERRA sample, **cost recovery, transparency and cost-reflectivity are the most common guiding principles** for the design of network use-of-system charges (see Table 6). Cost recovery helps to ensure that the network operator will recover its efficient costs while cost-reflectivity enhances economic efficiency. Transparency allows market users to make use of their rights and responsibilities.

As indicated above, the guiding principles mentioned in each MO include conflicting objectives. For example, cost recovery and cost-reflectivity are two conflicting objectives. Trying to achieve the former distorts the latter and vice versa. Fully cost-reflective tariffs would translate to very complex tariff designs which is not aligned with principles of simplicity. On the contrary uniform tariff designs improve simplicity but distort cost-reflectivity. Therefore, the design of electricity tariffs becomes an 'art' of how to achieve these conflicting objectives for the best interest of consumers, network operators, economic growth and security of supply. There is not one framework that fits all systems and jurisdictions and judgemental thinking is required to derive the tariff design.

Table 6 Guiding principles in regulations for the development of tariff design



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
TUoS charge																										
Affordability			✓	✓		✓										✓	✓	✓	✓			✓		✓	✓	✓
Allocative efficiency	✓				✓	✓				✓	✓		✓				✓	✓	✓			✓				✓
Avoid cross-subsidies	✓		✓	✓	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓		✓			✓			✓	✓
Cost recovery	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Cost-reflectivity	✓		✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Equity	✓			✓		✓		✓						✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Security of supply			✓	✓		✓			✓	✓		✓			✓	✓	✓	✓	✓			✓		✓		✓
Simplicity	✓			✓	✓	✓								✓			✓	✓	✓						✓	✓
Transparency	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
Other			✓	✓						✓	✓											✓				
DUoS charge																										
Affordability						✓						✓				✓	✓		✓		✓	✓	✓	✓	✓	✓
Allocative efficiency	✓		✓	✓	✓	✓				✓	✓		✓				✓		✓		✓	✓	✓			✓
Avoid cross-subsidies	✓		✓	✓	✓	✓		✓	✓	✓	✓				✓	✓	✓		✓			✓			✓	✓
Cost recovery	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cost-reflectivity	✓		✓		✓	✓		✓		✓	✓		✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Equity	✓			✓		✓		✓						✓	✓	✓	✓					✓		✓	✓	✓
Security of supply			✓	✓		✓			✓	✓		✓			✓	✓	✓					✓	✓	✓		✓
Simplicity	✓			✓	✓	✓								✓			✓	✓	✓				✓		✓	✓
Transparency	✓		✓		✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Other								✓		✓	✓											✓				

Source: Survey question 1.3.2 (use-of-system sheets). Key: ✓ (yes), x (no).

2.2.3 Methodology for the design of cost-reflective charges

One of the guiding principles and overall goals of tariff design is to determine **cost-reflective tariffs**. There are multiple approaches for determining cost-reflective design designs:

- **Long-run marginal cost (LRMC):** Attempts to mimic the price that should emerge in a competitive market. It estimates the LRMC for providing power and energy to each consumer group and designs tariffs that reflect marginal costs of supply. The long-run average incremental cost (LRAIC) approach also falls into this category - it attempts to estimate the incremental costs for serving an additional unit of capacity and is the methodology typically applied for transmission and distribution networks when using forward-looking or economic costs for tariff design purposes.

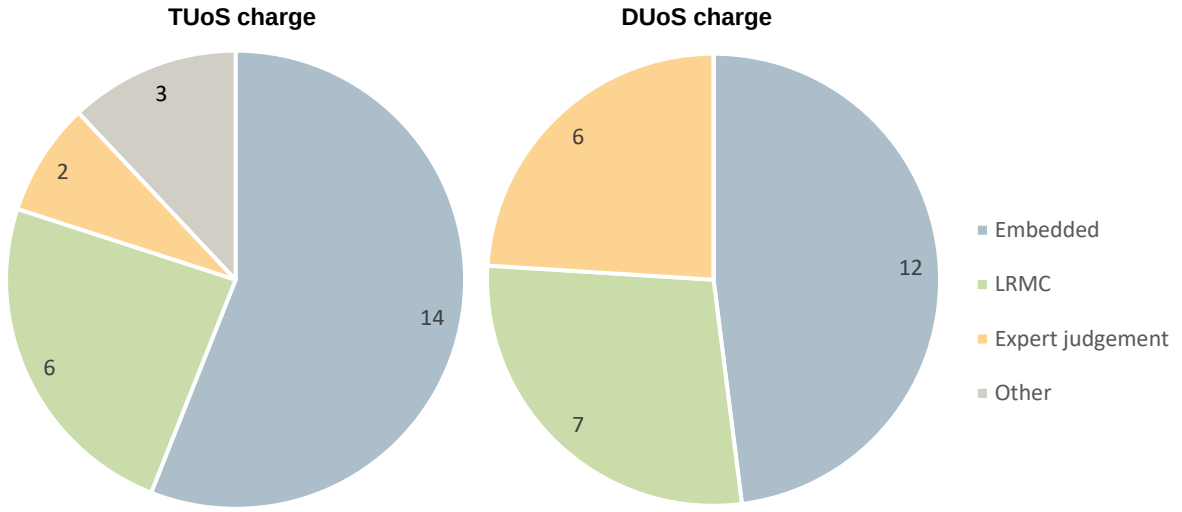
- **Embedded cost:** This approach is based on historical, accounting (hence embedded) expenses, and is, therefore more direct compared to the LRMC method. Using this approach actual accounting expenses are split into, functional components (transmission, distribution, billing, metering and customer service).

Similar to the LRMC method, these are then classified as demand-related (kW), energy-related (kWh) and customer-related; and then allocated to customer categories based on their load patterns. The key difference with the LRMC approach is that embedded cost is backward looking whereas LRMC is forward-looking.

- **Expert judgement:** The allocation of costs to different customers based on the judgement of the expert performing the calculation, without performing the detailed calculations associated with a well-known, established approach.

In the ERRA sample, **the embedded approach is the most common approach for determining cost-reflective tariff designs for network use-of-system charges**, adopted in approximately half of cases (see Table 7). However, we also see that the LRMC is adopted in approximately a quarter of cases, and expert judgement is applied in few others.

Table 7 Approaches for determining cost-reflective tariff designs



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
TUoS charge																										
LRMC	✓		✓					✓					✓					✓	✓							
Embedded				✓	✓	✓	✓		✓	✓					✓	✓	✓					✓	✓	✓	✓	✓
Expert judgement											✓	✓														
Other														✓						✓	✓					
DUoS charge																										
LRMC	✓		✓	✓				✓					✓					✓		✓						
Embedded					✓	✓	✓		✓	✓					✓	✓	✓		✓			✓			✓	✓
Expert judgement											✓	✓		✓							✓		✓	✓		
Other																										

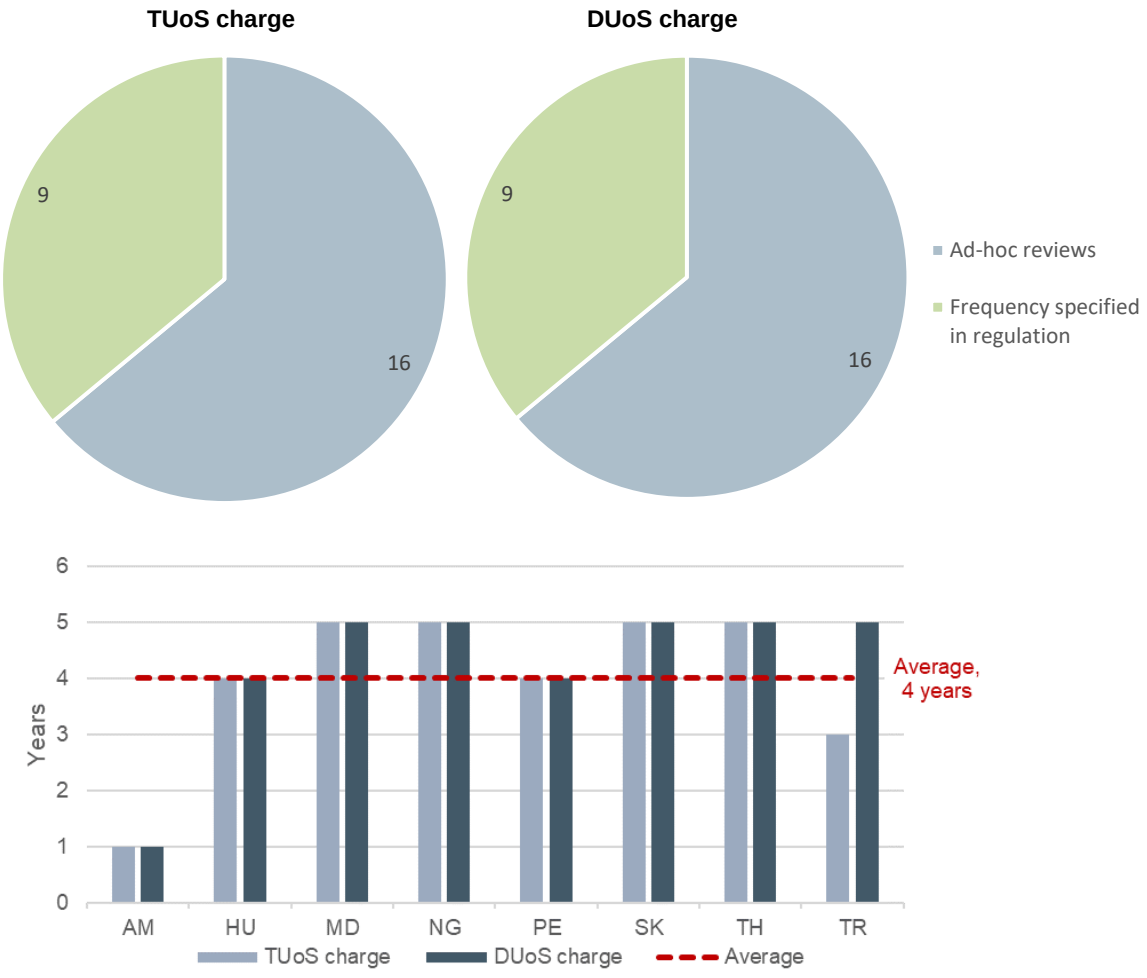
Source: Survey question 1.4 (use-of-system sheets). Key: ✓ (yes), ? (no data)

2.2.4 Frequency for the update of network tariff designs

The tariff design needs to be updated over time to reflect changing market conditions. However, updating the tariff design too often does not allow consumers and generators to react to pricing signals and suppresses economic efficiency. Updating the tariff design too often may also create instability, confusion and inefficiencies due to the continuous fluctuation of tariff levels. A rising question then is how often the tariff design should be updated. Typically, the tariff design is updated every 3-5 years to allow the market to understand and react to the pricing signals and reflect changing market condition in wider than annual intervals. However, there may be unexpected cases where it has to be updated at shorter or longer intervals depending on market conditions.

In the ERRA sample, **most MOs do not specify the period for the update of the tariff design and allow ad-hoc reviews of their tariff designs** (see Table 8). Only nine MOs specify the frequency for TUoS and DUoS charge reviews, respectively. **Where regulatory frameworks specify what the frequency should be, the modal response is every five years**. In most cases, the required frequency for the DUoS and TUoS tariff design update is the same. In some cases, a different timeframe exists for TUoS in comparison to DUoS charge redesigns. In Turkiye, the regulations specify different frequencies (every three years for the TUoS charge and every five years for the DUoS charge).

Table 8 Frequency of tariff design reviews mandated by regulation



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
TuoS charge																										
Regulation specifies frequency?	x		x	✓	x	x	x	✓	x	x	x	✓	x	x	✓	x	x	✓	x	✓	x	x	✓	✓	✓	x
>5 years																										
5 years															✓			✓					✓	✓		
4 years												✓								✓						
3 years																									✓	
2 years																										
<2 years				✓																						
Other								✓																		
DUoS charge																										
Regulation specifies frequency?	x		x	✓	x	x	x	✓	x	x	x	✓	x	x	✓	x	x	✓	x	✓	x	x	✓	✓	✓	x
>5 years																										
5 years															✓			✓					✓	✓	✓	
4 years												✓								✓						
3 years																										
2 years																										
<2 years				✓																						
Other								✓																		

Source: Survey questions 1.5 & 1.5.1 (use-of-system sheets). Key: ✓ (yes), x (no).

2.2.5 Considerations about regulations and principles

Considerations about regulations and principles for network tariff designs

Governance

The unbundling of tariffs helps better identify network costs and charge them in an economically efficient and fair manner to the appropriate network user. In the ERRA sample, TSOs and DSOs are separate entities in almost all MOs (23 out of 24 MOs). In the sample of 26 MOs analysed, most MOs had only one TSO (92%), while most MOs had more than three DSOs (50%).

Similarly, clarity, stability and predictability of the overall governance of the network tariff design and setting framework, as well as its independence from political or economic interests are critical requirements for the efficient operation of electricity markets. To that effect, the critical factor regarding the effectiveness of who develops and approves the relevant network tariff design, who develops the respective regulatory framework, is not the identity of the institution but rather its capacity to act as an independent and prudent entity, and the control mechanism established to enable that this role is executed as required.

In the ERRA sample, regulators are mainly responsible for the design and approval of network use-of-system charges, and the development of regulations on tariff design methodology. However, there is no best practice regarding the most appropriate entity to develop the tariff

designs. Both the regulator and the network operators are capable of developing the tariff design given that a regulatory framework for tariff designs exists. Due to the complexity of the tariff design determination, regulators typically define the key principles and methods and allow the network operators to do the detailed calculations for submission and approval by the regulator.

Regulatory principles and frequency for tariff redesigns

Regulatory principles are typically defined by regulators to guide the design of electricity tariffs. The principles are set to protect both consumers' and suppliers' interests. In many cases there may be conflicting objectives and the tariff design process becomes a complex exercise aiming to balance these conflicting objectives. Therefore, the design of electricity tariffs becomes an 'art' of how to achieve these conflicting objectives for the best interest of consumers, network operators, economic growth, and security of supply. There is not an ad-hoc rule or method that can be applied everywhere but judgmental thinking is required to meet the required objectives.

In the ERRA sample, cost recovery, transparency and cost-reflectivity are the most common guiding principles for the design of network use-of-system and connection charges. Cost recovery helps to ensure that the network operator will recover its efficient costs while cost-reflectivity enhances economic efficiency. Transparency allows market users to make use of their rights and responsibilities.

Then, methodologies for establishing a cost-reflective design can be developed with a view to the specific characteristics, and strategic targets adopted for the particular country. Part of that process should be the specification of a stable, rather than unscheduled or ad-hoc review process, with a frequency of review corresponding to the country's maturity of the electricity market, expected path of fundamental economic indicators, and other country-specific considerations. Typically, the tariff design is updated every 3-5 years, but there may be cases where it has to be updated at shorter or longer intervals depending on market conditions.

2.3 Customer categories

Customers that have similar characteristics are typically grouped into tariff categories to allow cost-reflective, simple, and practical charging structures for the use of electricity networks. This sub-section aims to unravel how customers are grouped into tariff categories and comment on the most common approaches among MOs.

2.3.1 Drivers for separating customers into tariff categories

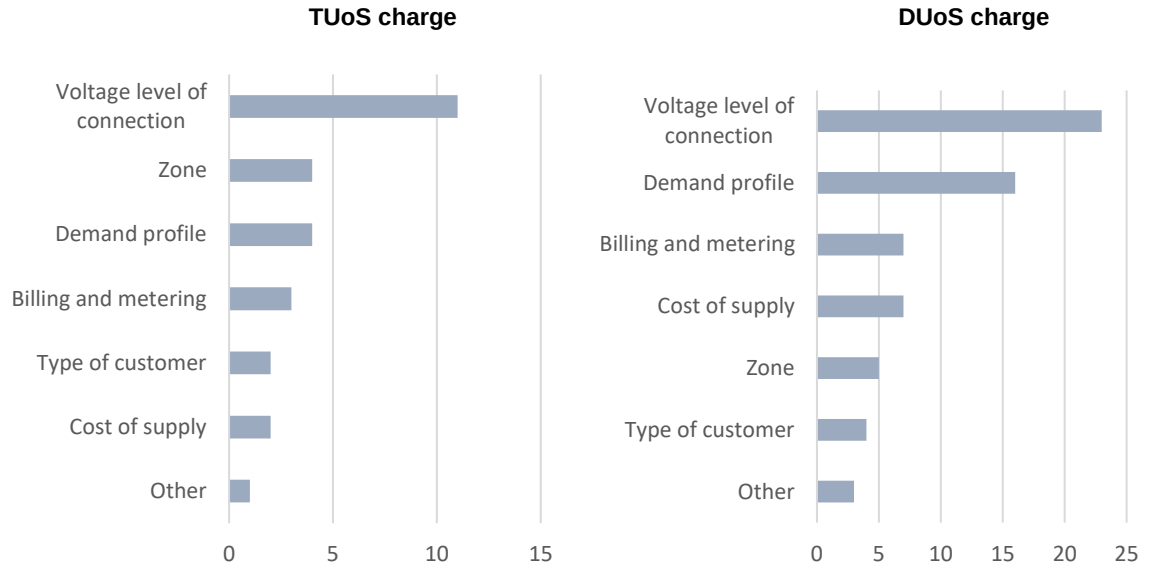
One of the key elements of the design of network charges is the grouping of customers to customer categories. Customers do not impose the same costs to the system and for cost-reflectivity reasons the charging structures should reflect this. However, it would be impractical to have different charges for each individual customer to achieve full cost-reflectivity. Hence the aim should be to group customers in a way that does not distort cost-reflectivity and at the same time is practical for the network operator to implement. Customers with similar cost characteristics and similar metering devices are typically grouped together.

The **drivers that are typically used to distinguish customer categories** are:

- **Voltage level of connection:** This is both a key determinant of costs and is a readily observable means of classifying customers.
- **Consumption profile:** Costs of service to individual customer classes are driven by their contribution to system peak demand and energy consumed in peak hours. Hence, customers with similar consumption profiles usually have similar cost of service and can be grouped together.
- **Billing and metering:** The tariff structure imposed to each customer class may differ due to billing and metering constraints. For example, typical electromechanical meters do not allow readings for time-of-use charges. Hence, customers with typical electromechanical meters cannot have charges with time-of-use rates.

In the ERRA sample, the principal driver for grouping customers to customer categories was **the voltage level of connection** both for TUoS and DUoS charges (see Table 9). For DUoS charges, the demand profile is also a key driver, while it is less prominent for the TUoS charge (in 16 MOs versus four MOs, respectively).

Table 9 Drivers for separating charges into customer classes



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
TuoS charge																										
Multiple customer categories?	x		x	x	✓	✓	x	x	✓	x	✓	✓	✓	✓	x	x	x	✓	✓	✓	x	✓	x	✓	✓	✓
Billing and metering											✓							✓	✓							
Cost of supply																								✓		✓
Demand profile					✓				✓										✓							✓
Type of customer						✓					✓															
Voltage level of connection					✓				✓		✓	✓	✓	✓				✓	✓	✓				✓		✓
Zone					✓													✓		✓					✓	
Other																						✓				
DUoS charge																										
Multiple customer categories?	x		✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Billing and metering						✓						✓					✓	✓	✓			✓		✓		
Cost of supply						✓								✓			✓				✓	✓		✓		✓
Demand profile					✓	✓	✓		✓	✓	✓		✓	✓			✓			✓	✓	✓	✓	✓	✓	✓
Type of customer											✓		✓						✓			✓				
Voltage level of connection			✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Zone					✓												✓	✓		✓		✓				
Other							✓			✓				✓												

Source: Survey question 2.1 (use-of-system sheets). Key: ✓ (yes), x (no).

2.3.2 Impact of metering devices on tariff designs

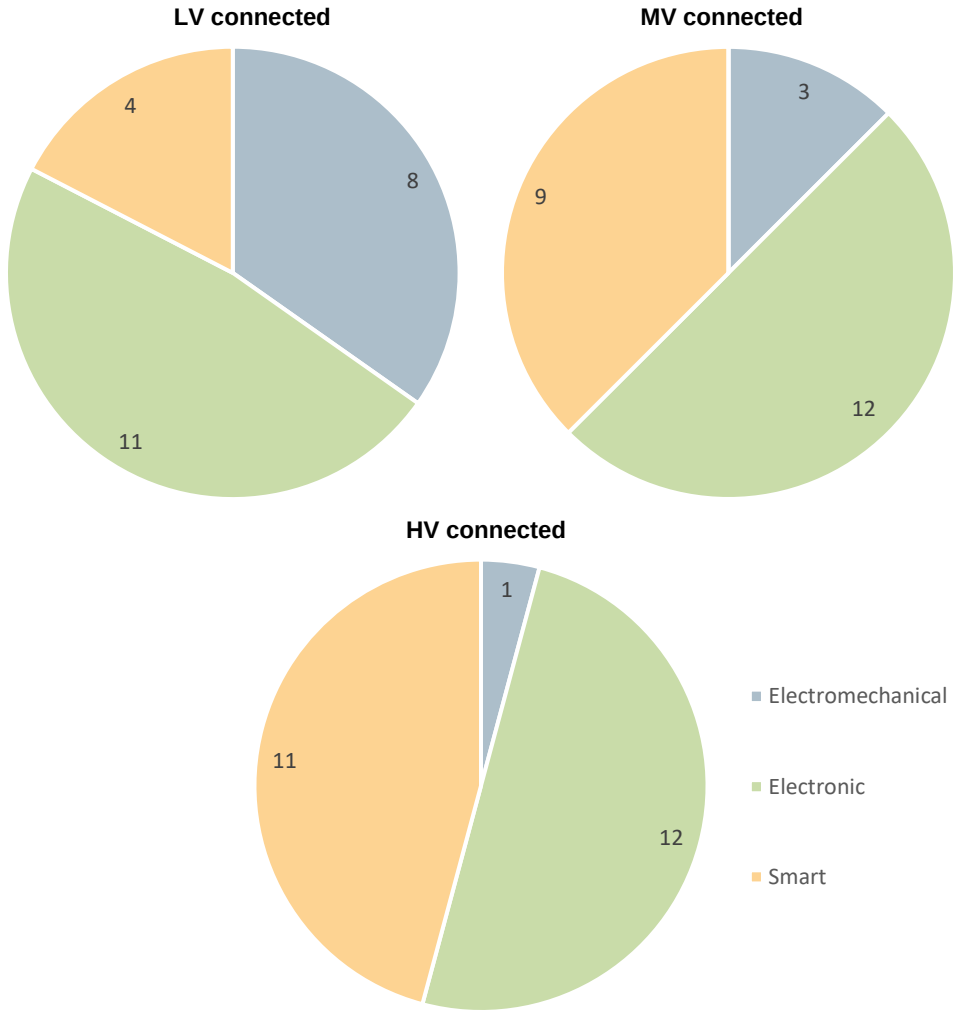
The type of meter installed affects what type of charges can be imposed. Thus, the extent of rollout across the customer base places limits on the tariff design and the separation into customer categories. The three broad categories of meter types are described in Table 10.

Table 10 Electricity meters

Meter	Description	Evaluation
Electromechanical meter	A traditional electricity meter. It does not have a digital display and must be read manually by a human meter reader on the property. On a single-phase AC supply, the electromechanical induction meter operates through electromagnetic induction by counting the revolutions of a non-magnetic, but electrically conductive, metal disc which is made to rotate at a speed proportional to the power passing through the meter. The number of revolutions is thus proportional to the energy usage.	• Cannot record when energy was consumed. However, they may be used for metering different time-of-use consumption, eg day/night, triggered by a signal sent by the operator via the wires. • Only record kWh and cannot record peak demand within a period. Therefore, cannot have a demand charge for customers who have these meters.
Electronic meter	Calculates energy usage based on input from various sensors for voltage, current and other needed parameters, converted into digital and fed into a digital processor, which produces the metering output. A simple electronic meter displays the energy used on an LCD or LED display. Unlike a smart meter, it still needs to be read manually by a human meter reader, who must come on to the property to read it.	• Can support time-of-use charges and demand charges. • Does not communicate real-time data. Therefore, cannot have dynamic charges for customers who have these meters.
Smart meter	An electronic device that records information such as consumption of electric energy, voltage levels, current, and power factor. Smart meters communicate the information to the consumer for greater clarity of consumption behaviour, and electricity suppliers for system monitoring and customer billing. Unlike a simple electronic meter, smart meters communicate information on the energy used automatically to the utility, meaning a human meter reader does not have to come onto the property to read it manually.	• Can be used to apply any type of charges, including dynamic charges.

In the ERRA sample, **electromechanical meters are still more common for LV-connected customers in over a third of MOs**, while **electronic and smart meters are more common for most MV- and HV-connected customers** (see Table 11). This is likely to be because more modern meters can be rapidly rolled out to a relatively small number of large consumers of electricity than to the vast number of LV-connected consumers, and the cost of meter installation and operation is relatively lower compared to the potential benefits that could result from such customers.

Table 11 Type of meter installed for majority of customers in each category



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
LV-connected																										
Electromechanical					✓	✓				✓	✓	✓						?		✓	✓			✓		
Electronic	✓		✓				✓						✓		✓	✓	✓	?	✓			✓			✓	✓
Smart				✓					✓					✓				?					✓			
MV-connected																										
Electromechanical										✓										✓	✓					
Electronic	✓		✓		✓							✓	✓		✓	✓	✓	✓	✓					✓	✓	
Smart				✓		✓	✓		✓		✓			✓								✓	✓			✓
HV-connected																										
Electromechanical																				✓						
Electronic	✓		✓		✓					✓		✓			✓	✓	✓	✓	✓				✓	✓		
Smart				✓		✓	✓		✓		✓		✓	✓							✓	✓			✓	✓

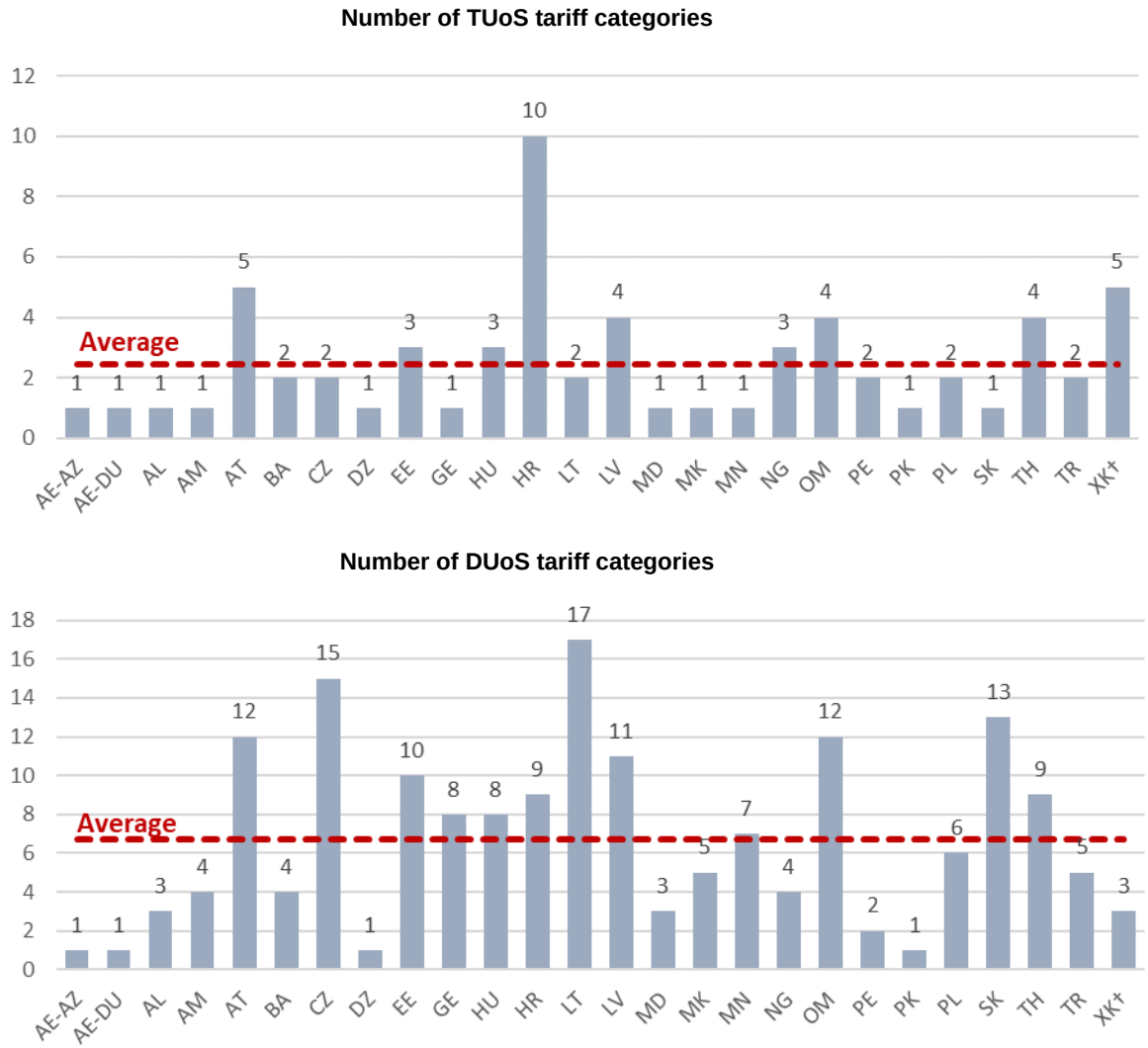
Source: Survey question 2.4 (use-of-system sheets). Key: ✓ (yes), ? (no data).

2.3.3 Number of tariff categories

The distinctions of customer categories should be very clear and easily verifiable to avoid the risk of 'gaming' by customers. An excessive number of categories should also be avoided, as it makes it harder for customers to understand, makes it more administratively complex for the operator, and can make it more difficult to verify distinctions. Customer categories are also often used to meet social objectives, for example subsidising residential customers or to deal with new emerging challenges such as the penetration of EVs.

In the ERRA sample, the average number of tariff categories for TUoS charges was three. The most typical structure included the following three categories: (1) for the use of the system by DSOs, (2) for the use of the system by generators and (3) for the use of the system by transmission connected industrial customers. The number of DUoS tariff categories was much higher due to the need to recognise the cost of supply for different customer categories. The minimum number of DUoS tariff categories was one, the maximum 17 and the average seven.

Figure 1 Number of tariff categories for network use-of-system charges

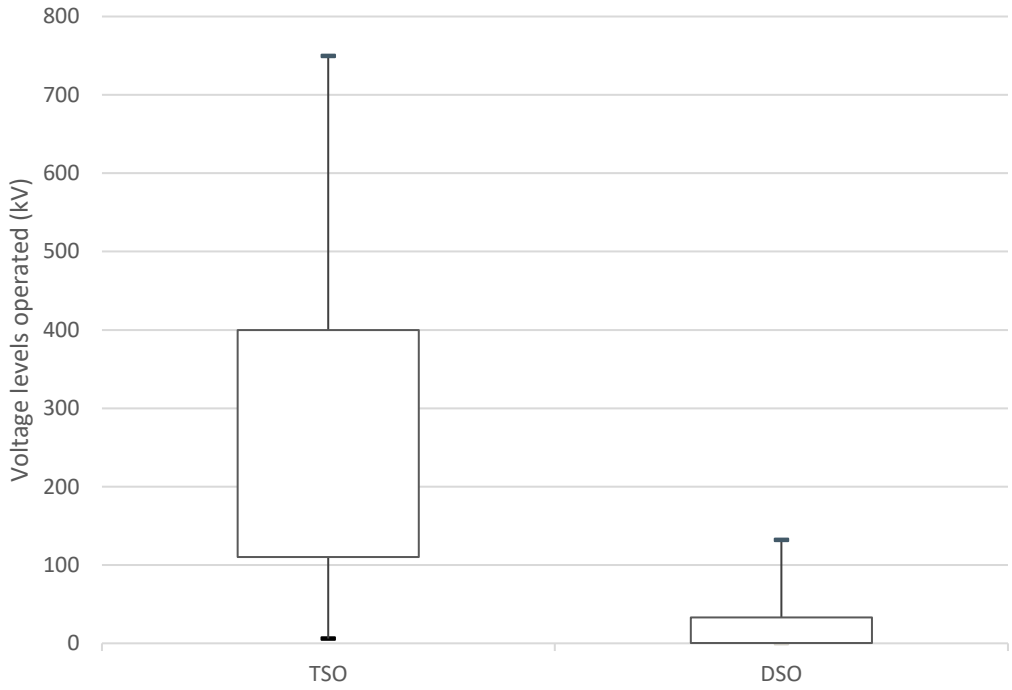


Source: Survey (present charges sheet).

2.3.4 Voltage levels operated by MO network operators

To complement the discussion on customer categories and metering, we present the **voltage levels operated by MOs** in Figure 2. We see that DSOs operate voltage levels spanning 0.22-132kV, while TSOs operate levels spanning 6-750kV. The low voltage levels operated by DSOs, coupled with the prevalence of electromechanical meters installed for low voltage customers, implies there should be a large share of energy charges among MOs in DUoS charge design.

Figure 2 Voltage levels operated by TSO and DSO



Source: Survey question 7.3 (use-of-system sheets).

2.3.5 Considerations about customer categories

Considerations about customer categories

Where necessary, the grouping of customers to tariff categories should be based on the costs of supply. This would include the separation of customers based on the voltage level of connection (customers connected at different voltage levels have different cost of supply[2]), the consumption profile (costs of service to individual customer classes are driven by their contribution to system peak demand and energy consumed in peak, partial peak and off-peak hours) and billing and metering capabilities to apply a tariff structure.

In the ERRA sample, the principal driver for grouping customers to customer categories was the voltage level of connection both for TUoS and DUoS charges. For DUoS charges, the

[2] For example, a customer connected at the HV level, should not pay for costs of the MV or the LV system as this customer does not utilise the MV and LV systems. In the absence of any other customer the MV and LV systems would not have to be constructed.

demand profile is also a key driver, while it is less prominent for the TUoS charge (in 16 MOs versus four MOs, respectively).

The distinctions of customer categories should be very clear and easily verifiable to avoid the risk of 'gaming' by customers. An excessive number of categories should also be avoided, as it makes it harder for customers to understand, makes it more administratively complex for the operator, and can make it more difficult to verify distinctions. Customer categories are also often used to meet social objectives, for example subsidising residential customers or to deal with new emerging challenges such as the penetration of EVs.

Where it is possible to offer complex cost-reflective rate designs, differentiated by time-of-use and voltage of supply, then it is not necessary to distinguish between customer categories, because, in that case all the information necessary to reflect costs will be contained in the rate design itself and the customer type would not provide any useful additional information to the network operator (see more on this in section 0). The same would apply if dynamic pricing is imposed through smart meters.

Only where the rate is simplified to, for example, a single kWh charge it is necessary to distinguish customers according to whether they are residential, commercial, industrial, etc.

In the prospect of further deployment of smart meters, the possibilities for rationalisation of charging based on actual time-of-use will increase for most of the countries in the ERRA sample. Still, each case should be considered separately and be tailor made, as there are many factors that would determine the timing of such interventions and the actual design of the charging scheme in each case. In the ERRA sample, electromechanical meters are still more common for LV-connected customers in over a third of MOs, while electronic and smart meters are more common for most MV- and HV-connected customers

2.4 Locational signals in the tariff designs

One element of the tariff design is the locational signals it will provide for the development of demand and generation. Locational signals can be provided through the connection charges (eg with a deep or intermediate connection charge) or through the network use-of-system charge. If **locational signals** are included in the tariff design of the network use-of-system charge, then typically they differentiate according to the customer's location on the network.

Locational signals can be important as they provide economic incentives for customers to connect at specific points of the network. The choice of location that the network company wishes to signal relates to the capacity of the network at different locations and associated costs to expand/upgrade the network. Where there are constraints on the transmission (or distribution) system then a generator who chooses to locate at a site which increases these constraints will increase costs (eg by making it necessary to reinforce the network or to dispatch plants sub-optimally and increase fuel and operating costs).

By contrast, locating generation at a site which reduces constraints (eg, close to a load centre) will also tend to lower system costs. Network charges that vary to reflect these constraints therefore incentivise users to locate generators or load in areas that reduce system cost. However, network charges need to be considered together with the connection charging framework, as locational signals could be given with the latter.

There are four broad approaches for designing use-of-system charges:

- **Postal stamp (uniform):** Unit pricing that is uniform across the network. While simple, it offers no locational incentives. For example, it does not encourage a generator to locate close to load centres and discourage connection in areas subject to network constraints.

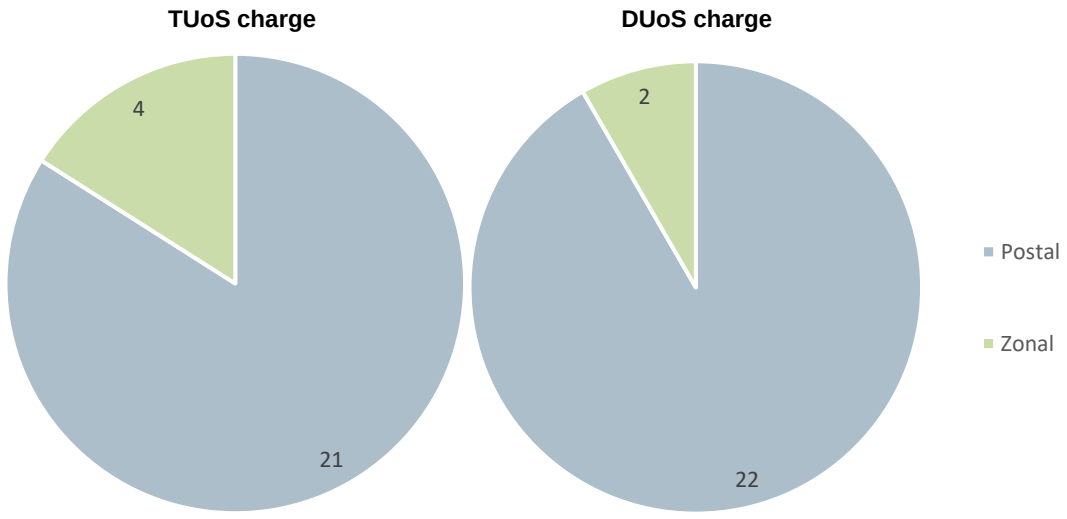
- **Zonal:** Price is differentiated by zone to reflect the marginal costs that an incremental generator locating in that zone would impose on the transmission system. Generators facing these charges would thereby incorporate these marginal transmission costs into their location decisions.

- **Nodal:** Similar to zonal pricing but at a nodal level.

- **Locational marginal pricing (LMP):** Price is differentiated by market arrangements. Wholesale energy prices are determined competitively through offers by generators and bids by buyers (suppliers or large consumers) but subject to constraints between nodes, and this leads to different prices at different nodes. The nodes are physically connected to other nodes and with LMP the capacity of those interconnectors is auctioned. The price that network users are willing to pay for using the interconnectors then depends on the wholesale price differentials between the nodes reflecting both the market price of the interconnector capacity and the wholesale price of generation at the nodes.

In the ERRA sample, **most use-of-system tariff designs do not adopt locational pricing** (ie they adopt postal stamp pricing) (see Table 12). **Where locational signals are adopted, zonal pricing is used in all cases**.

Table 12 Locational signals used when designing the tariff



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
TUoS charge																										
Postal	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓		✓
Zonal					✓												✓			✓					✓	
DUoS charge																										
Postal	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓
Zonal																	✓			✓						

Source: Survey question 3.1 (use-of-system sheets).

2.4.1 Considerations about locational signals in the tariff designs

Considerations about locational signals in the tariff designs

The arguments for location reflective rates are simple: these are more cost-reflective and, therefore, economically efficient. The use of such rates may also provide more opportunities for lower-cost electrification solutions, such as decentralised solar power.

On the other hand, the arguments against location specific rates and for uniform rates relate to equity and to regional development. To the extreme, location reflective rates are often not socially acceptable. Charging higher rates for more remote regions means that, in the absence of offsetting subsidy adjustments, households in these regions which will generally be poorer will pay more for electricity than richer households in more prosperous areas. Higher rates will also deter and raise the costs of industry and businesses in these regions, further exacerbating regional inequalities.

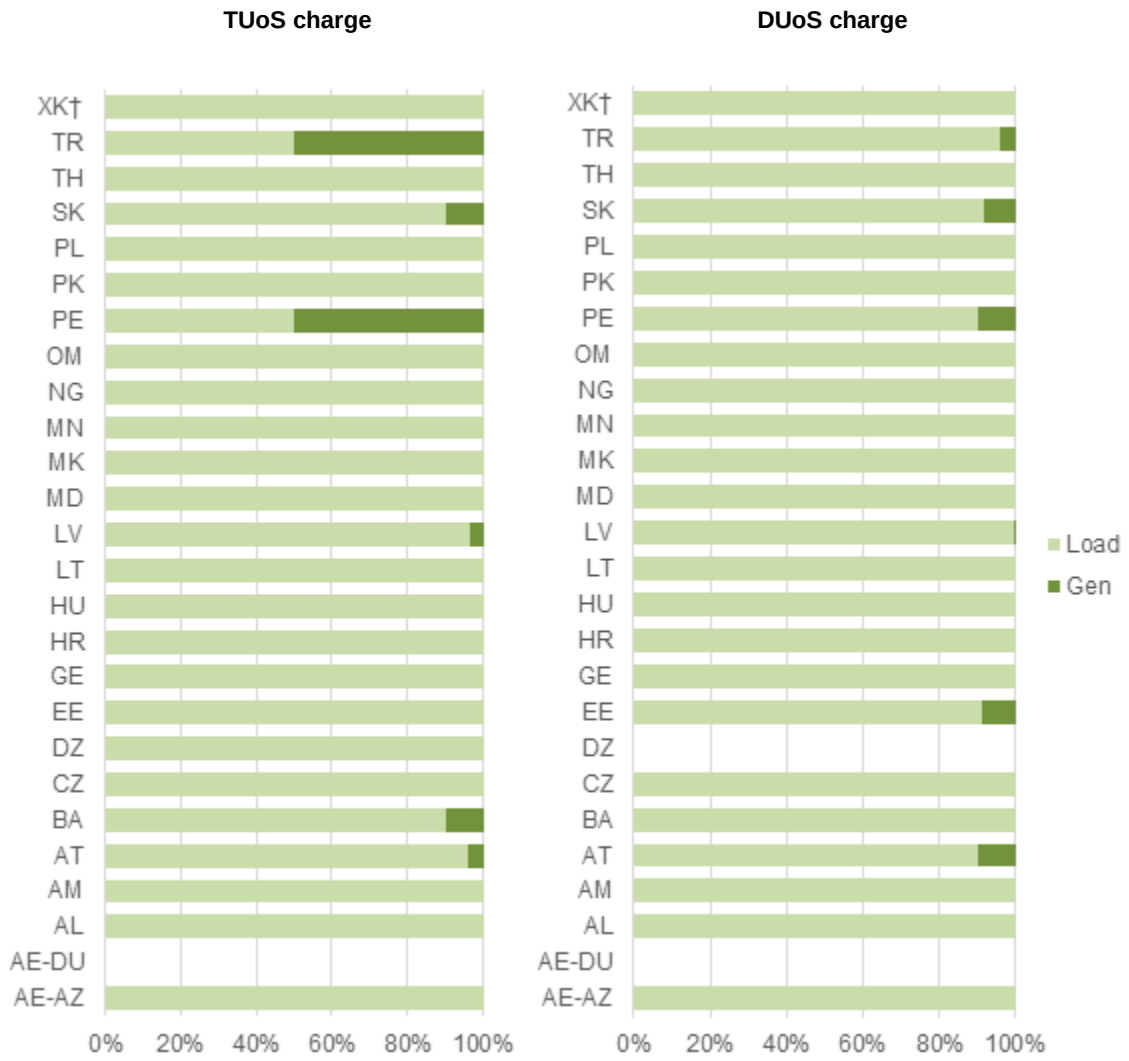
This leads to the conclusion that although significant potential exists among the ERRA MOs included in this sample to improve economic efficiency by introducing more locational signals in their network charges, this decision should be carefully considered in each case alongside the specific economic and social characteristics of each country, and the particular strategic objectives adopted as a matter of both economic and energy policy.

2.5 Split of charges for generators and load for the use-of-system

There are two broad categories of network users. Customers (load or demand) who consume electricity withdrawing electricity from the grid and generators that supply electricity by injecting electricity to the grid. To materialise their transaction, in which each side benefits, electricity is transferred across the electricity network. The tariff design could either treat each party equally in charging for use of the system or place greater onus on one party. Although in effect, use-of-system charges end up being paid by the final customer, the allocation of the initial charge to either side of the transaction may have an effect on the efficiency of the whole system (eg by providing locational signals).

In the ERRA sample, we see overwhelmingly that **load pays for 100% of the use-of-system costs in most MOs** (see Figure 3). In seven out of the 26 MOs, generators do pay a portion of the cost. There are only two MOs where the costs for using the transmission system are split equally between generators and load (in Turkiye and Peru).

Figure 3 Split of recovery of network use-of-system costs between load and generators



Source: Survey questions 4.1 & 4.2 (use-of-system sheets).

2.5.1 Considerations about generators and load charging in the tariff design

Considerations about generators and load charging in the tariff design

There are arguments for and against different treatment of generators and load with regard to the use-of-system charges, and there is no single best practice to be applied universally. The split should be part of the overall design of the tariff structure in each system, reflecting the specific objectives, conditions, timing, and other factors in the specific economy.

Equal treatment of generation and load is mostly based on the principle of cost-reflectivity, ie that all network users should be charged for use of the system since they are using it. On the other hand, charging only load for the use of the network, as in the majority of the ERRA sample, may be based on a variety of reasons, including the avoidance of distortions in cross border trade, in connection with the fact that such charges end up being transferred to final customers anyway, the avoidance of negative signals to generators, especially for distributed generation, etc.

2.6 Types of charges in the network tariff designs

To create a common basis for the comparison of types of network charges used among MOs the following definitions were determined for this study for all MOs.

Table 13 Definitions for types of charges

Charge	Sample unit	Definition
Fixed charges	Amount per day, month, or year	*A constant sum paid by the customer at pre-determined time intervals (eg per day, month, or year), irrespective of the customer's demand, system peak or other characteristics.*
Energy charges	Amount per kWh consumed	*A charge paid by the customer for each unit of energy consumed (eg per kWh, per MWh, etc). It may or may not differentiate by time-of-use.*
Demand charges	Amount per metered maximum KW or KVA in a specified period	*A charge paid by customers for use of network capacity. It is based on the metered maximum demand in a given time period (eg kW or kVA per period). It may or may not differentiate by time-of-use.*
Access charges	Amount per contracted KW or KVA in a specified period	*A charge paid by customers for contracted capacity or supply capacity per kW or kVA per period. It may or may not differentiate by time-of-use (eg it may be more expensive in some seasons).*
Reactive power charges	Amount per KVArh consumed	*A charge expressed in $/kVArh for reactive power*

Note: The above charges can vary by season and/or time-of-use (ToU). If the charge does not vary according to time-of-use the charge is referred to as flat.

Economic theory suggests that tariff structures should reflect economic costs. This implies that an ideal rate structure will comprise the following elements:

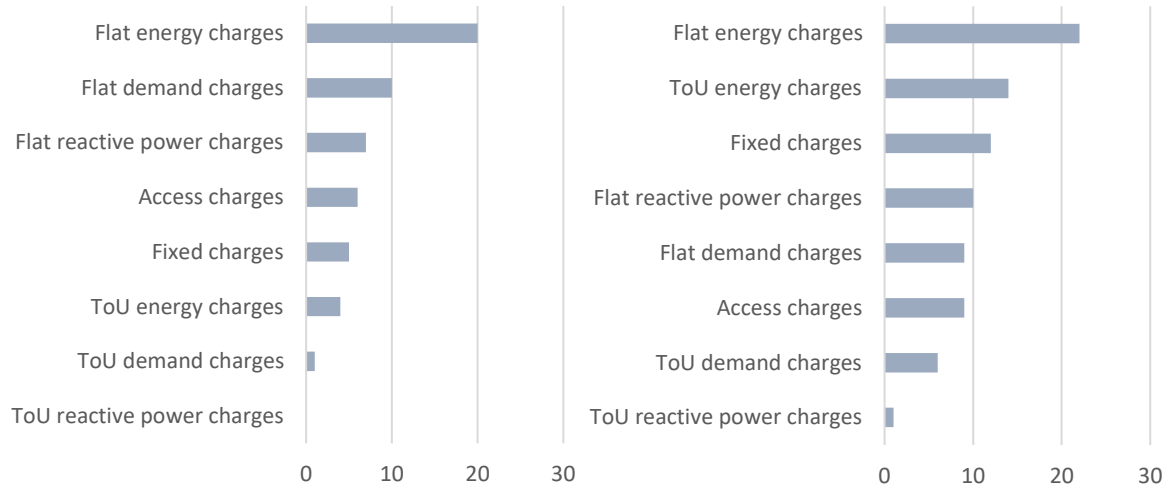
- Time-varying energy (kWh) charges should be used to recover the variable costs of electricity supply in each interval reflecting the variable costs of the system at each interval.
- The fixed costs of network capacity should be recovered through charges based on demand (kW or KVA) at time of system peak demand, as this is the driver of investment needs.
- Fixed or customer charges (per customer) should be used to recover the costs of customer-related activities such as metering, billing and collections which do not vary with customer demand or consumption and usually vary in relation to the number of customers.
- Reactive power charges (kVArh) should be used to provide incentives for customers to improve their power factor and, therefore, reduce the costs of supplying them.

In practice, rates will often deviate from this ideal structure for many reasons, including issues of acceptability, affordability, simplicity, equity and cost of metering relative to the benefits achieved from more complex rate structures and other policy objectives.

In the ERRA sample, **energy charges are more common than any other type of charges for both the transmission and the distribution networks** (see Table 14, which displays the various charges applied across all customer categories). Furthermore, **flat charges are more common than time-of-use charges for TUoS and less so for DUoS**. Fixed charges are more common for DUoS than TUoS, perhaps due to their simplicity to end-users. Simplicity and metering constraints seem to be the key drivers in adopted tariff designs.

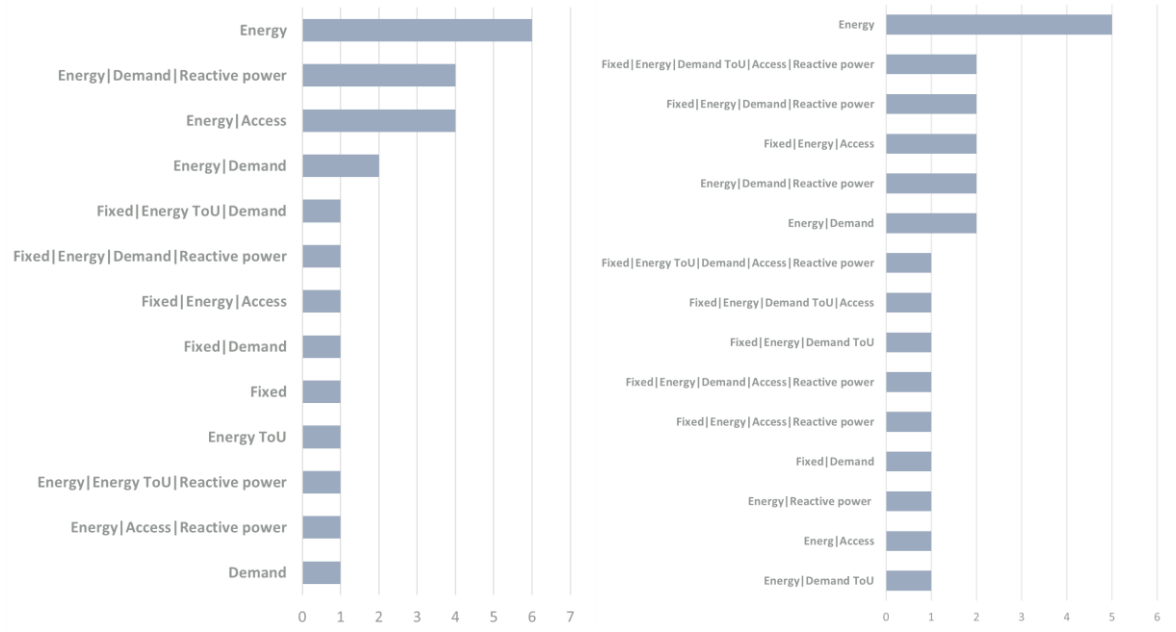
Table 14 Types of use-of-system charges applied in each country

TUoS charge	DUoS charge
Frequency of types of charges observed in tariff structures	



TUoS charge	DUoS charge

Frequency of combination of charges observed in tariff structures



Note: Several MOs also offer Energy ToU or Demand ToU charges instead of the flat charges mentioned above.

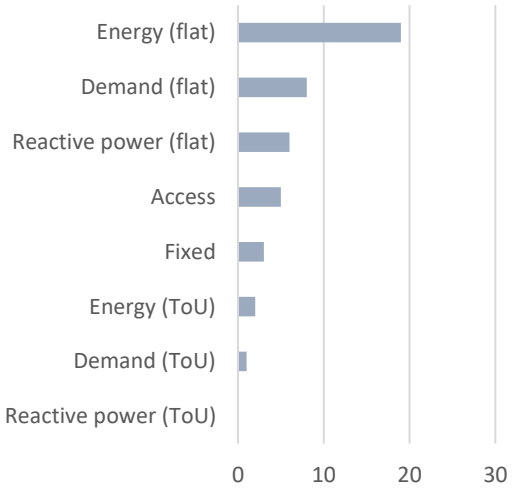
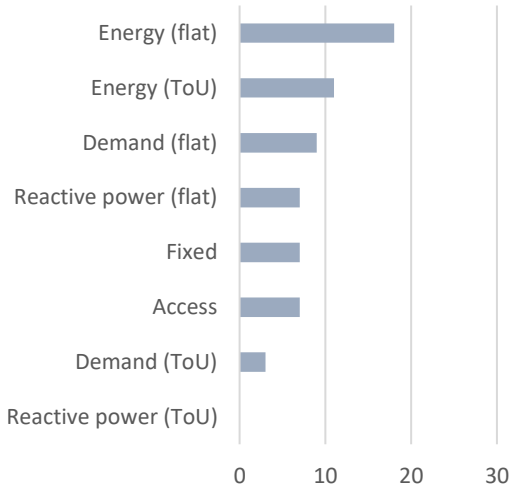
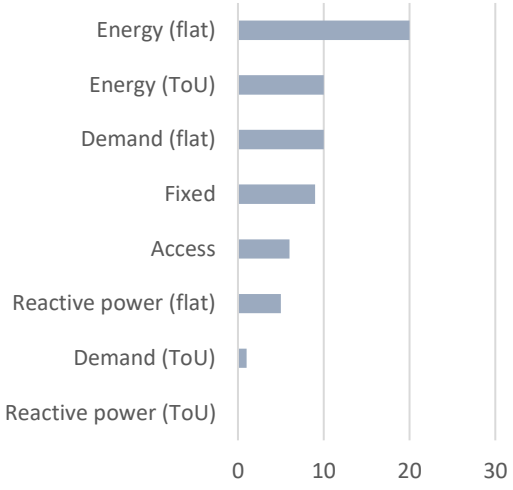
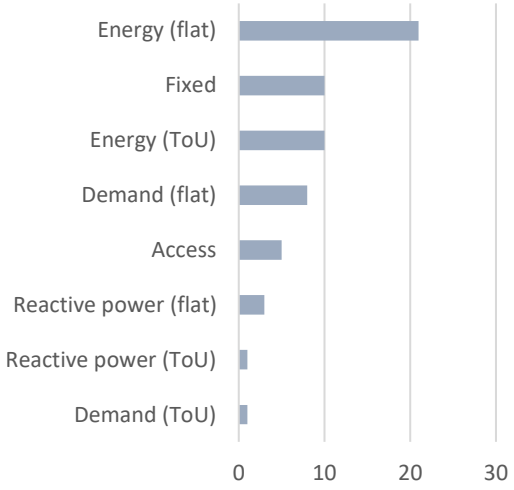
	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
TuoS charge																										
Fixed	✓										✓			✓			✓		✓							
Energy (flat)			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓		✓	✓
Energy (ToU)									✓		✓								✓					✓		
Demand (flat)	✓				✓	✓					✓					✓			✓	✓	✓	✓				✓
Demand (ToU)											✓															
Access							✓					✓	✓	✓									✓		✓	
Reactive power (flat)					✓				✓		✓		✓			✓				✓		✓				
Reactive power (ToU)																										
DUoS charge																										
Fixed	✓				✓		✓		✓		✓	✓	✓	✓			✓			✓		✓	✓			
Energy (flat)			✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Energy (ToU)					✓	✓	✓		✓		✓		✓	✓			✓		✓	✓	✓	✓	✓	✓		
Demand (flat)	✓				✓	✓			✓		✓					✓			✓		✓	✓				
Demand (ToU)						✓					✓	✓					✓			✓			✓	✓		
Access					✓		✓		✓			✓	✓	✓						✓			✓		✓	
Reactive power (flat)			✓		✓	✓			✓		✓	✓	✓			✓				✓		✓				
Reactive power (ToU)						✓																				

Source: Survey question 5.1 (use-of-system sheets).

The types of charges presented above include all applicable types of charges in several tariff categories. For greater insight, we present below the types of charges applied for four typical customer categories in each MO (ie TUoS charges for HV-connected customers and DUoS charges for MV-connected industrial customers, LV-connected commercial and residential customers (see Table 15)). Where different tariff structures were available for the above tariff categories, the category with the largest number of customers was chosen.

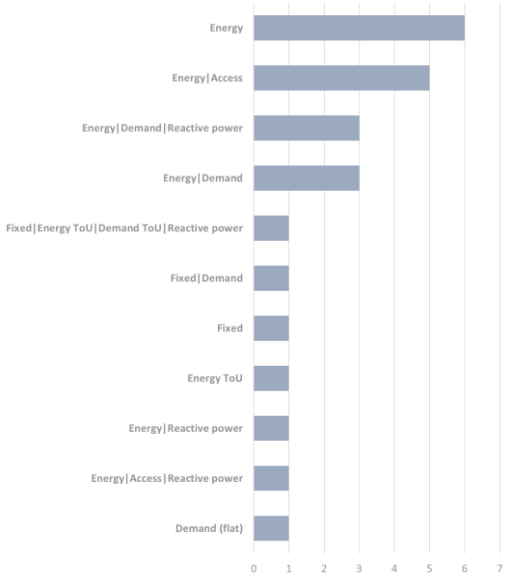
Flat energy charges are the most common across these typical customer categories. We see that customers connected at a higher voltage are more likely to have a demand charge, which is likely to be because their use of network capacity is much greater and worth capturing in their bill, and also because of the technical and subjective difficulty of introducing such charges to smaller customers.

Table 15 Types of use-of-system charges applied in sample tariff categories

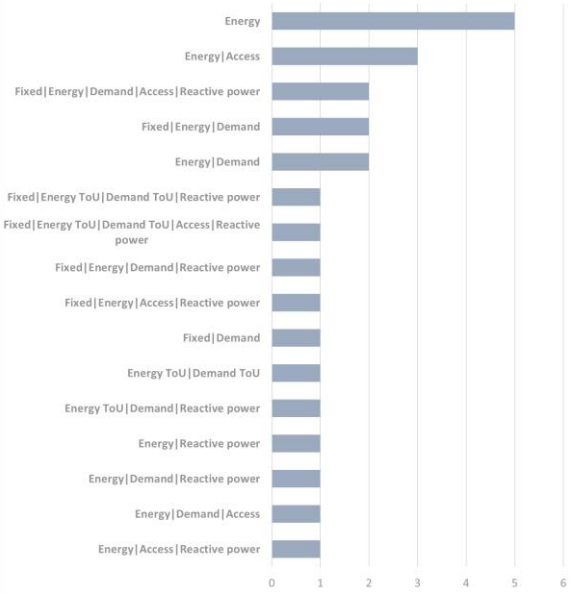
Frequency of types of charges observed in tariff structures	
TUoS charge (HV customers)	**DUoS charge (MV industrial)**
	
DUoS charge (LV commercial)	**DUoS charge (LV residential)**
	

Frequency of combination of charges observed in tariff structures

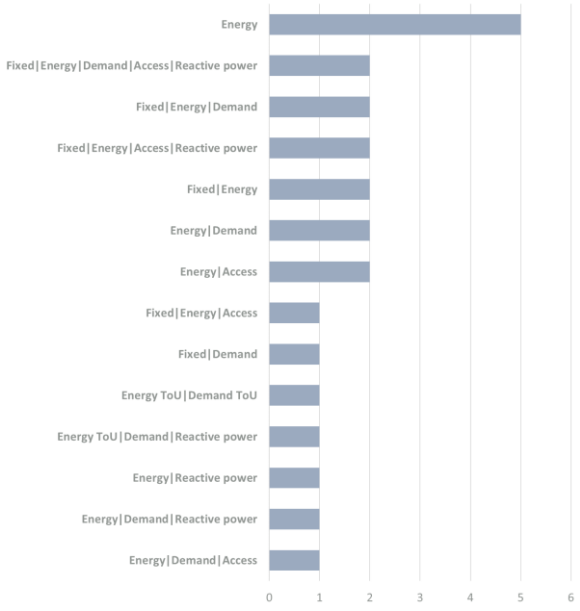
TUoS charge (HV customers)



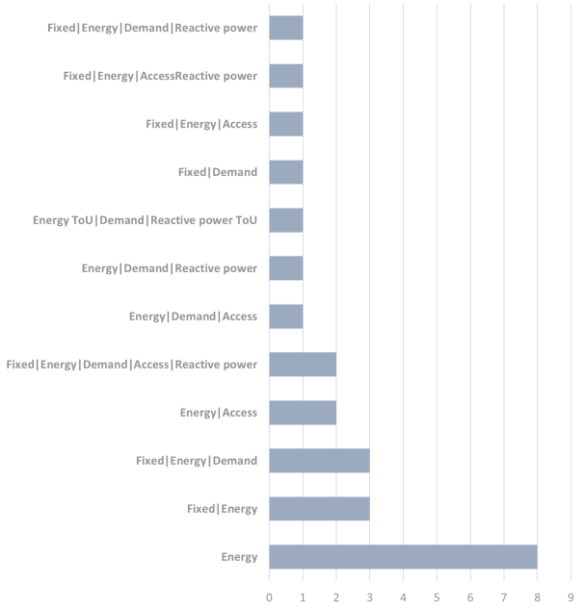
DUoS charge (MV industrial)



DUoS charge (LV commercial)



DUoS charge (LV residential)



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
TuoS charge (HV-connected customers)																										
Fixed	✓										✓						✓									
Energy (flat)			✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓		✓		✓	✓		✓	✓
Energy (ToU)											✓													✓		
Demand (flat)	✓				✓	✓										✓				✓	✓	✓				✓
Demand (ToU)											✓															
Access							✓					?	✓	✓									✓		✓	
Reactive power (flat)									✓		✓		✓			✓				✓		✓				
Reactive power (ToU)																										
DUoS charge (MV-connected industrial customers)																										
Fixed	✓							?	✓		✓	✓								✓	?	✓	✓			
Energy (flat)			✓	✓	✓		✓	?	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		?	✓	✓		✓	✓
Energy (ToU)					✓	✓		?	✓		✓		✓	✓			✓		✓	✓	?	✓		✓		
Demand (flat)	✓				✓	✓		?	✓							✓	✓		✓		?	✓	✓			
Demand (ToU)								?			✓									✓	?			✓		
Access					✓		✓	?				✓	✓	✓						✓	?				✓	
Reactive power (flat)			✓			✓	✓	?	✓		✓	✓				✓				✓	?					
Reactive power (ToU)								?													?					
DUoS charge (LV-connected commercial customers)																										
Fixed	✓						✓	?	✓		✓	✓		✓						✓	?	✓	✓			
Energy (flat)			✓	✓	✓		✓	?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	?	✓	✓		✓	✓
Energy (ToU)					✓	✓	✓	?	✓		✓		✓	✓			✓		✓		?			✓		
Demand (flat)	✓				✓	✓		?	✓		✓					✓	✓		✓		?	✓	✓			
Demand (ToU)								?													?			✓		
Access					✓		✓	?				✓	✓	✓							?				✓	
Reactive power (flat)			✓			✓		?	✓		✓	✓				✓					?					
Reactive power (ToU)								?													?					
DUoS charge (LV-connected residential customers)																										
Fixed	✓							?	✓		✓	✓	✓	✓			✓			✓	?	✓	✓			
Energy (flat)			✓	✓	✓		✓	?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	?	✓	✓	✓	✓	✓
Energy (ToU)					✓	✓	✓	?	✓		✓		✓	✓			✓		✓		?	✓				
Demand (flat)	✓				✓	✓		?	✓		✓					✓					?	✓	✓			
Demand (ToU)						✓		?													?					
Access					✓		✓	?				✓		✓							?				✓	
Reactive power (flat)								?	✓			✓				✓					?					
Reactive power (ToU)						✓		?													?					

Source: Survey question 5.1 (use-of-system sheets). Key: ✓ (yes), ? (no data).

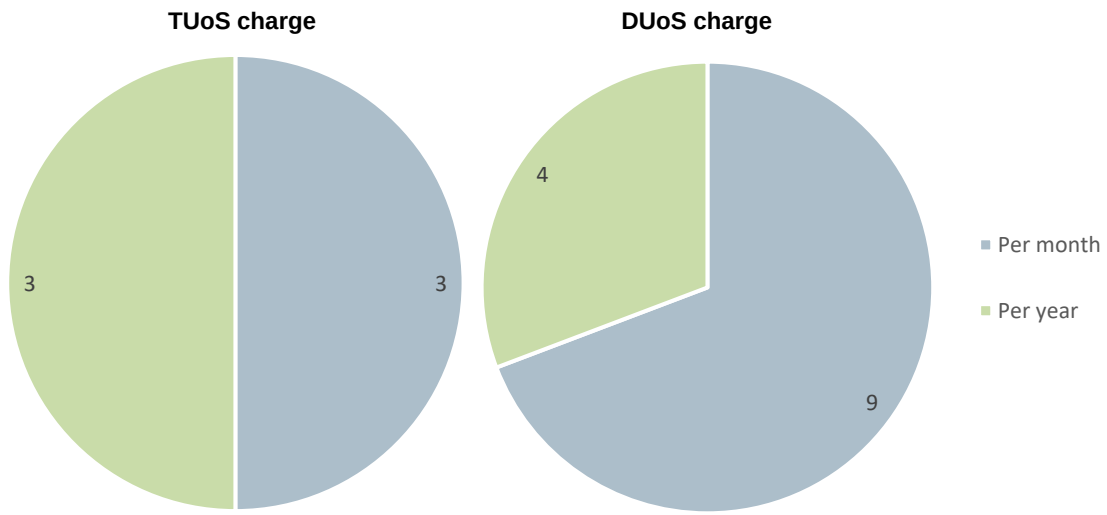
2.6.1 Analysis of fixed (per customer) charges

Fixed (per customer) charges are typically used to recover the costs of customer-related activities such as metering, billing and collections which do not vary with customer demand or consumption and usually vary in relation to the number of customers.

In the ERRA sample, 5 out of 26 MOs use fixed charges in their TUoS tariff structure while 12 out of 26 MOs use fixed charges in their DUoS tariff structure. Fixed charges seem to be less common in comparison to other types of charges both in TUoS and DUoS charges. It is also observed that fixed charges are more common in DUoS than in TUoS charges.

In relation to the time intervals for the application of fixed charges most MOs choose monthly intervals (see Table 16). The preference of monthly against annual fixed charges typically depends on the cash inflows needs of the network operator. Monthly charges distribute cash inflows throughout the year whereas cash inflows from annual payment are concentrated in one interval with lags of one year.

Table 16 Choice for the period of fixed charges



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
TuoS charge																										
Fixed charge?	✓		x	x	x	✓	x	x	x	x	✓	x	x	✓	x	x	✓	x	✓	x	x	x	x	x	x	x
Per month						✓					✓						✓									
Per year	✓													✓					✓							
DUoS charge																										
Fixed charge?	✓		x	x	✓	✓	✓		✓	x	✓	✓	✓	✓	x	x	✓	x	x	✓	x	✓	✓	x	x	x
Per month						✓	✓		✓		✓		✓				✓			✓		✓	✓			
Per year	✓				✓							✓		✓												

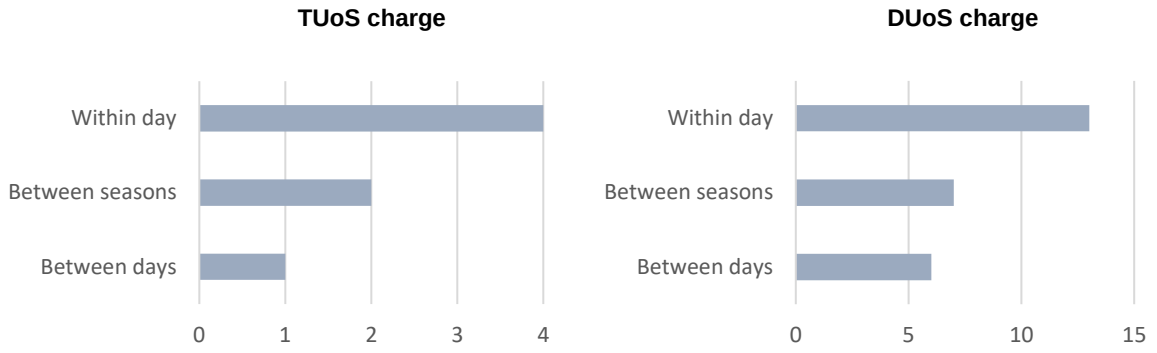
Source: Survey question 5.2 (use-of-system sheets). Key: ✓ (yes), x (no).

2.6.2 Analysis of time-of-use periods

Time-of-use (ToU) charges may have within day variation and sometimes contain type of day or seasonal variation (see Table 17).

ToU energy charges are applied in 4 out of 26 MOs in their TUoS tariff structures and in 14 out of 26 MOs in their DUoS tariff structures. Most MOs apply simple ToU charges with variations within the day only. Within day variation appears in all four MOs with time-of-use TUoS charges and in 13 of 14 MOs with time-of-use DUoS charges. Seasonal and type of day variations are less frequent. The table below summarises the most common periodic applications of time-of-use energy charges.

Table 17 Time-of-use energy charges

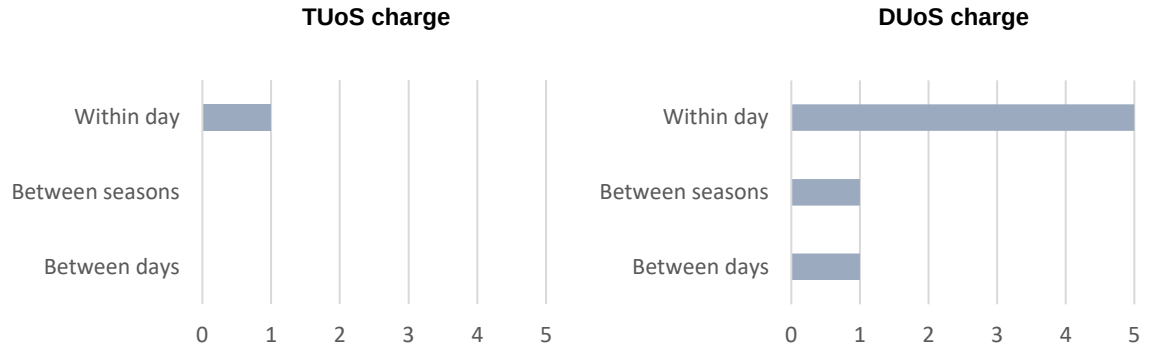


	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
TUoS charge																										
ToU energy charge?	x		x	x	x	x	x	x	✓	x	✓	x	x	x	x	x	x	x	✓	x	x	x	x	✓	x	x
Between days																			✓							
Between seasons									✓										✓							
Within day									✓		✓								✓					✓		
DUoS charge																										
ToU energy charge?	x		x	x	✓	✓	✓		✓	x	✓	x	✓	✓	x	x	✓	x	✓	✓	✓	✓	✓	✓	x	x
Between days						✓	✓		✓				✓	✓										✓		
Between seasons					✓	✓			✓								✓		✓		✓	✓				
Within day					✓	✓	✓		✓		✓		✓	✓			✓			✓	✓	✓	✓	✓		

Source: Survey question 5.3 (use-of-system sheets). Key: ✓ (yes), x (no).

ToU demand charges are less frequent than ToU energy charges. Only one TSO uses ToU demand charges and seven out of 26 MOs use ToU demand charges. **Time-of-use demand charges are used mainly with within day variation and sometimes have daily or seasonal variation** (see Table 18). Unlike the energy charge, the demand charge is expressed on a much simpler temporal basis with little combination of within day, between-day and seasonal variation.

Table 18 Time-of-use demand charges



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
TUoS charge																										
ToU demand charge?	x		x	x	x	x	x	x	x	x	✓	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Within day											✓															
Between days																										
Between seasons																										
DUoS charge																										
ToU demand charge?	x		x	x	x	✓	x		x	x	✓	x	x	x	x	x	✓	x	x	✓	x	x	✓	✓	x	x
Within day											✓						✓			✓			✓	✓		
Between days																								✓		
Between seasons						✓																				

Source: Survey question 5.4 (use-of-system sheets). Key: ✓ (yes), x (no).

2.6.3 Analysis of reactive power penalties

A reactive power *penalty* may be charged for parties deviating from a pre-specified power factor. For example, a common formulation is the customer paying a penalty for dropping below a power factor of x%, where x is contractually agreed. Thus, while a reactive power *charge* applies to all reactive power, a reactive power *penalty* applies only to reactive power that results from a drop below a pre-specified power factor.

In the ERRA sample, **reactive power penalties exist in seven MOs, and the minimum power factor range is 85-99%** (see Table 19). Reactive power penalties are more common in TUoS charges. In two cases, only the DSO charges reactive power charges (Czechia and Pakistan).

Table 19 Reactive power penalties

MO	Customer category	Min power factor (%)	Penalty description
AL	35kV connection (DSO)	90%	When a user is found to be operating outside the technical limits specified in the Distribution Code then the user shall correct the situation or disconnect the apparatus causing the problem from its electrical system connected to the distribution system immediately or within such time as agreed with the DSO. Continued failure to correct the situation shall result in the user being disconnected in accordance with the Connection Agreement.
AT	All customers (TSO)	90%	No explicit penalty. Observance is specified in connection contracts.
	All customers (DSO)	90%	The related expenses shall be charged to the system users separately.
CZ	Business MV and HV (Peak and usual consumption) (DSO)	95%	?
LV	All TSO and DSO categories	99%	0.013 EUR/kVArh for customers connected to at least 6kV with permitted load of 100 kW or more, and for customers with an input protection device with a rated current of at least 200A.
SK	All customers (TSO)	95%	Specified in connection contracts
	HV and MV-connected, and LV-connected business (DSO)	95%	Standard power factor and can be individually tailored. If not met, a penalty is applied.
TH	All customers (TSO)	87.5%	Penalty of 18.68 $/kVA whenever the power factor falls below 87.5%.
	Medium general service, larger general service, specific business service, and non-profit organisations (DSO)	85%	Penalty of 56.07 $/kVA applies when demand exceeds 61.97% of kW demand for consumers with a lagging power factor.
TR	Consumers (TSO)	95%	Penalty applied according to system use agreement
	Generators (TSO)	98%	Penalty applied according to system use agreement
	All customers (DSO)	99%	Reactive energy tariff of 0.03116 $/kVArh applied if ratio reactive/active falls below 85%, 80% or 67% depending on system user
PK	Industry (DSO)	90%	Two percent increase in the fixed charges with reference to maximum demand on the month with power factor below 90%

Source: Survey question 5.6 (use-of-system sheets). Key: ? (no data).

2.6.4 Analysis of demand and access charges

Demand or access charges are frequently used for the recovery of network use-of-system costs. Even though they can reflect the fixed costs of capacity for the network, they are less common than energy charges for reasons of simplicity and due to metering constraints.

In the ERRA sample, demand charges are more frequent than access charges for TUoS charges. Ten MOs use demand charges, and six MOs use access charges. None uses both. For DUoS charges, 14 MOs use demand charges, and nine MOs use access charges. Again, demand charges are more frequent than access charges. In DUoS charges there are four MOs using both.

Demand and access charges can be expressed in terms of kVA or kW. **Most MOs express these charges using kW**.[3] There are some exceptions. Slovakia expresses the access charge using kW, but the demand charge is based on the number of delivery points (DPs). Thus, the demand charge sometimes takes the form $/DP/month.[4] Estonia expresses its DUoS demand charge in $/A/month and Latvia its DUoS access charge in $/A/month.

2.6.5 Considerations about types of charges

Considerations about types of charges in network tariff designs

As mentioned earlier in this section, economically efficient network charges should have (ideally time-varying) energy charges to recover variable costs, plus a demand or access charge to recover fixed costs and a fixed charge per customer to recover costs that change by the number of customers. The cost for the provision of reactive power should also be recovered through an appropriate scheme, either through reactive power penalties that incentivise the improvement of power factors or through reactive power charges.

In practice, there is no unique, single best practice for implementing this theoretical standard, and rates will often deviate from this ideal structure for many reasons, including issues of acceptability, affordability, simplicity, equity and cost of metering relative to the benefits achieved from more complex rate structures and other policy objectives.

Demand or capacity, and access charges (per kW or KVA) are usually used to recover the fixed costs of network capacity. As already mentioned, in theory they should apply at time of system peak, as this is the driver of investment needs. However, they are often applied to other hours as well.

The most common type of charge used by MOs in the ERRA sample to recover network costs was a flat energy charge. Energy charges are simpler (both for customers to understand and for the network operator to apply) and they are typically supported by all types of metering devices. However, they weaken cost-reflectivity and fairness.

Whether demand charges can be introduced for various customer groups is dependent on metering capabilities. The application of demand charges requires the use of suitable metering. Most modern electronic metering can record maximum demand, but many older electromechanical meters do not unless they have been designed for such purposes. Electronic meters capable of recording maximum demand are currently mostly installed for larger customers in the ERRA sample, and the rollout of smart meter would enable the application of demand charges to more and all customer categories.

[3] Based on responses to survey questions 5.7 and 5.9 (use-of-system sheets).
[4] Slovakia also expresses some demand charges in $/kWh, which we interpret as energy charges.

Another factor that affects the application of demand or access charges is the ability of customers (especially residential and small commercial customers) to understand this type of charges. For simplicity and practicality this type of charges is often avoided for smaller customers.

Whether charges are applied per kW (or per kVA) or per kWh, to be cost-reflective the charges should ideally be differentiated by time-of-use.

Demand or access charges are typically used when costs do not vary with kWh produced. They are best for network charges that depend almost entirely on maximum demand on the national network or a large area network (which may differ from national system maximum demand).

However, although costs are driven by the coincident maximum demand, the charges can be cost-reflectively charged per kWh at peak times. This spreads the charge over a longer period and, though it appears to dilute the incentive to reduce peak demand, it can be shown to be equivalent to a per kW demand charge, and it is not obvious that one is superior to the other in terms of cost-reflectivity.

For local networks supplying individual customers or smallish groups of customers, network charges based on contracted capacity are most cost-reflective. Network are designed to be able to meet the current and future capacity requirements and the contracted capacity is a good proxy of the capacity costs each customer imposes to the system. The customers may be asked to pay a penalty if they exceed the contracted capacity – this is in order to incentivise them to forecast their network capacity reasonably accurately.

Relative lack of time-of-use charges, along with the diversity in the application of fixed, demand and access charges among the ERRA sample countries, means there is ground for in depth analysis of the special conditions and objectives guiding the setup of network charges in each country, and possibly the improvement of economic efficiency through the modification of the combination of the types of charges currently in use. Although there are clear theoretical standards for this practice, practical implementation cannot copy “best practices” as the latter are only best for the specific conditions they were applied.

2.7 Special tariff designs

With existing and emerging challenges, electricity authorities internationally are adapting their tariff designs to reflect new market conditions. In this analysis, we questioned participants whether they have developed new tariff designs for special emerging technologies or challenges. These included special tariff designs for:

- **Electric vehicles (EVs):** As countries move towards their decarbonisation targets, one option is to phase out traditional vehicles with internal combustion engines that rely on fossil fuels and to phase in EVs that are powered by a green power sector. This would mean an increased need in electricity demand and network capacity. Several Utilities worldwide develop special tariff designs for EVs to mitigate the impact of charging on peak demand and consequently on network investment costs. The most common approach is to apply ToU charges to signal the higher price for charging during peak hours and incentivise customers to charge at other off-peak hours.

- **Smart technologies:** A self-monitoring, analysis, and reporting technology (or smart technology) is a technology that offers interaction and control through use of the Internet. In the context of the electricity sector, a smart technology may receive

information from the utility company to automatically switch off during times of high prices (eg a freezer may turn off temporarily if prices spike) or to schedule operation for a time of low prices (eg a washing machine may be scheduled to turn on during the night). These technologies can help reduce demand peaks, which is important for lowering system costs and at the same time would reduce consumers bills. Smart technologies are becoming more popular nowadays, but they are still at an early stage of development. Adequate network, IT, charging and billing infrastructure would be required to implement dynamic pricing to interact with smart devices.

- **Self-generators:** Entities that generate electricity for their own consumption. This is increasingly popular with entities investigating the development of renewable generators on-site. To achieve economic efficiency, it is important to implement cost-reflective structures that signal the true cost of electricity supply for investors to take economically efficient decision for the development of self-generation. Another issue that may evolve is the overriding of the network which may increase charges for other consumers who are bound to receive electricity from the grid.

- **Distributed generation and storage:** Generators and storage facilities connected to the distribution network. This will be increasingly common as economies decarbonise. For example, roof-top solar and other small-scale renewables will be connected to the distribution network.

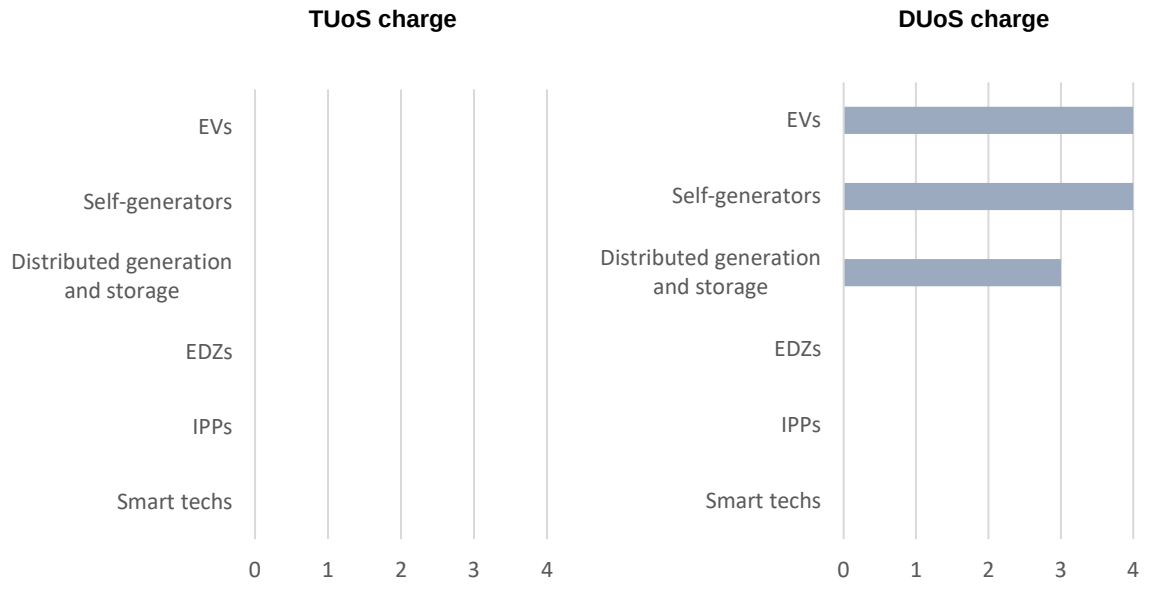
- **Independent power producers (IPPs):** Non-utility generators (NUGs) that are typically not owned by the national electricity company or public utility. Special charges that describe the connection terms for IPP are increasingly adopted by countries.

- **Social tariffs:** Tariff categories for socially or economically vulnerable customers.

- **Economic development zones (EDZs):** Geographical areas that enjoy preferential policies. They are employed as policy instruments to foster economic growth and technological innovation and increase exports and employment. Such zones may receive special charging arrangements to attract investments and improve economic growth.

In the ERRA sample, **no MOs adopt special tariff designs for the TUoS charge** for the categories discussed above (see Table 20). However, **special tariff designs exist for EVs, self-generators and distributed generation and storage for the DUoS charge** across six MOs. No special tariff designs exist for EDZs, IPPs or smart technologies in our sample.

Table 20 Special tariff designs



MO	Special charges	Description
AT	Distributed generation and storage	For the DUoS charge, the special charge for pumped storage power plants connected to the distribution network consists of a flat energy charge, a flat demand charge, an access charge, and a reactive power charge. A net metering arrangement is used, in which an electronic meter is required.
CZ	EVs	For the DUoS charge, the special charge for EVs consists of a flat energy charge and an access charge. Electronic meter required.
HU	Self-generators	For the DUoS charge, the special charge for prosumers with micro generators consists of a fixed charge and a flat energy charge. A net metering arrangement is used.
LT	Self-generators	For the DUoS charge, the special charge for prosumers consists of a flat energy charge and (or) an access charge. Prosumers also may choose another type of charge – a percentage of electricity, provided to the grid. A net metering arrangement is used, in which a smart meter is required.
PL	EVs	For the DUoS charge, the special charge for EVs consists of a flat energy charge and a flat demand charge.
SK	EVs	For the DUoS charge, the special charge for EVs consists of a flat energy charge and an access charge.
	Distributed generation and storage	For the DUoS charge, the special charge for distributed generation and storage consists of an access charge. Smart meter required.
TH	Self-generators	Respondent did not provide information.
	EVs	Respondent did not provide information.
TR	Self-generators	For the DUoS charge, the special charge for unlicenced generators consists of a flat energy charge. Reactive power penalties apply.

MO	Special charges	Description
	Distributed generation and storage	For the DUoS charge, the special charge for licenced generators connected to the distribution network consists of a flat energy charge. Reactive power penalties apply.

Source: Survey questions 6.1-6.13 (use-of-system sheets).

2.7.1 Considerations about special tariff designs

Considerations about special tariff designs for emerging technologies

The key benefit to be gained from smart technologies is the shifting of demand away from peak periods. This becomes increasingly important as countries shift to renewable technologies for generation and therefore need to match consumption schedules to generation schedules. The introduction of smart meters and appropriate time of day reflecting charges may be effective to that. At the residential level this may be combined with the automations offered by 'smart' appliances allowing 'delayed start' and interruptions when combined with a smart meter.

The benefits consumers see by shifting demand away from peak can be realised both in the short and the long-run. In the short run they can reduce their bills as they will be consuming less electricity in high-cost period and more electricity during low cost periods. The benefits in the long-run will be realised through reduced investments in network infrastructure costs due to lower capacity requirements.

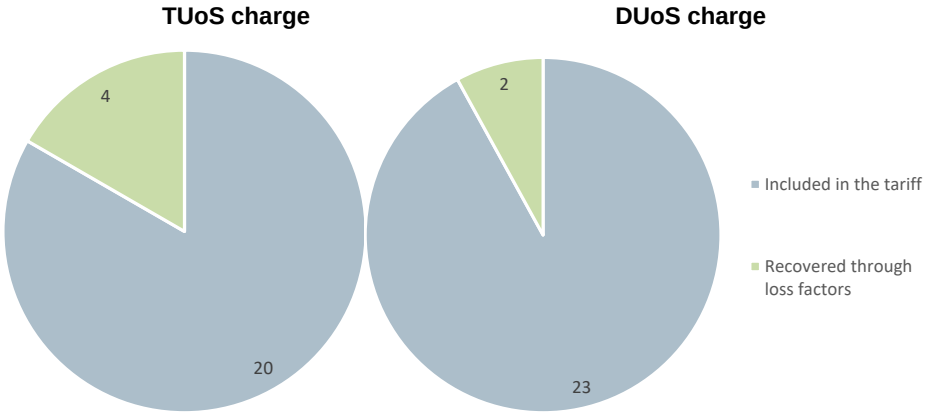
Moreover, while batteries, and other storage systems become indispensable for the shift of energy markets to renewables, helping to integrate more RES in the networks, their integration in electricity trading may impose significant burden on networks, considering their ability to discharge or absorb high volumes of electricity in short time. Appropriate network charges should incentivise efficient use of the network, and to that effect special tariffs may be designed. A problem to be dealt with storage facilities is that being both generators and load, an arrangement should be made for fair allocation of network costs.

With the introduction and planned wide penetration of electric vehicles, and electrification of activities such as space heating, not only the provision of signals for timing of consumption becomes critical, but also the expected high rise in prior not existing demand has to be faced, as this may be expected to have a significant impact on electricity system cost, including both transmission and distribution network infrastructure. Hence, the question is how to structure network charges to make an efficient use of electricity, optimise the requirements for new investments to cover the increasing demand and enhance economic efficiency.

2.8 Treatment of losses

The recovery of the cost of network losses may be incorporated in the TUoS or DUoS tariff design or charged elsewhere in the end-use tariff. In the ERRA sample, **almost all MOs incorporate the recovery of the cost of losses in TUoS and DUoS charges**. One minor exception is in Mongolia. Although this MO does account for losses across the network, these losses are only accounted for entirely through the DUoS charge and not the TUoS charge.

Table 21 Treatment of losses



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
TUoS charge																										
Losses accounted for?	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓
Included in the network tariff	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
Recovered elsewhere					✓													✓	✓	✓						
DUoS charge																										
Losses accounted for?	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Included in the network tariff	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Recovered elsewhere					✓														✓							

Source: Survey question 7.1 (use-of-system sheets). Key: ✓ (yes), x (no).

2.8.1 Considerations about the treatment of losses

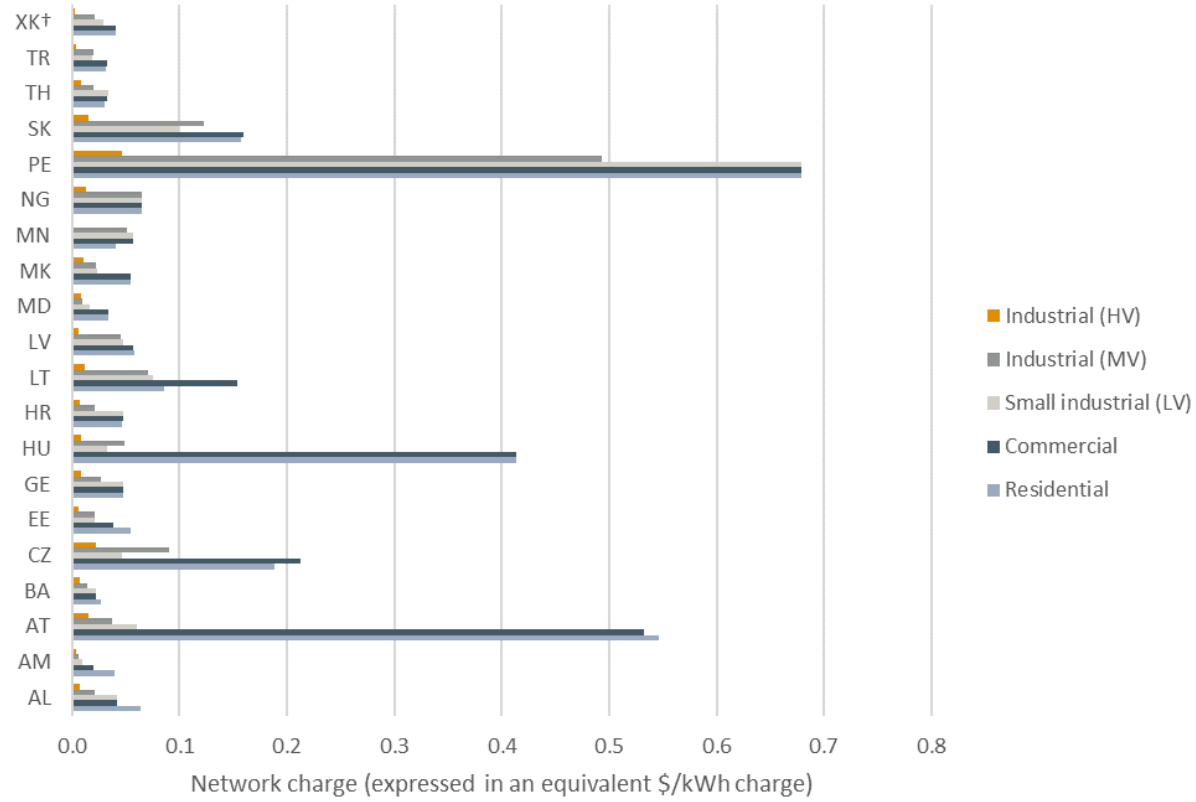
Considerations about the treatment of losses

In one way or another the cost of network losses has to be recovered by end-users. The most common practice is to incorporate the cost of losses in the network use-of-system charge. The network operator should be incentivised to reduce the cost of losses which is typically accounted in the allowed revenue regulations and not in the tariff designs.

2.9 Level of use-of-system charges

The following figure compares the level of network charges among the 26 MOs for five typical customer categories - Industrial HV, Industrial MV, Small industrial LV, Commercial LV and Residential LV. The level of network charges was calculated using typical consumption profiles for each customer category and the network charges submitted by TSOs and DSOs[5]. We see that **commercial and residential users tend to pay the highest rates for network use-of-system charges**. This is because they are connected at the lowest voltage on the distribution network and typically have a lower load factor (ie "peaky" demand).

Figure 4 Equivalent network charges for each MO



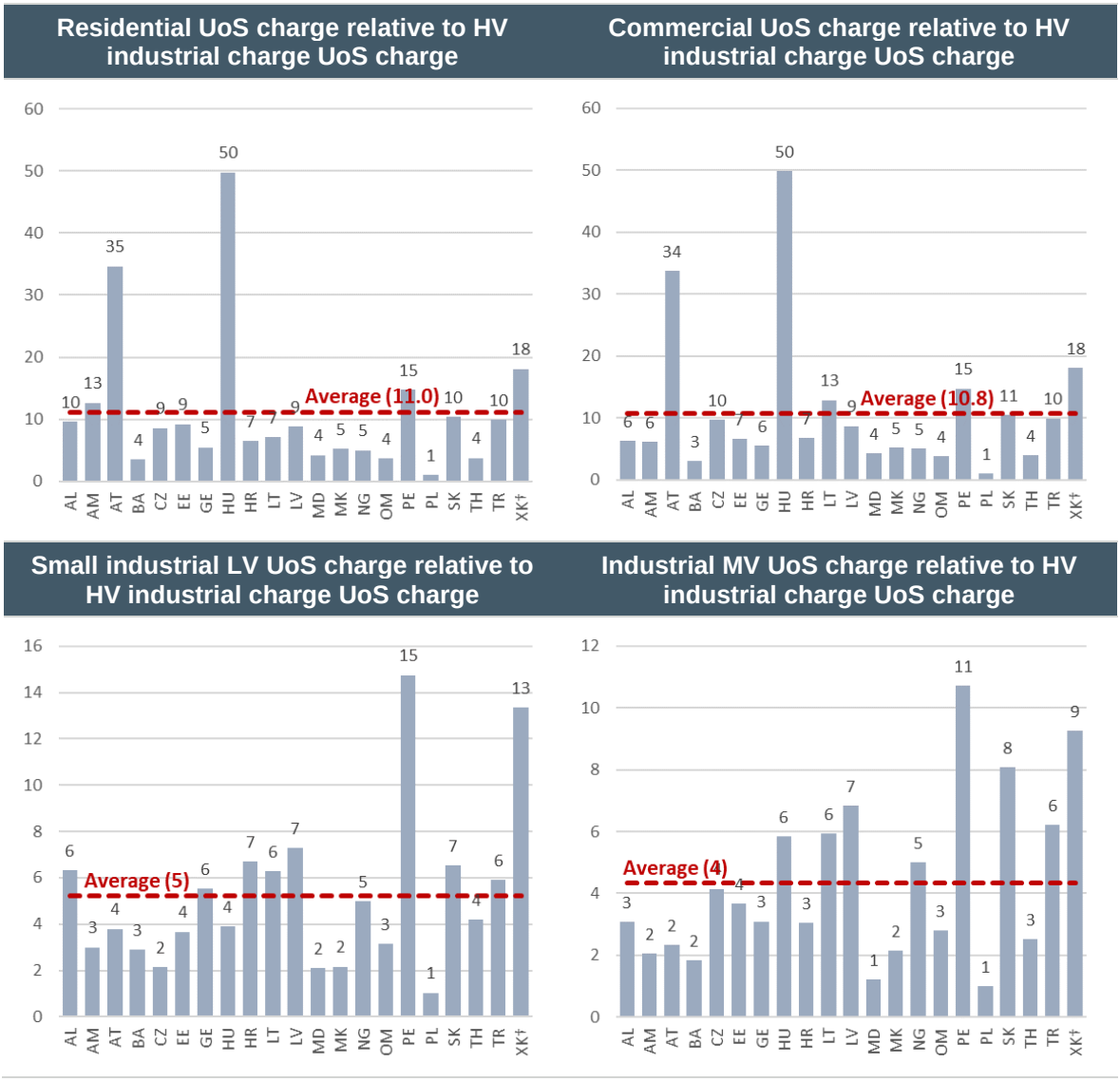
Source: Survey (present charges sheet).

Relative level of network use-of-system charges among customer categories

The relative level of network use-of-system charges among customer categories is shown in the figure below. The comparison is conducted relative to the HV industrial charge of each country. Residential tariffs are on average 11.0 times higher than HV industrial tariffs. Commercial tariffs are on average 10.8 times higher than HV industrial tariffs. Small industrial LV tariffs are on average five times higher than HV industrial tariffs and MV Industrial tariffs are four times higher than HV industrial tariffs.

[5] The charges are expressed in an equivalent energy charge in $/kWh. Annexes A1.1, A1.2 and A1.3 provide more details for the calculations and the resulting equivalent energy charges..

Figure 5 Relative level of network use-of-system charges among customer categories

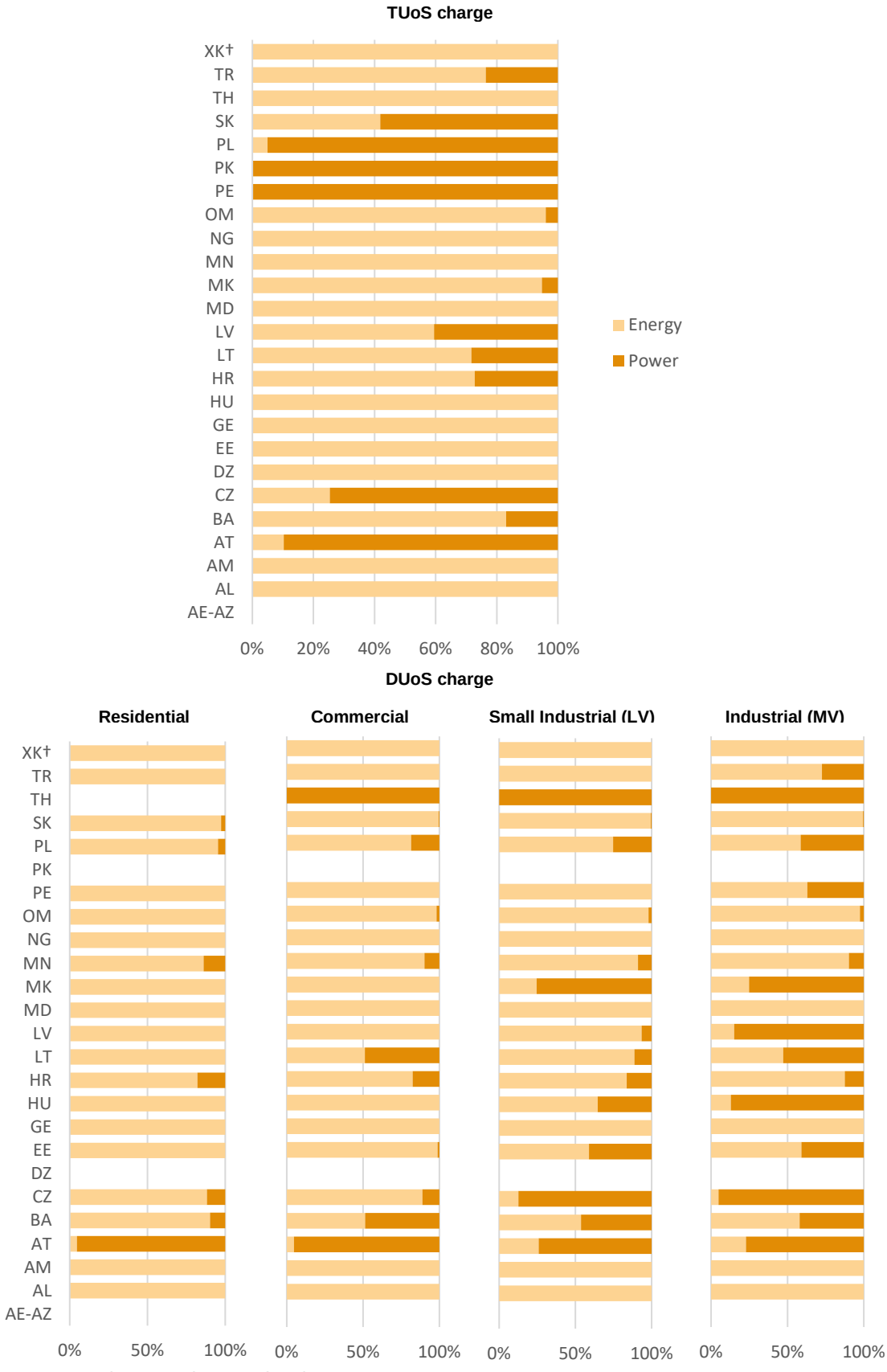


Source: Survey (present charges sheet).

Energy and capacity split of network use-of-system charges

The split between energy and capacity charges for the TUoS charge and the individual categories in the DUoS charge is presented in Figure 6. We see that **energy charges are the primary means for raising revenue** for the **TUoS charge** (75% of the MOs), though for some MOs such as Austria, Czechia, Pakistan, Peru, Poland, and Slovakia, most of the revenue is raised by power charges. For **DUoS charges**, however, we see that **power charges become more important sources of revenue for large (industrial) consumers** in seven MOs, whereas for residential consumers they only account for a significant share of revenue in Austria.

Figure 6 Split of energy and power charges in the network tariff designs



Source: Survey (present charges sheet).

3 Connection charges

Connection charges refer to charges for connecting to the electricity network. The charge is typically used by TSOs and DSOs to pay for the construction and maintenance of assets used to connect the user to the network. In this section, we discuss and evaluate the principles and approaches that are used for designing connection charges.

We structure our discussion across six subsections:

- **Regulations and principles:** Tariff regulations and guiding principles for designing connection charges.
- **Customer categories:** Customer categories in the connection charge design.
- **Depth of charge:** Whether connection charges are deep or shallow and who pays for the line.
- **Generators versus load:** Whether generators and load are treated equivalently in the connection charge policy.
- **Levels of charges:** The existing transmission and distribution connection charges for each country.

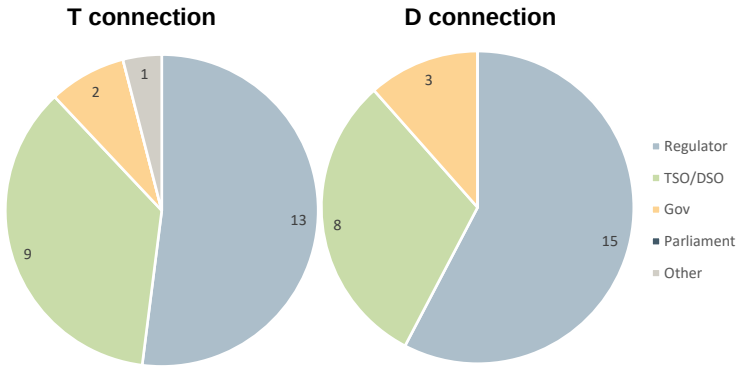
In Pakistan, there are no customers directly connected to the transmission system, so there is no transmission connection charge. In Turkiye, the TSO does not charge a connection fee to system users – if a system user builds a connection, then the TSO pays connection costs back to the user according to an approved methodology. Therefore, **we do not report most transmission connection charge data for Pakistan or Turkiye in this chapter.**

3.1 Regulations and principles for connection charges

In the ERRA sample, **regulators are mostly responsible for developing and approving the connection charge policy** (see Table 22 and Table 23). **TSOs and DSOs have a larger role in the development of the connection charges in comparison to the development of use-of-system charges**. For example, more TSOs and DSOs *develop* the connection charge policy (nine TSOs and eight DSOs) than the use-of-system charge design (six TSOs and seven DSOs).

There is one MO in which the TSO *approves* the connection charge policy, but generally **TSOs and DSOs play no role in approving the use-of-system charge design**.

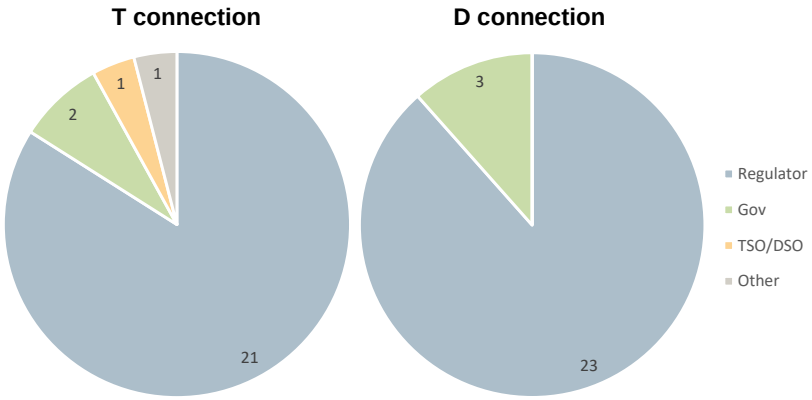
Table 22 Entity responsible for developing the connection charge policy



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Transmission connection charge																										
Regulator				✓	✓	✓	✓	✓		✓	✓	✓			✓				✓	✓			✓		✓	
TSO	✓	✓	✓						✓							✓	✓	✓						✓		✓
Government													✓	✓												
Other																						✓				
Distribution connection charge																										
Regulator				✓	✓	✓	✓	✓		✓	✓	✓			✓			✓	✓	✓	✓		✓		✓	
DSO	✓	✓	✓						✓							✓	✓							✓		✓
Government													✓	✓								✓				

Source: Survey question 1.2 (connection sheets).

Table 23 Entity responsible for approving the connection charge policy



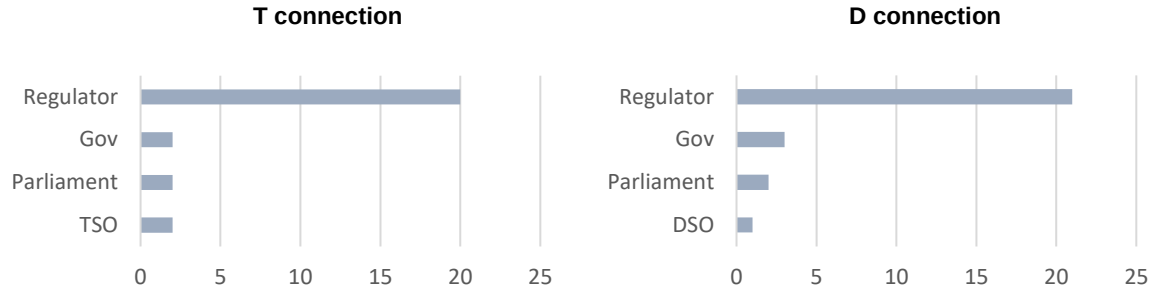
	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Transmission connection charge																										
Regulator	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓
Government		✓						✓																		
TSO																	✓									
Other																						✓				

	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Distribution connection charge																										
Regulator	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Government		✓						✓														✓				

Source: Survey question 1.1 (connection sheets).

Similar to the use-of-system charge design, **regulatory frameworks** can be used to guide the connection charge calculation process. In the ERRA sample, **connection charge regulatory frameworks exist in most cases** (see Table 24). Where they exist, the **regulator is mostly responsible for developing the framework**. In some cases, there is a joint role between entities. For example, in Lithuania, the Government sets in law the basic rules and guidelines for the connection charge policy, and the regulator then prepares and approves the final methodology for setting connection charges.

Table 24 Entity responsible for developing regulations on connection charge method



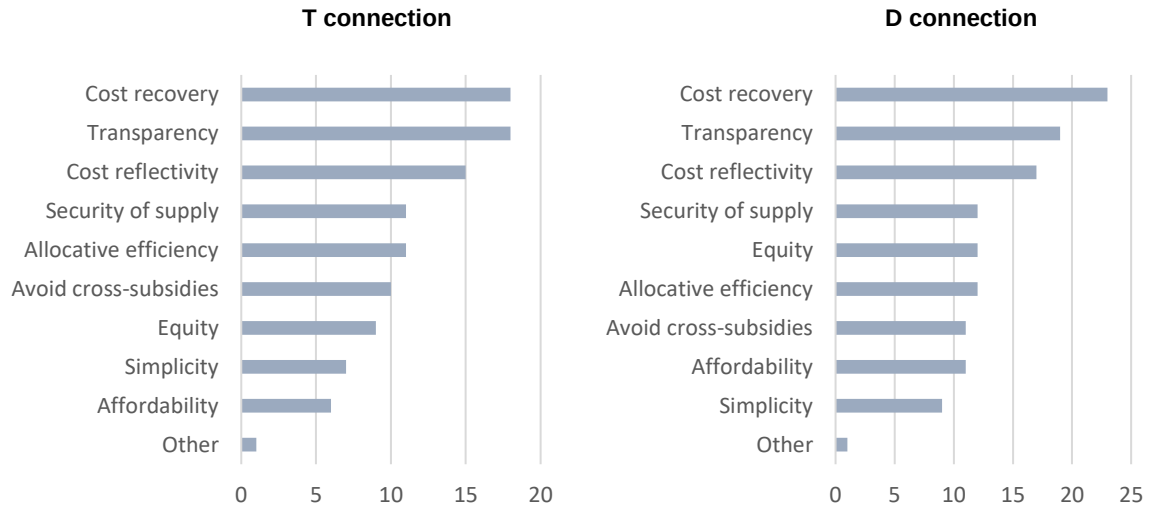
	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Transmission connection charge																										
Regulation defines method?	✓	x	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
TSO																✓		✓								
Parliament														✓								✓				
Gov													✓				✓		✓							
Regulator	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓				✓			✓	✓	✓	✓
Distribution connection charge																										
Regulation defines method?	✓	x	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓
DSO																✓										
Parliament														✓								✓				
Government													✓						✓			✓				
Regulator	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓		✓	✓	✓	✓

Source: Survey questions 1.3 & 1.3.1 (connection sheets). Key: ✓ (yes), x (no).

Where regulatory frameworks are adopted, the body responsible for developing the connection charges has a multitude of **guiding principles** to codify into the connection charge design

approach. In the ERRA sample, **cost recovery, transparency and cost-reflectivity are the most common guiding principles** (see Table 25). However, we also see that many other guiding principles are included. This mirrors what we observe for the use-of-system charge.

Table 25 Guiding principles for tariff design in regulations



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Transmission connection charge																										
Regulation defines method?	✓	x	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Affordability			✓			✓										✓	?					✓		✓		✓
Simplicity					✓	✓								✓			?	✓	✓			✓				✓
Equity	✓					✓		✓						✓	✓		?					✓	✓	✓		✓
Allocative efficiency	✓				✓	✓		✓		✓			✓				?	✓	✓			✓		✓		✓
Avoid cross-subsidies					✓	✓			✓	✓			✓	✓	✓	✓	?		✓							✓
Security of supply			✓			✓			✓	✓			✓		✓	✓	?		✓			✓		✓		✓
Cost-reflectivity	✓		✓	✓	✓			✓		✓		✓			✓	✓	?	✓	✓			✓	✓	✓		✓
Transparency	✓		✓		✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	?	✓	✓	✓			✓	✓		✓
Cost recovery	✓		✓		✓	✓			✓	✓		✓	✓	✓	✓	✓	?	✓	✓	✓		✓	✓	✓		✓
Other													✓				?									
Distribution connection charge																										
Regulation defines method?	✓	x	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓
Simplicity				✓	✓	✓						✓		✓				✓					✓		✓	✓
Affordability			✓	✓		✓						✓				✓			✓			✓	✓	✓	✓	✓
Allocative efficiency	✓			✓	✓	✓		✓		✓			✓						✓			✓	✓	✓		✓
Equity	✓			✓		✓		✓						✓	✓						✓	✓	✓	✓	✓	✓
Avoid cross-subsidies					✓	✓			✓	✓	✓		✓		✓	✓			✓						✓	✓

	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Security of supply			✓			✓		✓	✓	✓			✓		✓	✓			✓			✓		✓		✓
Cost-reflectivity	✓		✓	✓	✓			✓		✓		✓	✓		✓	✓			✓		✓	✓	✓	✓	✓	✓
Transparency	✓		✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓			✓	✓			✓	✓	✓	✓
Cost recovery	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Other													✓													

Source: Survey question 1.3.2 (connection sheets). Key: ✓ (yes), x (no), ? (no data).

3.1.1 Considerations about regulations and principles for the design of connection charges

Considerations about regulations and principles for the design of connection charges

The considerations discussed in section 2.2.5 regarding the regulations and principles governing use-of-system charges mostly apply to connection charges.

Apparently due to the relatively heavy technical element of connections, TSOs and DSOs are more involved with the development of the connection charge policy, compared to that for use-of-system charges. As discussed above, it is the institution's capacity to act independently and prudently, and the control mechanism in place to enable and monitor this performance, that determine the effectiveness of the governing framework. The regulator's central role in this process for the majority of countries in the ERRA sample does provide a good basis, which would need to be confirmed in each case through close review of the details of the respective governing regulations.

3.2 Customer categories for connection charges

When designing a connection charge policy, standard **drivers that distinguish customer categories** are:

- **Capacity requirement:** A network user with a higher capacity requirement requires a more expensive high-capacity line to connect to the network. Since high-capacity customers typically connect to high voltage networks, the customer is also unlikely to share the cost of new infrastructure with other connecting customers. Further, since high-capacity customers impact the network more than low-capacity customers, they therefore impose greater network reinforcement costs, such as for the reinforcement of substations. For these reasons, some countries separate connection charges according to the connecting user's capacity requirement.

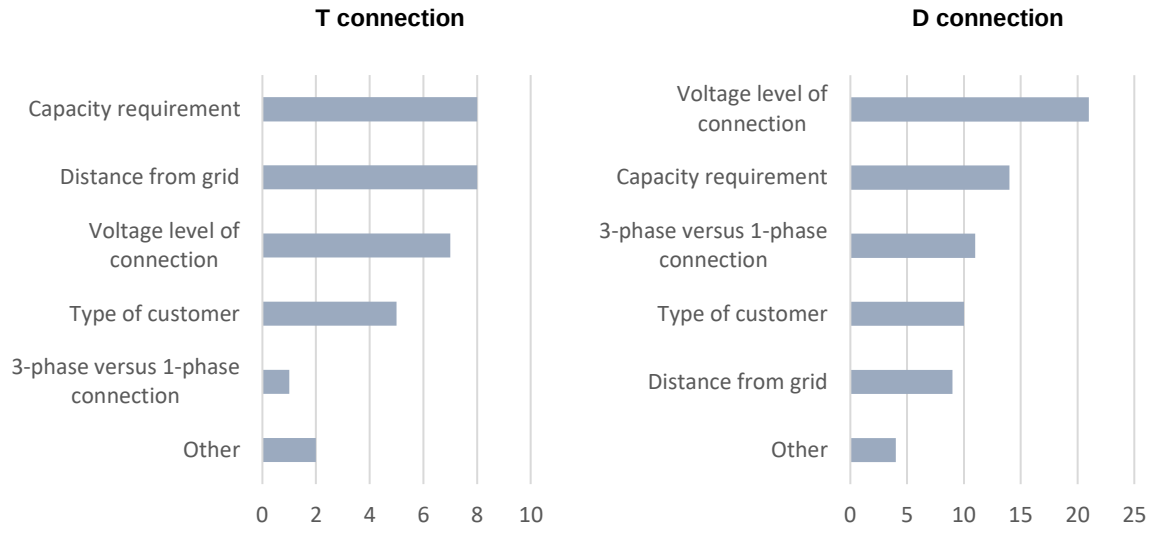
- **Distance from grid:** The distance from the grid affects how much line must be built from the customer's premises to the existing network. Therefore, some countries use the distance from the grid as a driver for setting customer categories.

- **Voltage level of connection:** This carries similar arguments to the capacity requirement. The lower the voltage level of connection the lower the capacity requirement will be, both in terms of cables and for substations.

- **Three-phase versus single-phase connection:** A three-phase connection has higher costs that a single-phase connection. A three-phase connection has one neutral wire and three-phase wires to complete the circuit. A single-phase connection also has a neutral wire but only one phase wire.

In the ERRA sample, **separation of connection charges into distinct customer categories is more common for distribution** (in 23 MOs) than for transmission (in 12 MOs) (see Table 26). **The capacity requirement and distance from the grid are the principal drivers** for separating charges into customer categories for transmission connection charges. The voltage level of connection plays also a key role for the determination of the categories for the connection charges. The primary driver for distribution connection charges is the **voltage level** of connection. However, capacity requirements and three-phase versus single-phase connection play a role as well.

Table 26 Drivers for separating charges into customer classes



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Transmission connection charge																										
Multiple consumer categories?	x	✓	x	x	✓	x	✓	✓	x	✓	✓	x	x	x	x	x	x	✓	✓	✓		✓	✓	x	x	✓
3-phase versus 1-phase connection																										✓
Type of customer							✓				✓											✓	✓			✓
Voltage level of connection					✓			✓		✓								✓	✓	✓						✓
Distance from grid					✓			✓		✓								✓	✓	✓			✓			✓
Capacity requirement		✓			✓			✓		✓								✓		✓			✓			✓

	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Other											✓											✓				
Distribution connection charge																										
Multiple consumer categories?	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	✓	x	✓	✓	✓	✓	✓	✓	✓	✓	✓
3-phase versus 1-phase connection						✓	✓	✓		✓				✓				✓		✓	✓		✓	✓		✓
Distance from grid	✓						✓	✓	✓									✓			✓	✓			✓	✓
Type of customer	✓			✓				✓	✓		✓		✓								✓	✓	✓			✓
Capacity requirement	✓	✓			✓	✓		✓		✓			✓			✓				✓	✓	✓		✓	✓	✓
Voltage level of connection	✓			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Other							✓				✓			✓										✓		

Source: Survey question 2.1 (connection sheets). Key: ✓ (yes), x (no).

3.2.1 Considerations about customer categories for connection charges

Considerations about customer categories for connection charges

The key driver for grouping customers for connection charges should be the cost of the connection. Customers with similar costs of connection should be grouped together. Distance from the grid, capacity requirements, three-phase versus single-phase connection and the voltage level of supply are and can be used as proxies for the cost of the connection. Therefore, customer categories for connection charges are typically defined using the above drivers.

Most MOs in the ERRA sample distinguish multiple customer categories for transmission and distribution network charging. However, the categorisation of customer to categories using the above driveps does not in itself provide the essential factor regarding the determination of fair and cost-reflective connection charges. The outcome also depends on how cost is calculated, whether connection costs may be shared when multiple users connect to the grid at different pints in time, and other factors specific to each particular case.

3.3 Depth of charge and payment method for connection charges

The purpose of connection charges (irrespective of the model chosen) is to recover the initial, non-recurring connection costs that enable users to receive network services. In general terms, and as further discussed below, there are key design choices to be made (‘shallow’ charging, ‘deep’ charging and hybrid), as well as variations within each regarding the payment options (up front, in limited instalments, periodically).

Depending on the location of the charging boundary a 'deep', 'shallow' or a 'hybrid' methodology may be developed. The basic variants of the connection charging policies comprise:

- **Shallow policy –** this does not charge the applicant project for reinforcements to the existing system but charges only for the connection line/cable and other equipment directly or exclusively relating to the connection. All other costs are socialised through the use-of-system charge.

- **Deep policy –** this charges for reinforcements to the existing system as well as the direct connection costs (ie all network costs incurred as a result of the connection). This can include network expansion costs (the cost for expanding the network to the customer's area) and any remote costs (ie upstream costs to the network).

There are also intermediate situations aiming to promote specific interests which create 'hybrid' charging policies, including a semi-shallow or shared-shallow policy in which the costs of reinforcements and extensions are shared. Rules for sharing are often based on theoretical allocations (ie capacity share).

The main connection costs recovered though the connection charges are:

- **Capital Costs –** cost of installing and commissioning connection assets. Capital costs may be fully paid by the customer or they might be shared between the network operator and the customer. They might be paid upfront as a one-off payment or they can be amortised over a certain period of time. In the case of customers connecting to the grid through an existing line, there might be a provision for proportional capital refunds to the customer who has initially paid the cost of the connection.

- **Operating and Maintenance Costs –** cost of operating and maintaining the connection assets. The costs of maintaining and operating dedicated connection related assets can be ring-fenced and allocated directly to the customer or it can be spread over all network customers according to the approved transmission or distribution pricing methodologies.

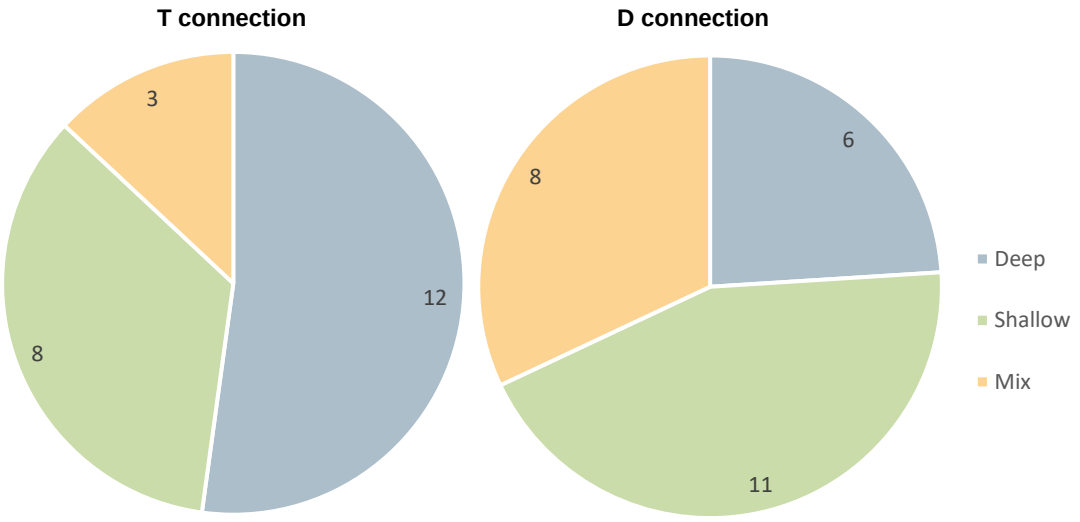
The connection charge policy can be also used to signal location constraints or costs to network users. Deep connection charges provide locational signals regarding the development of new generators and load centres. On the contrary, shallow connection charges cannot provide locational signals regarding the cost of connection to and using the network.

In the ERRA sample, **transmission connection charges are mostly deep, but distribution connection charges are mostly shallow** (see Table 27). This is a typical approach since customers or generators connecting to the transmission system have higher costs to connect which are solely attributed to their premises. It is fair to charge these customers the costs of connection through deep connection charges rather than socialise the costs through the use-of-system charge and have other customers pay for their connection costs. At the same time it is simple to have deep connection charges for such customers as their number is limited and the administrative burden to implement individual connection charges through a deep policy is relatively small.

On the other hand, the number of customers connecting to the distribution network is large and applying deep connection charges for smaller customers would impose a high administrative burden for the network operator; either to estimate the actual cost of connection for each individual customer or to approve the cost of connection estimated by the customer. Therefore, for smaller customers shallow approaches are preferred for reasons of simplicity. Shallow approaches undermine cost-reflectivity, and this creates the need of several customer categories with different connection charges to reflect the cost of connecting each group of customers. As it was seen in the customer categories section above, due to the shallow policy for distribution connected customers there is higher need to have several types of connection charge categories.

Shallow charges are sometimes preferred for reasons of social equity. The argument in favour of social equity is that customers in remote areas which have higher costs for connection should not be penalised and should receive equal treatment to those who had the luck to be born in urban centres.

Table 27 Depth of connection charge



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Transmission connection charge																										
Deep		✓	✓	✓		✓			✓		✓	✓	✓	✓		✓				✓			✓			
Shallow	✓				✓		✓			✓					✓		✓		✓			✓				
Mix								✓										✓								✓
Distribution connection charge																										
Deep		✓	✓	✓							✓		✓							✓	?					
Shallow	✓				✓	✓	✓								✓		✓	✓	✓		?	✓		✓	✓	
Mix								✓	✓	✓		✓		✓		✓					?		✓			✓

Source: Survey question 3.1 (connection sheets). Key: ✓ (yes), ? (no data)

To understand the depth of the connection charge, it is useful to know how payment for the line is handled. Specifically, it is useful to know who pays for the line, whether ownership is transferred to the TSO when the customer pays for that line, and who pays for the maintenance of the line.

In the ERRA sample, **most transmission and distribution connections require the customer to pay for the line**. This is the case for 22 of 26 MOs for the transmission connection, and there are examples of this in 24 of 26 MOs for the distribution connection (see Table 28). **In most cases, ownership is transferred to the TSO/DSO,** but there are some cases where the lines and equipment are still in the ownership of the customer.

The ownership of the asset should typically rest with the network operator. This approach is necessary for the purpose of safe and reliable operation and maintenance of the assets. We also see that, **in most cases, the TSO/DSO pays for maintenance of the line**. There are examples of this in 15 MOs for the transmission connection and 20 MOs for the distribution connection. In other cases, the customer pays for maintenance of the line following a connection.

Table 28 Payment for transmission connection assets

MO	Customer category	Customer pays for line?	Ownership transferred to TSO/DSO?	Who pays for maintenance?
Transmission connection charge				
AE-AZ	All	✓	✓	Customer
AE-DU	All	✓	✓	TSO
AL	All	✓	✓	Customer
AM	All	✓	x	Customer
AT	All	✓	✓	TSO
BA	All	✓	✓	TSO
CZ	All	✓	✓	TSO
DZ	All	✓	✓	Customer
EE	All	✓	✓	TSO
GE	Load	x		Customer
	Generators	x		Customer
HU	All	✓	✓	TSO
HR	All	✓	✓	TSO
LT	All	✓	✓	TSO
LV	All	✓	✓	TSO
MD	All	✓	x	Customer
MK	All	✓	x	Customer
MN	All	✓	✓	TSO
NG	Shallow connection	✓	✓	TSO
	Deep connection	✓	✓	TSO

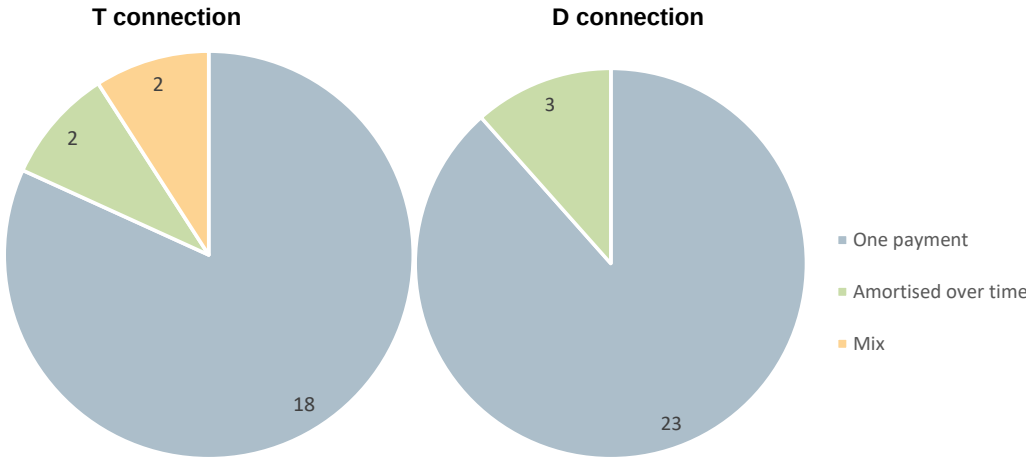
MO	Customer category	Customer pays for line?	Ownership transferred to TSO/DSO?	Who pays for maintenance?
OM	All	✓	✓	Customer
PE	All	✓	x	Customer
PK				
PL	All	✓	✓	TSO
SK	Generators and Load	✓	x	Customer
	DSOs	✓	✓	TSO
TH	All	x		TSO
TR				
XK*	Load	✓	✓	TSO
	Generator	✓	✓	TSO
Distribution connection charge				
AE-AZ	All	✓	✓	DSO
AE-DU	All	✓	✓	DSO
AL	All	✓	✓	Customer
AM	All	✓	✓	DSO
AT	All	✓	✓	DSO
BA	All	✓	✓	DSO
CZ	All	✓	✓	DSO
DZ	All	✓	✓	Customer
EE	All	✓	✓	DSO
GE	LV and MV (regulated)	x		DSO
	LV and MV (deregulated)	✓	x	Customer
	HV	✓	x	Customer
	Generator	✓	x	Customer
HU	HV	✓	✓	DSO
	HV/MV	x		DSO
	MV	✓	✓	DSO
	MV/LV	x		DSO
	LV	✓	✓	DSO
HR	All	✓	✓	DSO
LT	All	✓	✓	DSO
LV	All	✓	✓	DSO
MD	All	✓	x	Customer
MK	Standard connections	x		DSO
	Non-standard connections	✓	x	Customer

MO	Customer category	Customer pays for line?	Ownership transferred to TSO/DSO?	Who pays for maintenance?
MN	All	✓	✓	DSO
NG	All	✓	x	Customer
OM	All	x		DSO
PE	All	✓	✓	Customer
PK	All	✓	✓	DSO
PL	All	x		DSO
SK	HV (DSO 1)	✓	✓	DSO
	MV (DSO 1)	✓	✓	DSO
	LV (DSO 1)	✓	x	DSO
	Households (DSO 2)	✓	x	DSO
	Non-Household LV (DSO 2)	✓	x	DSO
	Non-Household MV (DSO 2)	✓	x	DSO
	Non-Household HV (DSO 2)	✓	x	DSO
	HV (DSO 3)	✓	x	DSO
	MV (DSO 3)	x		DSO
	LV (DSO 3)	✓	x	DSO
TH	All	✓	✓	DSO
TR	All	✓	✓	DSO
XK*	All	✓	x	Customer

Source: Survey question 3.2 (connection sheets). Key: ✓ (yes), x (no), ? (no data)

The utility can either recover the cost of a connection at once with an upfront payment or amortise the costs over a certain period of time. In the ERRA sample, **the connection charge is typically made in one payment** (see Table 29). In Oman, a mixed approach is used for the transmission connection charge payment; although the charge primarily takes the form of an upfront payment, and distribution companies have an option to pay in instalments for up to 15-20 years.

Table 29 Connection charge payment method



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Transmission connection charge																										
One payment		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	?	✓				✓	✓			✓
Amortised over time								✓									?			✓						
Mix	✓																?		✓							
Distribution connection charge																										
One payment	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	?	✓	✓		✓	✓	✓	✓	✓	✓
Amortised over time								✓									?			✓	✓					
Mix																	?									

Source: Survey question 4.1 (connection sheets). Key: ✓ (yes), ? (no data)

Sharing of costs is necessary when one customer pays to connect to the network and the infrastructure developed is planned to cover the connection of other potential customers in the future as well. For example, the cost of the substation to electrify a village will be designed to cover the capacity requirements of the village. The costs of this substation will be high and should not be recovered only through the person who make the first connection. Cost sharing is crucial to promote electricity connection and equality. The sharing of the costs should be time limited and it should define how the costs should be allocated (distance, capacity, etc.). Cost sharing implies an extra administrative burden to the network operator and its necessity should be judged trough the benefits it can bring.

Cost sharing occurs in under half of MOs for connection charges (see Table 30). Ten MOs report cost sharing for the transmission connection, and nine MOs report this for the distribution connection. **Cost sharing tends to have a longer time limit for the distribution connection charge than for transmission**. Most time limits for distribution are above five years, while most time limits for transmission are less than five years. In Slovakia, cost sharing is reviewed annually and the new policy only affects newly-connected customers. They therefore do not share the cost with existing customers. In Poland, generators must pay 100% of distribution connection costs. However, the connection cost for customers is 25% of the capex for building the connection; for RES <5MW, batteries and co-generation <1MW, it is 50% of the capex; for microinstallations, it is free; for EV charging infrastructure, it is 1/16 of the capex.

Table 30 Cost sharing in the connection charge

MO	Customer category	Cost sharing?	Time limit
Transmission connection charge			
AE-AZ	All	x	
AE-DU	All	x	
AL	All	✓	<1 year
AM	All	x	
AT	All	✓	1-5 years
BA	All	x	
CZ	All	x	
DZ	All	✓	>10 years
EE	All	✓	No time limit
GE	All	x	
HU	All	✓	1-5 years
HR	All	✓	1-5 years
LT	All	✓	1-5 years
LV	All	x	
MD	All	x	
MK	All	x	
MN	All	x	
NG	All	x	
OM	All	x	
PE	All	✓	>10 years
PK			
PL	All	x	
SK	Generators and Load	x	
	DSOs	✓	No time limit
TH	All	✓	>10 years
TR	x		
XK*	All	x	
Distribution connection charge			
AE-AZ	All	x	
AE-DU	All	x	
AL	All	x	
AM	All	x	
AT	All	x	
BA	All	x	
CZ	All	x	

MO	Customer category	Cost sharing?	Time limit
DZ	MV	✓	>10 years
	LV	✓	1-5 years
	Generators	✓	>10 years
EE	Charge in specified area	x	
	Charge in unspecified area	✓	No time limit
	Charge for connection to MV and to electricity producer	✓	No time limit
GE	All	x	
HU	All	✓	1-5 years
HR	All	✓	1-5 years
LT	All	✓	1-5 years
LV	Under 100A	✓	No time limit
	Above 100A	x	
MD	All	x	
MK	All	✓	No time limit
MN	All	x	
NG	All	x	
OM	All	x	
PE	All	✓	>10 years
PK	Residential	?	?
	Commercial	?	?
	General services	?	?
	Industrial	?	?
	Bulk	?	?
	Agriculture	?	?
	Public lighting	?	?
	Residential colonies attached to industrials	?	?
	Special contracts	?	?
PL	Group II-VI	✓	No time limit
	RES < 5MW, batteries and co-generation <1MW	✓	No time limit
	EV charging infrastructure	✓	No time limit
	Microinstallations	✓	No time limit
	Generators	x	

MO	Customer category	Cost sharing?	Time limit
SK	HV (DSO 1)	x	
	MV (DSO 1)	x	
	LV (DSO 1)	x	
	Households (DSO 2)	?	?
	Non-Household LV (DSO 2)	?	?
	Non-Household MV (DSO 2)	?	?
	Non-Household HV (DSO 2)	?	?
	HV (DSO 3)	?	?
	MV (DSO 3)	?	?
	LV (DSO 3)	?	?
TH	All	x	
TR	All	✓	1-5 years
XK*	All	x	

Source: Survey question 4.2 (connection sheets). Key: ✓ (yes), x (no), ? (no data).

3.3.1 Considerations about the depth of charge and payment method

Considerations about the depth of charge and payment method

The purpose of connection charges (irrespective of the model chosen) is to recover the initial, non-recurring connection costs that enable users to receive network services. In general terms, and as further discussed below, there are key design choices to be made ('shallow' charging, 'deep' charging and hybrid), as well as variations within each regarding the payment options (up front, in limited instalments, periodically).

Depending on the location of the charging boundary a 'deep', 'shallow' or a 'hybrid' methodology may be developed. The basic variants of the connection charging policies comprise:

- **Shallow policy –** this does not charge the applicant project for reinforcements to the existing system but charges only for the connection line/cable and other equipment directly or exclusively relating to the connection. All other costs are socialised through the use-of-system charge.

- **Deep policy –** this charges for reinforcements to the existing system as well as the direct connection costs (ie all network costs incurred as a result of the connection). This can include network expansion costs (the cost for expanding the network to the customer's area) and any remote costs (ie upstream costs to the network).

The connection charge policy can be also used to signal location constraints or costs to network users. Deep connection charges provide locational signals regarding the development of new generators and load centres. On the contrary, shallow connection

charges cannot provide locational signals regarding the cost of connection to and using the network.

In the ERRA sample, **transmission connection charges are mostly deep, but distribution connection charges are mostly shallow** (see Table 27). This is a typical approach since customers or generators connecting to the transmission system have higher costs to connect which are solely attributed to their premises. It is fair to charge these customers the costs of connection through deep connection charges rather than socialise the costs through the use-of-system charge and have other customers pay for their connection costs. At the same time it is simple to have deep connection charges for such customers as their number is limited and the administrative burden to implement individual connection charges through a deep policy is relatively small.

On the other hand, the number of customers connecting to the distribution network is large and applying deep connection charges for smaller customers would impose a high administrative burden for the network operator; either to estimate the actual cost of connection for each individual customer or to approve the cost of connection estimated by the customer. Therefore, for smaller customers shallow approaches are preferred for reasons of simplicity. Shallow approaches undermine cost-reflectivity, and this creates the need of several customer categories with different connection charges to reflect the cost of connecting each group of customers. As it was seen in the customer categories section above, due to the shallow policy for distribution connected customers there is higher need to have several types of connection charge categories.

Shallow charges are sometimes preferred for reasons of social equity. The argument in favour of social equity is that customers in remote areas who have higher costs for connection should not be penalised and should receive equal treatment to those who had the luck to be born in urban centres.

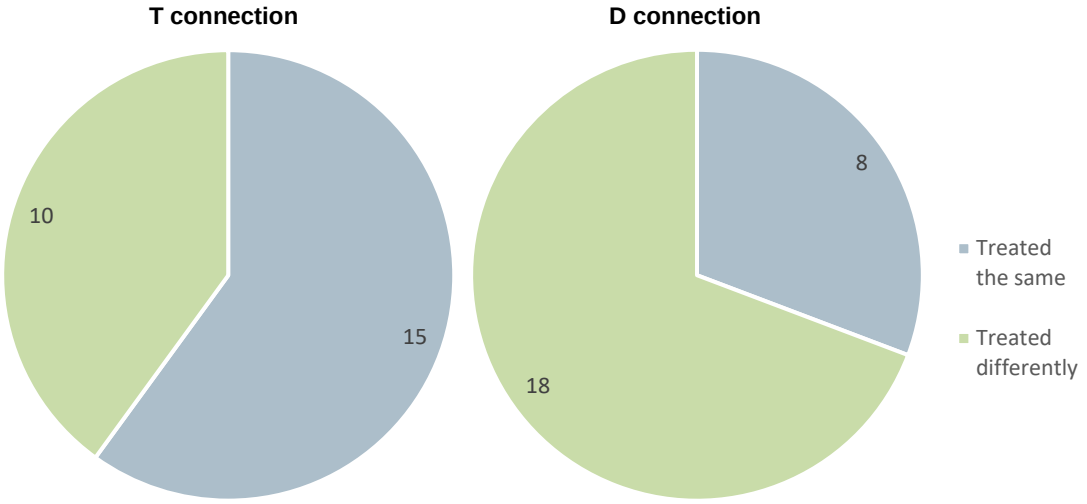
The decision for the depth of charge and the payment methods depends on several factors which are different in each case. There is not one best practice that can fit all cases. Below we have summarised some key benefits and disadvantages of deep against shallow connection charge policies:

Principles	Comment
Cost-reflectivity	Deep connection charges are more cost-reflective in comparison to shallow connection charges and can better provide locational signals.
Cost recovery	Both deep and shallow connection charges can ensure cost recovery given that the cost estimates for the development of the assets is close to the actual cost of the connection. However, shallow charging most typically requires the determination of the connection cost early in advance as a standard payment. If the cost of materials changes rapidly then the standard fee may be inadequate to cover the actual connection costs. In such cases frequent updates of connection fees are required.
Equity	Deep connection charges are more cost-reflective and fair but they do not promote social equity.
Simplicity	Deep connection charges for a wide number of customers can become very complex. Shallow connection charges are typically simpler and easier to understand.
Administrative burden	The administrative burden of deep connection charges is higher than shallow connection charges for the same number of customers.
Affordability	Deep connection charges may be unaffordable for some customer categories especially for poor households living in remote areas. Shallow connection charges social the costs for reinforcements needed upstream in the network.

3.4 Generators and load

The connection charge can either apply equivalent principles to generators and load connecting to the network or can treat them differently. In the ERRA sample, **generators and load are mostly treated the same in the transmission connection charge but not in the distribution connection charge** (see Table 31).

Table 31 Connection charge generators versus load



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Transmission connection charge																										
Treated the same?	x	x	✓	✓	x	✓	x	✓	✓	✓	x	x	✓	✓	✓	✓	x	✓	x	✓		x	✓	✓	✓	x
Distribution connection charge																										
Treated the same?	x	x	✓	x	x	x	x	✓	x	x	x	x	x	✓	✓	x	x	x	x	✓	x	x	✓	✓	✓	x

Source: Survey question 5.1 (connection sheets). Key: ✓ (yes), x (no).

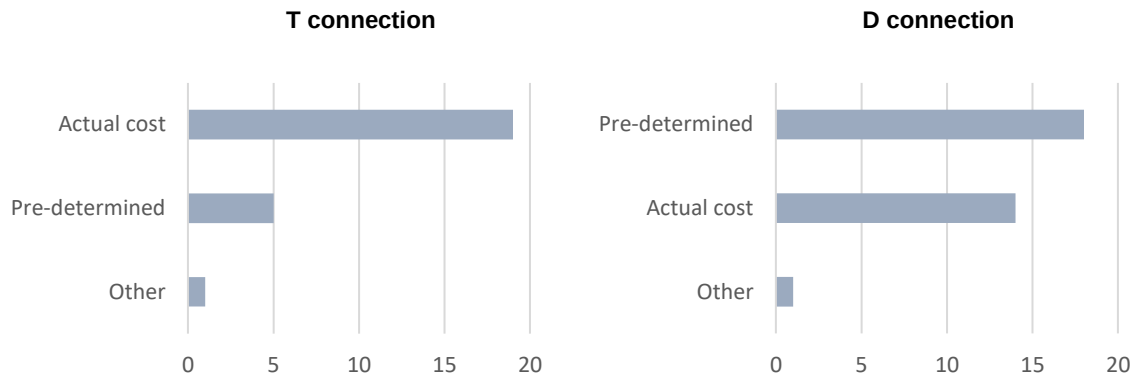
3.5 Level of connection charges

The connection charge can be expressed as a pre-determined charge for specified customer categories. Alternatively, the actual cost for the connection can be calculated on a case-by-case basis.[6] In the ERRA sample, the **transmission connection charge is typically calculated on a case-by-case basis.** Usually, the party wishing to connect to the network submits to the network operator a study including the technical specification and the costs for the connection for approval. The **distribution connection charge is typically pre-determined for customer**

[6] In some cases, countries have lists of pre-determined costs for each asset in the connection but calculate the total cost of the connection on a case-by-case basis. We consider this approach to be based on actual cost.

categories based on average historical costs for connecting customers or through updated estimates of equipment costs and typical historical equipment requirements (see Table 32).

Table 32 Pre-determined connection charges versus actual cost



	AE-AZ	AE-DU	AL	AM	AT	BA	CZ	DZ	EE	GE	HR	HU	LT	LV	MD	MK	MN	NG	OM	PE	PK	PL	SK	TH	TR	XK*
Transmission connection charge																										
Pre-determined		✓				✓	✓			✓	✓															
Actual cost	✓			✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓
Other			✓																							
Distribution connection charge																										
Pre-determined		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓		✓	✓	✓	✓	✓
Actual cost	✓		✓						✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓				
Other																✓										

Source: ECA analysis of survey data. Key: ✓ (yes), ? (no data)

For customers with pre-determined connection charges, their present connection charges are presented in Annexes A1.4 and A1.5.

Annexes

A1 Present charges

A1.1 Transmission use-of-system charges

Table 33 Present TUoS charges

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
AE-AZ	All customers	?		?			Cannot share due to confidentiality.
AE-DU							TUoS and DUoS charges are embedded in the end-user tariff and cannot be distinguished.
AL	All customers		0.00668 $/kWh				
AM	All customers		0.0031 $/kWh				
AT	Generators (All locations)		0.028 $/kWh				
	Withdrawing parties (Eastern Austria)		0.00233 $/kWh	9.10 $/kW/month			
	Withdrawing parties (Tyrol)		0.0019 $/kWh	13.38 $/kW/month			
	Withdrawing parties (Voralberg)		0.00021 $/kWh	2.04 $/kW/month			
	Prosumers (All locations)		0.028 $/kWh	1 $/kW/month			
BA	Suppliers, 110 kV consumers		0.00634 $/kWh	0.82156 $/kW/month			
	Generators		0.00271 $/kWh				
CZ	Customer		0.002 $/kWh		3.73 $/kW/month		

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
	Generator		0.002 $/kWh		3.73 $/kW/month		
DZ	All customers		0.0049 $/kWh				While the DUoS and TUoS charges are embedded in the end-user tariff, the TUoS (but not the DUoS) charge can be distinguished.
EE	330kV		0.00588 $/kWh			1.76 $/kVArh	
	110kV		• 0.0148 $/kWh *(07.00-23.00 Oct-Mar)* • 0.0074 $/kWh *(All other times)*				
	Undervoltage of 110kV transformer		• 0.01604 $/kWh *(07.00-23.00 Oct-Mar)* • 0.00802 $/kWh *(All other times)*				
GE	All customers		0.00859 $/kWh				
HU	DSOs		0.008302 $/kWh				
	Consumers above 132kV		0.008302 $/kWh		?		
	Consumers at 132kV		0.008972 $/kWh		?		
HR	HV - Industry	10 $ /customer /month	• 0.006 $/kWh *(08.00-22.00)* • 0.003 $/kWh *(22.00-08.00)*	2.057 $/kW/month *(08.00-22.00)*		0.024 $/kVArh	
	MV - Industry		• 0.006 $/kWh *(08.00-22.00)* • 0.003 $/kWh *(22.00-08.00)*	2.057 $/kW/month *(08.00-22.00)*			
	LV - Industry (blue tariff)		0.013 $/kWh				
	LV - Industry (white tariff)		• 0.019 $/kWh *(08.00-22.00)* • 0.007 *(22.00-08.00)*				
	LV - Industry (red tariff)		• 0.007 $/kWh *(08.00-22.00)* • 0.003 $/kWh *(22.00-08.00)*	2.13 $/kW/month			

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
	LV - Industry (yellow tariff)		0.009 $/kWh				
	LV - Households (blue tariff)		0.013 $/kWh				
	LV - Households (white tariff)		• 0.019 $/kWh *(08.00-22.00)* • 0.007 $/kWh *(22.00-08.00)*				
	LV - Households (red tariff)		• 0.007 $/kWh *(08.00-22.00)* • 0.003 $/kWh *(22.00-08.00)*	2.13 $/kW/month			
	LV - Households (yellow tariff)		0.007 $/kWh				
LT	High Voltage		0.004989 $/kWh		1.313 $/kW/month	• 0.00174 $/kVArh (generating reactive power) • 0.00087 $/kVArh (using reactive power)	
	Medium Voltage		0.00538 $/kWh		1.3489 $/kW/month	• 0.00174 $/kVArh (generating reactive power) • 0.00087 $/kVArh (using reactive power)	
LV	Connected to 110kV lines		0.00159 $/kWh		0.68727 $/kW/month		
	Connected to 110kV bus bars		0.00182 $/kWh		0.76492 $/kW/month		
	Connected to 110/6-20kV transformer		0.0021 $/kWh		0.83671 $/kW/month		
	Producers				0.06902 $/kW/month		
MD	All customers		0.00785 $/kWh				
MK	Load		0.01 $/kWh	0.35 $/kW/month		0.0021 $/kVArh	
MN	All customers		0.002569 $/kWh				
NG	DSO		0.013 $/kWh				
	Export		0.013 $/kWh				

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
	Eligible customer		0.013 $/kWh				
OM	Agriculture and fisheries			8.2051 $/kW/month			
	CRT Government, commercial and industrial	128 $ /customer /year	• 0.3077 $/kWh *(Jan-Mar)* • 0.3846 $/kWh *(Apr)* • 0.4872 $/kWh *(03.00-13.00,16.00-22.00 May-Jul)* • 1.0256 $/kWh *(22.00-03.00 May-Jul)* • 1.2821 $/kWh *(13.00-16.00 Sun-Thu, May-Jul)* • 1.0000 $/kWh *(13.00-16.00 Fri-Sat, May-Jul)* • 0.0385 $/kWh *(03.00-13.00,16.00-22.00 Aug-Sep)* • 0.5641 $/kWh *(22.00-03.00 Mon-Sun, 13.00-16.00 Fri-Sat, Aug-Sep)* • 0.7179 $/kWh *(13.00-16.00 Sun-Thu, Aug-Sep)* • 0.3846 $/kWh *(Oct)* • 0.3077 $/kWh *(Nov-Dec)*	8.2051 $/kW/month			
PE	Guaranteed system			40.23 $/kW/month		0.0148 $/kVArh	
	Complementary System		0.046 $/kWh				
PK	DISCOs			• 1.02 $/kW/month (TSO 1)			

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
				• 0.0075 $/kW/month (TSO 2) • 0.0029 $/kW/month (TSO 3)			
PL	DSOs with at least two points of delivery (POD)		1.43709 $/kWh	32,719 $/kW/month			
	DSOs only one POD and final consumer's POD		1.40891 $/kWh	16,932 $/kW/month		Formula-based	
SK	All users (UHV)		0.00296 $/kWh		31,201.01 $/MW/year		Energy charge consists of losses (0.00163 $kWh) and transmitted energy (0.00133 $/kWh)
TH	230 kV		0.0081 $/kWh			0.556 $/kVArh	
	69-115kV		0.0146 $/kWh			0.556 $/kVArh	
	End of line 69-115kV		0.0254 $/kWh			0.556 $/kVArh	
	11-33kV		0.0304 $/kWh			0.556 $/kVArh	
TR	Generator		0.00160 $/kWh		• 0.1864 $/kW/month (Min, zone 1) • 0.3970 $/kW/month (Max, zone 15)		
	Consumer		0.00158 $/kWh		• 0.2354 $/kW/month (Min, zone 1)		

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
					• 0.3840 $/kW/month (Max, zone 15)		
XK*	Suppliers (400/220 kV)		0.00166 $/kWh	0.3796 $/kW/month			
	Suppliers (110kV)		0.00166 $/kWh	0.774 $/kW/month			
	Distribution operator		0.00002 $/kWh				
	Generation connected to transmission		0.00189 $/kWh				
	Generation connected to distribution		0.0001 $/kWh				

Source: Survey (present charges sheet). Key: ? (no data).

A1.2 Distribution use-of-system charges

Table 34 Present DUoS charges

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
AE-AZ	All customers	?			?		Cannot share due to confidentiality.
AE-DU							TUoS and DUoS charges are embedded in the end-user tariff and cannot

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
							be distinguished.
AL	35kV connection		0.01 $/kWh				
	0.6-20kV connection		0.04 $/kWh				
	0.4kV connection		0.06 $/kWh				
AM	110kV		0.0033 $/kWh				
	35kV connection		0.0063 $/kWh				
	6 (10)kV		0.0163 $/kWh				
	0.4kV		0.0366 $/kWh				
AT	High Voltage metered capacity (Vienna)		0.00432 $/kWh	2.806 $/kW/month	0.7889 $/kW/month		
	High Voltage metered capacity (Upper Austria)		• 0.00478 $/kWh *(06.00-22.00)* • 0.00469 $/kWh *(22.00-06.00)*	1.472 $/kW/month	0.90467 $/kW/month		
	High Voltage metered capacity (Styria)		0.0046 $/kWh	2.1344 $/kW/month	0.8740 $/kW/month		
	Medium Voltage metered capacity (Vienna)		0.01086 $/kWh	3.8088 $/kW/month	6.91993 $/kW/month		
	Medium Voltage metered capacity (Upper Austria)		• 0.00929 $/kWh *(06.00-22.00, Apr-Sep)*	3.3396 $/kW/month	7.475 $/kW/month		

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
			• 0.00745 $/kWh *(22.00-06.00, Apr-Sep)* • 0.00104 $/kWh *(06.00-22.00, Oct-Mar)* • 0.00837 $/kWh *(22.00-06.00, Oct-Mar)*				
	Medium Voltage metered capacity (Styria)		0.013248 $/kWh	3.404 $/kW/month	6.9383 $/kW/month		
	Low Voltage metered capacity (Vienna)		0.02364 $/kWh	4.0112 $/kW/month	18.05270 $/kW/month		
	Low Voltage metered capacity (Upper Austria)		• 0.03321 $/kWh *(06.00-22.00, Apr-Sep)* • 0.03165 $/kWh *(22.00-06.00, Apr-Sep)* • 0.03542 $/kWh *(06.00-22.00, Oct-Mar)* • 0.03248 $/kWh *(22.00-06.00, Oct-Mar)*	3.19240 $/kW/month	15.94667 $/kW/month		
	Low Voltage metered capacity (Styria)		• 0.040848 *(06.00-22.00)* • 0.031556 *(22.00-06.00)*	3.6432 $/kW/month	15.2490 $/kW/month		
	Low Voltage no capacity metering (Vienna)		0.044344 $/kWh	2.76 $/kW/month	18.0527 $/kW/month		
	Low Voltage no capacity metering (Upper Austria)		0.044344 $/kWh	2.76 $/kW/month	15.94667 $/kW/month		

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
	Low Voltage no capacity metering (Styria)		0.044344 $/kWh	2.76 $/kW/month	15.2490 $/kW/month		
BA	35kV		• 0.00407 $/kWh *(peak 6.00-22.00)* • 0.00207 $/kWh *(off-peak, 22.00-6.00)*	1.50136 $/kW/month		0.0134 $/kVArh	
	10kV		• 0.00876 $/kWh *(peak)* • 0.00435 $/kWh *(off-peak)*	3.80084 $/kW/month		0.01686 $/kVArh	
	0.4kV public lighting		0.03438 $/kWh				
	0.4kV households		• 0.02333 $/kWh *(winter)* • 0.01166 *(summer)*	• 1.08835 $/kW/month *(winter)* • 0.83719 $/kW/month *(summer)*			
			• 0.00124 $/kWh *(peak)* • 0.00062 $/kWh *(off-peak)*	6.41845 $/kW/month			
			• 0.02406 $/kWh *(winter)* • 0.01847 $/kWh *(summer)*	• 1.90321 $/kW/month *(winter)* • 1.46229 $/kW/month *(summer)*			
			• 0.04281 $/kWh *(winter, peak)* • 0.02143 $/kWh *(winter, off-peak)* • 0.02393 $/kWh *(summer, peak)* • 0.01646 $/kWh *(summer, off-peak)*	• 1.90321 $/kW/month *(winter)* • 1.46229 $/kW/month *(summer)*		• 0.02400 $/kVArh *(winter)* • 0.01847 $/kVArh *(summer)*	

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
CZ	Household LV (small consumption)		• 0.098 $/kWh (DSO 1) • 0.103 $/kWh (DSO 2) • 0.091 $/kWh (DSO 3)		• 0.14 $/kW/month *(DSO 1)* • 0.12 $/kW/month *(DSO 2)* • 0.14 $/kW/month *(DSO 3)*		
	Household LV (medium consumption)		• 0.074 $/kWh *(DSO 1)* • 0.083 $/kWh *(DSO 2)* • 0.07 $/kWh *(DSO 3)*		• 0.36 $/kW/month *(DSO 1)* • 0.35 $/kW/month *(DSO 2)* • 0.34 $/kW/month *(DSO 3)*		
	Household LV (weekend consumption)		• 0.008 $/kWh *(Fri 12.00-Sun 22.00, DSO 1)* • 0.122 $/kWh *(Sun 22.00-Fri 12.00, DSO 1)* • 0.009 $/kWh *(Fri 12.00-Sun 22.00, DSO 2)* • 0.127 $/kWh *(Sun 22.00-Fri 12.00, DSO 2)* • 0.006 $/kWh *(Fri 12.00-Sun 22.00, DSO 3)* • 0.102 $/kWh *(Sun 22.00-Fri 12.00, DSO 3)*		• 0.23 $/kW/month *(DSO 1)* • 0.27 $/kW/month *(DSO 2)* • 0.18 $/kW/month *(DSO 3)*		
	Household LV (usual consumption - water heating)		• 0.008 $/kWh *(8h a day, DSO 1)* • 0.077 $/kWh *(16h a day, DSO 1)* • 0.009 $/kWh *(8h a day, DSO 2)*		• 0.41 $/kW/month *(DSO 1)* • 0.4 $/kW/month *(DSO 2)* • 0.37 $/kW/month *(DSO 3)*		

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
			• 0.081 $/kWh *(16h a day, DSO 2)* • 0.006 $/kWh *(8h a day, DSO 3)* • 0.067 $/kWh *(16h a day, DSO 3)*				
	Household LV (usual consumption - direct heating)		• 0.008 $/kWh *(20h a day, DSO 1)* • 0.011 $/kWh *(4h a day, DSO 1)* • 0.009 $/kWh *(20h a day, DSO 2)* • 0.012 $/kWh *(4h a day, DSO 2)* • 0.006 $/kWh *(20h a day, DSO 3)* • 0.01 $/kWh *(4h a day, DSO 3)*		• 0.89 $/kW/month *(DSO 1)* • 0.84 $/kW/month *(DSO 2)* • 0.81 $/kW/month *(DSO 3)*		
	Business LV (small consumption)		• 0.122 $/kWh *(DSO 1)* • 0.14 $/kWh *(DSO 2)* • 0.137 $/kWh *(DSO 3)*		• 0.19 $/kW/month • 0.19 $/kW/month • 0.2 $/kW/month		
	Business LV (medium consumption)		• 0.099 $/kWh *(DSO 1)* • 0.116 $/kWh *(DSO 2)* • 0.107 $/kWh *(DSO 3)*		• 0.46 $/kW/month • 0.48 $/kW/month • 0.47 $/kW/month		
	Business LV (high consumption)		• 0.047 $/kWh *(DSO 1)* • 0.057 $/kWh *(DSO 2)* • 0.05 $/kWh *(DSO 3)*		• 3.37 $/kW/month 3.89 $/kW/month 3.55 $/kW/month		
	Business LV (usual consumption - water heating)		• 0.008 $/kWh *(8h a day, DSO 1)* • 0.083 $/kWh *(16h a day, DSO 1)* • 0.009 $/kWh *(8h a day, DSO 2)* • 0.01 $/kWh *(16h a day, DSO 2)* • 0.006 $/kWh *(8h a day, DSO 3)*		• 0.84 $/kW/month *(DSO 1)* • 0.95 $/kW/month *(DSO 2)* • 0.89 $/kW/month *(DSO 3)*		

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
			• 0.094 $/kWh *(16h a day, DSO 3)*				
	Business LV (usual consumption - direct heating)		• 0.008 $/kWh *(20h a day, DSO 1)* • 0.011 $/kWh *(4h a day, DSO 1)* • 0.009 $/kWh *(20h a day, DSO 2)* • 0.012 $/kWh *(4h a day, DSO 2)* • 0.006 $/kWh *(20h a day, DSO 3)* • 0.011 $/kWh *(4h a day, DSO 3)*		• 2.73 $/kW/month *(DSO 1)* • 2.97 $/kW/month *(DSO 2)* • 2.74 $/kW/month *(DSO 3)*		
	Business LV (non-metered)	• 2.15 $/customer/month *(DSO 1)* • 2.3 $/customer/month *(DSO 2)* • 2.25 $/customer/month *(DSO 3)*					
	Business MV (peak consumption)		• 0.161 $/kWh *(DSO 1)* • 0.151 $/kWh *(DSO 2)* • 0.178 $/kWh *(DSO 3)*				
	Business MV (usual consumption)		• 0.004 $/kWh *(DSO 1)* • 0.004 $/kWh *(DSO 2)* • 0.003 $/kWh *(DSO 3)*		• 7.85 $/kW/month • 7.37 $/kW/month • 8.77 $/kW/month		
	Business HV (peak consumption)		• 0.067 $/kWh *(DSO 1)* • 0.062 $/kWh *(DSO 2)* • 0.073 $/kWh *(DSO 3)*				
	Business HV (usual consumption)		• 0.002 $/kWh *(DSO 1)* • 0.003 $/kWh *(DSO 2)* • 0.002 $/kWh *(DSO 3)*		• 3.21 $/kW/month • 2.95 $/kW/month • 3.51 $/kW/month		

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
DZ							While the DUoS and TUoS charges are embedded in the end-user tariff, the TUoS (but not the DUoS) charge can be distinguished.
EE	6-35kV basic (DSO 2)		0.0069 $/kWh	2.79 $/A/month		• 0.0022 $/kVArh *(consumption)* • 0.0044 $/kVArh *(supply)*	
	6-35kV time (DSO 2)		• 0.0082 $/kWh *(day)* • 0.0047 $/kWh *(night)*	2.79 $/A/month		• 0.0022 $/kVArh *(consumption)* • 0.0044 $/kVArh *(supply)*	
	Main fuses 0.4 (0.23)kV Partner 24 (DSO 2)		0.0433 $/kWh			• 0.0022 $/kVArh *(consumption)* • 0.0044 $/kVArh *(supply)*	
	Main fuses 0.4 (0.23)kV Partner 12/12 (DSO 2)		• 0.0520 $/kWh *(day)* • 0.0302 $/kWh *(night)*			• 0.0022 $/kVArh *(consumption)* • 0.0044 $/kVArh *(supply)*	
	1-phase Main fuses 0.4 (0.23)kV Partner 24 plus (DSO 2)		0.0277 $/kWh	0.16 $/A/month		• 0.0022 $/kVArh *(consumption)* • 0.0044 $/kVArh *(supply)*	
	3-phase Main fuses 0.4 (0.23)kV Partner 24 plus (DSO 2)		0.0277 $/kWh	0.47 $/A/month		• 0.0022 $/kVArh *(consumption)* • 0.0044 $/kVArh *(supply)*	
	1-phase Main fuses 0.4 (0.23)kV		• 0.0333 $/kWh *(day)* • 0.0194 $/kWh *(night)*	0.16 $/A/month		• 0.0022 $/kVArh *(consumption)*	

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
	Partner 12/12 (DSO 2)					• 0.0044 $/kVArh *(supply)*	
	3-phase Main fuses 0.4 (0.23)kV Partner 12/12 (DSO 2)		• 0.0333 $/kWh *(day)* • 0.0194 $/kWh *(night)*	0.47 $/A/month		• 0.0022 $/kVArh *(consumption)* • 0.0044 $/kVArh *(supply)*	
	0.4kV main fuse over 63A Partner 63 plus (DSO 2)		• 0.0247 $/kWh *(day)* • 0.0143 $/kWh *(night)*	0.84 $/A/month		• 0.0022 $/kVArh *(consumption)* • 0.0044 $/kVArh *(supply)*	
	0.4kV main fuse over 63A Partner 63 plus T (DSO 2)		• 0.0520 $/kWh *(day)* • 0.0302 $/kWh *(night)*	0.9 $/A/month		• 0.0022 $/kVArh *(consumption)* • 0.0044 $/kVArh *(supply)*	
GE	HV (DSO 1)		0.0078 $/kWh				
	MV(DSO 1)		0.0139 $/kWh				
	LV (DSO 1)		0.0264 $/kWh				
	HV (DSO 2)		0.011 $/kWh				
	MV (DSO 2)		0.018 $/kWh				
	LV Residential <101kWh/month (DSO 2)		0.028 $/kWh				
	LV Residential 101-301 kWh/month and non-residential (DSO 2)		0.039 $/kWh				

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
	LV Residential >301kWh/month (DSO 2)		0.049 $/kWh				
HU	HV	895.82 $/customer/year	0.0006 $/kWh		0.3872 $/kW/month	0.0075 $/kVArh	
	HV/MV	447.91 $/customer/year	0.0016 $/kWh		1.5191 $/kW/month	0.0091 $/kVArh	
	MV	447.91 $/customer/year	0.0051 $/kWh		2.7583 $/kW/month	0.0091 $/kVArh	
	MV/LV profile based	14.94 $/customer/year	0.0267 $/kWh			0.0125 $/kVArh	
	MV/LV not profile based	149.30 $/customer/year	0.0099 $/kWh		2.8982 $/kW/month	0.0125 $/kVArh	
	LV profile based all day	4.31 $/customer/year	0.405 $/kWh				
	LV profile based controlled	1.41 $/customer/year	0.019 $/kWh				
	LV not profile based	149.30 $/customer/year	0.0156 $/kWh		2.4097 $/kW/month	0.0125 $/kVArh	
HR	MV - Industry	9.697 $/customer/month	• 0.015 $/kWh *(08.00-22.00)* • 0.007 $/kWh *(22.00-08.00)*	1.763 $/kW/month (08.00-22.00)		0.024 $/kVArh	
	LV - Industry (blue tariff)	6.068 $/customer/month	0.032 $/kWh			0.024 $/kVArh	
	LV - Industry (white tariff)	6.068 $/customer/month	• 0.038 $/kWh *(08.00-22.00)* • 0.018 $/kWh *(22.00-08.00)*			0.024 $/kVArh	
	LV - Industry (red tariff)	6.068 $/customer/month	• 0.025 $/kWh *(08.00-22.00)* • 0.012 $/kWh *(22.00-08.00)*	3.6 $/kW/month		0.024 $/kVArh	

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
	LV - Industry (yellow tariff)	2.270 $/customer/month	0.026 $/kWh				
	LV - Households (blue tariff)	1.704 $/customer/month	0.032 $/kWh				
	LV - Households (white tariff)	1.704 $/customer/month	• 0.038 $/kWh *(08.00-22.00)* • 0.018 $/kWh *(22.00-08.00)*				
	LV - Households (red tariff)	6.068 $/customer/month	• 0.025 $/kWh *(08.00-22.00)* • 0.012 $/kWh *(22.00-08.00)*	3.6 $/kW/month			
	LV - Households (black tariff)	0.896 $/customer/month	0.021 $/kWh				
LT	I category (Standard, LV 1TZ)		0.0576 $/kWh			•	
	I category (Standard, LV 2TZ)		• 0.0652 $/kWh *(07.00-23.00 Mon-Fri)* • 0.0370 $/kWh *(23.00-07.00 Mon-Fri, weekend)*			•	
	I category (Home, LV 1TZ)	2.70 $/customer/month	0.043 $/kWh			•	
	I category (Home, LV 2TZ)	2.70 $/customer/month	• 0.0489 $/kWh *(07.00-23.00 Mon-Fri)* • 0.0283 $/kWh *(23.00-07.00 Mon-Fri, weekend)*			•	
	I category (Home plus, LV 1 TZ)	5.39 $/customer/month	0.039 $/kWh			•	
	I category (Home plus, LV 2 TZ)	5.39 $/customer/month	• 0.0446 $/kWh *(07.00-23.00 Mon-Fri)*			•	

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
			• 0.0261 $/kWh *(23.00-07.00 Mon-Fri, weekend)*				
	I category (Smart, LV)		• 0.0337 $/kWh *(22.00-05.00 Mon-Fri, 22.00-07.00 weekend)* • 0.0435 $/kWh *(05.00-07.00 Mon-Sun)* • 0.0543 $/kWh *(07.00-17.00 Mon-Fri, 07.00-22.00 weekend and holiday)* • 0.0728 $/kWh *(17.00-22.00 Mon-Sun)*			•	
	I category (MV, 1 TZ)		0.023 $/kWh			•	
	I category (MV, 2 TZ)		• 0.0261 $/kWh *(07.00-23.00 Mon-Fri)* • 0.0152 $/kWh *(23.00-07.00 Mon-Fri, weekend)*			•	
	II category (LV, 1TZ)		0.015 $/kWh		2.065 $/kW/month	•	
	II category (LV, 2TZ)		• 0.0163 $/kWh *(07.00-23.00 Mon-Fri)* • 0.0120 $/kWh *(23.00-07.00 Mon-Fri, weekend)*		2.065 $/kW/month	•	
	II category (MV, 1TZ)		0.012 $/kWh		2.065 $/kW/month	•	
	II category (MV, 2TZ)		• 0.0120 $/kWh *(07.00-23.00 Mon-Fri)* • 0.0098 $/kWh *(23.00-07.00 Mon-Fri, weekend)*		2.065 $/kW/month	•	

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
	III category (LV, 1TZ)		0.015 $/kWh		2.065 $/kW/month	•	
	III category (LV, 4TZ)		• 0.0196 $/kWh *(Max load hours)* • 0.0141 $/kWh *(Med load hours)* • 0.0120 $/kWh *(Weekends and holidays)* • 0.0120 $/kWh *(23.00-07.00 Mon-Sun)*		2.065 $/kW/month	•	
	III category (MV, 1TZ)		0.012 $/kWh		2.065 $/kW/month	•	
	III category (MV, 4TZ)		• 0.0152 $/kWh *(Max load hours)* • 0.0109 $/kWh *(Med load hours)* • 0.00978 $/kWh *(Weekends and holidays)* • 0.00978 $/kWh *(23.00-07.00 Mon-Sun)*		2.065 $/kW/month	•	
LV	S1 Household 1-phase w/input protection up to 40A (DSO 1)	13.57 $/customer/year	0.03716 $/kWh				
	S2 Household 3-phase w/input protection up to 17-63A (DSO 1)		0.03716 $/kWh		0.18234 $/A/month		
	S3 Household 3-phase w/input protection 64A and above (DSO 1)		• 0.04684 $/kWh *(07.00-23.00 Mon-Fri)* • 0.02416 $/kWh *(23.00-07.00 Mon-Fri, weekends)*		• 0.79926$/A/month • 0.79926$/A/month		

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
	S4 other users 1-phase w/input protection up to 40A (DSO 1)	13.57 $/customer/year	0.03716 $/kWh				
	S6 one time zone 0.4kV lines (DSO 1)		0.04032 $/kWh		0.79926 $/A/month		
	S6-1 plan one time zone 6-20kV bus bars (DSO 1)		0.00483 $/kWh		2.19188 $/kW/month		
	S8 basic, three time zones 6-20kV lines (DSO 1)		• 0.01424 $/kWh *(23.00-07.00 Mon-Fri, holidays)* • 0.02514 $/kWh *(08.00-10.00, 17.00-20.00 Mon-Fri)* • 0.01736 $/kWh *(07.00-08.00, 10.00-17.00, 20.00-23.00 Mon-Fri)*		• 1.48607$/kW/month		
	S8 basic, three time zones w/input protection 801A and over, 0.4kV bus bars (DSO 1)		• 0.02145 $/kWh *(23.00-07.00 Mon-Fri, holidays)* • 0.03915 $/kWh *(08.00-10.00, 17.00-20.00 Mon-Fri)* • 0.02767 $/kWh *(07.00-08.00, 10.00-17.00, 20.00-23.00 Mon-Fri)*		• 0.87675 $/A/month		
	S1 Household one time zone (DSO 2)		0.06529 $/kWh		0.45585 $/A/month		
	S1 other one time zone. 0.4kV bus bars (DSO 2)		0.04795 $/kWh		0.45585 $/A/month		

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
	S2 other, three time zones 6-20kV		• 0.02896 $/kWh *(23.00-07.00 Mon-Fri, holidays)* • 0.03668 $/kWh *(08.00-10.00, 17.00-20.00 Mon-Fri)* • 0.03125 $/kWh *(07.00-08.00, 10.00-17.00, 20.00-23.00 Mon-Fri)*		• 1.82340 $/kW/month		
MD	High Voltage		0.00162 $/kWh *(DSO 1)*				
	Medium Voltage		• 0.00866 $/kWh *(DSO 1)* • 0.00866 $/kWh *(DSO 2)*				
	Low Voltage		• 0.02544 $/kWh *(DSO 1)* • 0.04114 $/kWh *(DSO 2)*				
MK	MV1 (DSO 1)		0.001 $/kWh	2.566 $/kW/month		0.0004 $/kVArh	
	MV2 (DSO 1)		0.003 $/kWh	5.3077 $/kW/month		0.0012 $/kVArh	
	LV1.1 (DSO 1)		0.034 $/kWh				
	LV1.2 (DSO 1)		0.005 $/kWh	8.026 $/kW/month		0.002 $/kVArh	
	LV2 (DSO 1)		0.439 $/kWh				
MN	Mining and processing industry w/		• 0.05057 $/kWh *(DSO 1)* • 0.05829 $/kWh *(DSO 2)*	• 8.1098 $/kW/month *(DSO 1)*			

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
	electromechanical meter		• 0.04918 $/kWh *(DSO 3)*	• 8.1098 $/kW/month *(DSO 2)* • 8.1098 $/kW/month *(DSO 3)*			
	Mining and processing industry w/ electronic meter		• 0.04561 $/kWh *(06.00-17.00, DSO 1)* • 0.07198 $/kWh *(17.00-22.00, DSO 1)* • 0.02893 $/kWh *(22.00-06.00, DSO 1)* • 0.05332 $/kWh *(06.00-17.00, DSO 2)* • 0.07970 $/kWh *(17.00-22.00, DSO 2)* • 0.03665 $/kWh *(22.00-06.00, DSO 2)*	• 2.9195 $/kW/month *(DSO 1)* • 2.9195 $/kW/month *(DSO 2)*			
	Other entities w/ electromechanical meter		• 0.04561 $/kWh *(DSO 1)* • 0.05332 $/kWh *(DSO 2)* • 0.04808 $/kWh *(DSO 3)*	• 2.9195 $/kW/month *(DSO 1)* • 2.9195 $/kW/month *(DSO 2)* • 2.9195 $/kW/month *(DSO 3)*			
	Other entities w/ electronic meter		• 0.05057 $/kWh *(06.00-17.00, DSO 1)* • 0.08953 $/kWh *(17.00-22.00, DSO 1)* • 0.02501 $/kWh *(22.00-06.00, DSO 1)* • 0.05829 $/kWh *(06.00-17.00, DSO 2)* • 0.09725 $/kWh *(17.00-22.00, DSO 2)*	• 8.1098 $/kW/month *(DSO 1)* • 8.1098 $/kW/month *(DSO 2)*			

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
			• 0.03273 $/kWh *(22.00-06.00, DSO 2)*				
	Street lighting		• 0.04561 $/kWh *(06.00-19.00 Oct-Mar, DSO 1)* • 0.02893 $/kWh *(19.00-06.00 Oct-Mar, DSO 1)* • 0.04561 $/kWh *(06.00-19.00 Apr-Sep, DSO 1)* • 0.02893 $/kWh *(19.00-06.00 Apr-Sep, DSO 1)* • 0.05332 $/kWh *(06.00-19.00 Oct-Mar, DSO 2)* • 0.03665 $/kWh *(19.00-06.00 Oct-Mar, DSO 2)* • 0.05332 $/kWh *(06.00-22.00 Apr-Sep, DSO 2)* • 0.03665 $/kWh *(22.00-06.00 Apr-Sep, DSO 2)*				
	Households w/ electromechanical meter	• 0.6488 $/customer/month *(DSO 1)* • 0.6488 $/customer/month *(DSO 3)*	• 0.03584 $/kWh *(Below 150 kWh, DSO 1)* • 0.04227 $/kWh *(Above 150 kWh, DSO 1)* • 0.04356 $/kWh *(Below 150 kWh, DSO 2)*	• 8.1098 $/kW/month *(DSO 1)* • 8.1098 $/kW/month *(DSO 2)* • 8.1098 $/kW/month *(DSO 3)*			

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
			• 0.04998 $/kWh *(Below 150 kWh, DSO 2)* • 0.03594 $/kWh *(DSO 3)*				
	Households w/ electronic meter	0.6488 $/customer/month (DSO 1)	• 0.03776 $/kWh *(06.00-21.00, DSO 1)* • 0.02893 $/kWh *(21.00-06.00, DSO 1)* • 0.04547 $/kWh *(06.00-21.00, DSO 2)* • 0.03665 $/kWh *(21.00-06.00, DSO 2)*	• 2.9195 $/kW/month *(DSO 1)* • 2.9195 $/kW/month *(DSO 1)* • 2.9195 $/kW/month *(DSO 1)* • 2.9195 $/kW/month *(DSO 2)* • 2.9195 $/kW/month *(DSO 2)* • 2.9195 $/kW/month *(DSO 2)*			
NG	Non-maximum Demand		0.052 $/kWh				
	Maximum demand LV		0.052 $/kWh				
	Maximum demand HV		0.052 $/kWh				
	Lifeline R1		0.052 $/kWh				
OM	Residential HV (basic)		0.5641 $/kWh				
	Residential HV (time)		• 0.71795 $/kWh *(May-Aug)*				

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
			• 0.43590 $/kWh *(Sep-Apr)*				
	Residential MV (basic)		0.66667 $/kWh				
	Residential MV (time)		• 0.69231 $/kWh *(May-Aug)* • 0.41026 $/kWh *(Sep-Apr)*				
	Residential LV (basic)		0.87179 $/kWh				
	Residential LV (time)		• 0.97436 $/kWh *(May-Aug)* • 0.71795 $/kWh *(Sep-Apr)*				
	Non-residential HV (basic)		0.5614 $/kWh	8.20513 $/kW/month			
	Non-residential HV (time)		• 0.71795 $/kWh *(May-Aug)* • 0.43590 $/kWh *(Sep-Apr)*	8.20513 $/kW/month			
	Non-residential MV (basic)		0.66667 $/kWh	8.20513 $/kW/month			
	Non-residential MV (time)		• 0.69231 $/kWh *(May-Aug)* • 0.41026 $/kWh *(Sep-Apr)*	8.20513 $/kW/month			
	Non-residential LV (basic)		0.87179 $/kWh	8.20513 $/kW/month			
	Non-residential LV (time)		• 0.97436 $/kWh *(May-Aug)* • 0.71795 $/kWh *(Sep-Apr)*	8.20513 $/kW/month			
PE	MV users	5.63 $/customer/month	• 0.3221 $/kWh *(18.00-23.00 Mon-Sun)*	• 68.06 $/kW/month	10.11 $/kW/month	0.0559 $/kVArh	

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
			• 0.2714 $/kWh *(23.00-18.00 Mon-Sun)*	*(18.00-23.00 Mon-Sun)* • 10.94 $/kW/month *(23.00-18.00 Mon-Sun)*			
	LV users	3.14 $/customer/month	0.6326 $/kWh				
PK	?	?	?	?	?	?	MO did not provide data.
PL	A23 (large industrial)	• 3.52 $/customer/month *(DSO 1)* • 4.23 $/customer/month *(DSO 2)* • 2.35 $/customer/month *(DSO 3)*	• 0.0062 $/kWh *(07.00-13.00 Summer, DSO 1)* • 0.0147 $/kWh *(19.00-22.00 Summer, DSO 1)* • 0.0034 $/kWh *(13.00-19.00, 22.00-07.00 Summer, DSO 1)* • 0.0062 $/kWh *(07.00-13.00 Winter, DSO 1)* • 0.0147 $/kWh *(16.00-21.00 Winter, DSO 1)* • 0.0034 $/kWh *(13.00-16.00, 21.00-07.00 Winter, DSO 1)* • 0.0062 $/kWh *(07.00-13.00 Summer, DSO 2)* • 0.0070 $/kWh *(19.00-22.00 Summer, DSO 2)* • 0.0043 $/kWh *(13.00-19.00, 22.00-07.00 Summer, DSO 2)* • 0.0062 $/kWh *(07.00-13.00 Winter, DSO 2)*				

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
			• 0.0070 $/kWh *(16.00-21.00 Winter, DSO 2)* • 0.0043 $/kWh *(13.00-16.00, 21.00-07.00 Winter, DSO 2)* • 0.0037 $/kWh *(07.00-13.00 Summer, DSO 3)* • 0.0051 $/kWh *(19.00-22.00 Summer, DSO 3)* • 0.0026 $/kWh *(13.00-19.00, 22.00-07.00 Summer, DSO 3)* • 0.0039 $/kWh *(07.00-13.00 Winter, DSO 3)* • 0.0052 $/kWh *(16.00-21.00 Winter, DSO 3)* • 0.0028 $/kWh *(13.00-16.00, 21.00-07.00 Winter, DSO 3)*				
	B21 (industrial)	• 3.52 $/customer/month *(DSO 1)* • 4.23 $/customer/month *(DSO 2)* • 2.35 $/customer/month *(DSO 3)*	• 0.0143 $/kWh *(DSO 1)* • 0.0134 $/kWh *(DSO 2)* • 0.0161 $/kWh *(DSO 3)*				
	C21 (commercial, small industrial)	• 2.23 $/customer/month *(DSO 1)* • 2.23 $/customer/month *(DSO 2)*	• 0.0337 $/kWh *(DSO 1)* • 0.0344 $/kWh *(DSO 2)* • 0.0452 $/kWh *(DSO 3)*				

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
		• 1.17 $/customer/month *(DSO 3)*					
	C11 (commercial, small industrial)	• 0.53 $/customer/month *(DSO 1)* • 0.54 $/customer/month *(DSO 2)* • 0.47 $/customer/month *(DSO 3)*	• 0.0409 $/kWh *(DSO 1)* • 0.0340 $/kWh *(DSO 2)* • 0.0632 $/kWh *(DSO 3)*				
	G11 (residential)	• 0.53 $/customer/month *(DSO 1)* • 0.54 $/customer/month *(DSO 2)* • 0.37 $/customer/month *(DSO 3)*	• 0.0409 $/kWh *(DSO 1)* • 0.0428 $/kWh *(DSO 2)* • 0.0573 $/kWh *(DSO 3)*				
	G12 (residential)	• 0.53 $/customer/month *(DSO 1)* • 0.54 $/customer/month *(DSO 2)* • 0.37 $/customer/month *(DSO 3)*	• 0.0603 $/kWh *(06.00-15.00,17.00-22.00 Summer, DSO 1)* • 0.0116 $/kWh *(15.00-17.00,22.00-06.00 Summer, DSO 1)* • 0.0603 $/kWh *(06.00-13.00,15.00-22.00 Winter, DSO 1)* • 0.0116 $/kWh *(13.00-15.00,22.00-06.00 Winter, DSO 1)* • 0.0462 $/kWh *(Peak, DSO 2)* • 0.0121 $/kWh *(Non-peak, DSO 2)*				

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
			• 0.8385 $/kWh *(Peak, DSO 2)* • 0.2197 $/kWh *(Non-peak, DSO 2)* • 0.0632 $/kWh *(Peak, DSO 3)* • 0.0137 $/kWh *(Non-peak, DSO 3)*				
SK	DD1 (DSO 1)	1.1579 $/customer/month	0.1471 $/kWh	1.1789 $/DP/month			
	DD2 (DSO 1)	1.1579 $/customer/month	0.1073 $/kWh	6.6421 $/DP/month			
	DD3 (DSO 1)	1.1579 $/customer/month	0.099 $/kWh	11.4421 $/DP/month			
	DD4 (DSO 1)	1.1579 $/customer/month	0.1206 $/kWh	7 $/DP/month			
	DD5 (DSO 1)	1.1579 $/customer/month	0.1737 $/kWh	10.8421 $/DP/month			
	DD6 (DSO 1)	1.1579 $/customer/month	0.1769 $/kWh	10.8421 $/DP/month			
	DD7 (DSO 1)	1.1579 $/customer/month	• 0.1644 $/kWh *(15.00 Fri-06.00 Mon)* • 0.0652 *(All other times)*	1.1789 $/DP/month			
	DD8 (DSO 1)	1.1579 $/customer/month	0.1362 $/kWh	7 $/DP/month			
	DMP1 (DSO 1)		• 0.1396 $/kWh *(06.00-22.00 Mon-Sun)* • 0.0560 *(All other times)*	1.579 $/DP/month	11.6143 $/MW/year		
	DMP4 (DSO 1)		0.1511 $/kWh	1.579 $/DP/month	11.66 $/MW/year	0.00078 $/MWh	

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
	DMP6 (DSO 1)		0.1448 $/kWh	1.579 $/DP/month	11.7466 $/MW/year	0.00177 $/MWh	
	DMP7 (DSO 1)		0.1804 $/kWh	1.579 $/DP/month	13.4939 $/MW/year	0.002004 $/MWh	
	DMP10 (DSO 1)		0.1134 $/kWh	1.579 $/DP/month	11.7853 $/MW/year	0.000296 $/MWh	
TH	Small residential		Embedded				TUoS and DUoS charges are embedded in the end-user tariff. However, the TUoS charge and parts of the DUoS charge can be distinguished from the end-user tariff.
	Large residential		Embedded				
	Small general service		Embedded				
	Medium general service		Embedded	• 2.2053 $/kW/month *(09.00-22.00 Mon-Fri, LV)* • 3.9562 $/kW/month *(09.00-22.00 Mon-Fri, MV)* • 6.25 $/kW/month *(09.00-22.00 Mon-Fri, HV)*		1.669 $/kVArh	
	Large general service		Embedded	• 2.2053 $/kW/month *(09.00-22.00 Mon-Fri, LV)* • 3.9562 $/kW/month *(09.00-22.00 Mon-Fri, MV)* • 6.25 $/kW/month		1.669 $/kVArh	

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
				(09.00-22.00 Mon-Fri, HV)			
	Speceific business service		Embedded	• 2.2053 $/kW/month *(09.00-22.00 Mon-Fri, LV)* • 3.9562 $/kW/month *(09.00-22.00 Mon-Fri, MV)* • 6.25 $/kW/month *(09.00-22.00 Mon-Fri, HV)*		1.669 $/kVArh	
	Non-profit organisations		Embedded	• 2.2053 $/kW/month *(09.00-22.00 Mon-Fri, LV)* • 3.9562 $/kW/month *(09.00-22.00 Mon-Fri, MV)* • 6.25 $/kW/month *(09.00-22.00 Mon-Fri, HV)*		1.669 $/kVArh	
	Agricultural water pumping		Embedded	• 3.9562 $/kW/month *(09.00-22.00 Mon-Fri, MV)* • 6.25 $/kW/month *(09.00-22.00 Mon-Fri, HV)*			
	Temporary service		Embedded				

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
TR	Industrial		• 0.00961 $/kWh *(MV double term)* • 0.01061 $/kWh *(MV single term)* • 0.01642 $/kWh *(LV single term)*		0.31934 $/kW/month *(MV double term)*		
	Residential		• 0.01483 $/kWh *(MV double term)* • 0.01831 $/kWh *(MV single term)* • 0.02177 $/kWh *(LV single term)*		0.50139 $/kW/month *(MV double term)*		
	Commercial		• 0.01497 $/kWh *(MV double term)* • 0.01868 $/kWh *(MV single term)* • 0.02225 $/kWh *(LV single term)*		0.51413 $/kW/month *(MV double term)*		
	Agriculture		• 0.01233 $/kWh *(MV double term)* • 0.01536 $/kWh *(MV single term)* • 0.01829 $/kWh *(LV single term)*		0.49617 $/kW/month *(MV double term)*		
	Lighting		• 0.01437 $/kWh *(MV double term)* • 0.01793 $/kWh *(MV single term)* • 0.02131 $/kWh *(LV single term)*		0.51104 $/kW/month *(MV double term)*		
	Industrial		• 0.00961 $/kWh *(MV double term)* • 0.01061 $/kWh *(MV single term)* • 0.01642 $/kWh *(LV single term)*		0.31934 $/kW/month *(MV double term)*		

MO	Customer	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charge	Comments
XK*	35kV		0.0176 $/kWh				
	10kV		0.02667 $/kWh				
	0.4kV		0.04021 $/kWh				

Source: Survey (present charges sheet). Key: ? (no data).

A1.3 Equivalent use-of-system charges

Table 35 Equivalent network charges for each MO ($/kWh)

	Residential	Commercial	Small industrial (LV)	Industrial (MV)
AE-AZ	0.000	0.000	0.000	0.000
AE-DU				
AL	0.064	0.042	0.042	0.020
AM	0.040	0.019	0.009	0.006
AT	0.546	0.532	0.060	0.037
BA	0.027	0.023	0.022	0.014
CZ	0.188	0.213	0.047	0.091
DZ				
EE	0.054	0.039	0.022	0.022
GE	0.047	0.048	0.048	0.027
HU	0.090	0.087	0.015	0.014
HR	0.046	0.048	0.047	0.021
LT	0.085	0.154	0.075	0.071
LV	0.058	0.057	0.048	0.045
MD	0.033	0.033	0.017	0.009
MK	0.055	0.055	0.023	0.023
MN	0.041	0.057	0.057	0.052
NG	0.065	0.065	0.065	0.065
OM	1.195	1.210	1.003	0.897
PE	0.679	0.679	0.679	0.493
PK				
PL	1.480	1.478	1.456	1.418
SK	0.157	0.159	0.099	0.122
TH	0.030	0.033	0.034	0.020
TR	0.032	0.032	0.019	0.020
XK*	0.040	0.040	0.030	0.021

Source: Survey (present charges sheet).

A1.4 Transmission connection charges

Table 36 Present transmission connection charges

MO	Customer category	Connection charge
AE-AZ	All	Based on costs of dedicated assets
AE-DU	All	1-170kW: 68$/kW 171-400kW: 79$/kW 401-1000kW: 82$/kW 1001-2000kW: 84$/kW 2001-3000kW: 86$/kW 3001-4000kW: 131$/kW 4001-5000kW: 287$/kW 5001-6000kW: 508$/kW 6001-7000kW: 586$/kW 7001-8000kW: 665$/kW 8001-9000kW: 731$/kW 9001-10000kW: 825$/kW 10001-11000kW: 918$/kW Above 11000kW: 451$/kW
AL	All	Application and supervisory tariff
AM	Qualified consumer	Actual costs
AT	Ultra HV	Actual costs
	Transformation ultra HV to HV	Actual costs
BA	All customers	26,640 $/MW
CZ	Customers who reserve power input	11,364 $/MW
	Customers who reserve power output	28,182 $/MW
DZ	All	Actual costs
EE	All	Actual costs
GE	All	?
HU	HV-connected	Based on needed investment
HR	Load (Zagreb)	250 $ (Connection to HV)
	Producer	Actual costs
	Load (outside of Zagreb)	198 $ (Connection to HV)
LT	All	Actual costs
LV	All	Depending on location and construction costs
MD	All	Actual costs
MK	All	Actual costs
MN	All	Actual costs
NG	Shallow connection	Actual costs
	Deep connection	Actual costs
OM	All customers	Specific to the customer's actual cost
PE	HV users	Actual cost

MO	Customer category	Connection charge
	MV users	Actual cost
PK		
PL	Final customers	25% of CAPEX
	RES units up to 5MW	50% of CAPEX
	Co-gen units up to 1MW	50% of CAPEX
	Storage units	50% of CAPEX
	Other generators	100% of CAPEX
	DSOs	100% of CAPEX
	EVs charging infrastructure	1/16 of CAPEX
SK	All	Actual costs
TH	All	Actual costs
TR		
XK*	All	Actual costs

Source: ECA analysis of survey data. Key: ? (no data)

A1.5 Distribution connection charges

Table 37 Present distribution connection charges

MO	Customer category	Connection charge	
AE-AZ	All	Based on costs of dedicated assets	
AE-DU	All	1-170kW: 68$/kW 171-400kW: 79$/kW 401-1000kW: 82$/kW 1001-2000kW: 84$/kW 2001-3000kW: 86$/kW 3001-4000kW: 131$/kW 4001-5000kW: 287$/kW 5001-6000kW: 508$/kW 6001-7000kW: 586$/kW 7001-8000kW: 665$/kW 8001-9000kW: 731$/kW 9001-10000kW: 825$/kW 10001-11000kW: 918$/kW Above 11000kW: 451$/kW	
AL	All customers	Actual cost	
AM	Single-phase 0.22kV customers in (or within 200m of) residential areas, 10 kVA, Yerevan	$153.7	
	Single-phase 0.22kV customers in (or within 200m of) residential areas, 10 kVA, other areas	$125.3	
	Single-phase 0.22kV customers in (or within 200m of) residential areas, 14 kVA, Yerevan	$215.2	
	Single-phase 0.22kV customers in (or within 200m of) residential areas, 14 kVA, other areas	$146.6	
	Three-phase 0.4kV customers in (or within 200m of) residential areas, Yerevan	$480.2 + 24.8$/kVA	
	Three-phase 0.4kV customers in (or within 200m of) residential areas, other areas	$480.2 + 17.7$/kVA	
	6(10)kV customers in (or within 1,200m of) residential areas, Yerevan	$2000 + 7.1$/kVA	
	6(10)kV customers in (or within 1,200m of) residential areas, other areas	$2000 + 5$/kVA	
		Standard fee for a HV line up to 12 km	*Fee for each 250 meters of HV line. if it exceeds 12 km*
	35kV customers (3000kVA)	51 337.9$	3 028.2$
	35kV customers (3,001-4,000kVA)	61 960.3$	40 21.9$

MO	Customer category	Connection charge	
	35kV customers (4,001-5,000kVA)	72 559.1$	5 039.2$
	35kV customers (5,001-6,000kVA)	83 157.9$	6 032.8$
	35kV customers (6,001-7,000kVA)	93 756.7$	7 097.4$
	35kV customers (7,001-8,000kVA)	104 355.4$	8 043.7$
	35kV customers (8,001-9,000kVA)	114 954.2$	9 061.0$
	35kV customers (9,001-10,000kVA)	125 576.7$	10 054.6$
	35kV customers (10,001-11,000kVA)	136 175.4$	11 071.9$
	35kV customers (11,001-12,000kVA)	146 774.2$	12 065.6$
	35kV customers (12,001-13,000kVA)	157 373.0$	13 082.9$
	35kV customers (13,001-14,000kVA)	167 971.8$	14 076.5$
	35kV customers (14,001-15,000kVA)	178 570.6$	15 093.8$
AT	HV-connected	0.7889 $/MW (Vienna)	
		0.9047 $/MW (Upper Austria)	
		0.874 $/MW (Styria)	
	Transformation HV to MV	4.04493 $/MW (Vienna)	
		3.5014 $/MW (Upper Austria)	
		3.427 $/MW (Styria)	
	MV-connected	6.91993 $/MW (Vienna)	
		7.475 $/MW (Upper Austria)	
		6.9383 $/MW (Styria)	
	Transformation MV to LV	8.72543 $/MW (Vienna)	
		11.5 $/MW (Upper Austria)	
		10.258 $/MW (Styria)	
	LV-connected	18.0527 $/MW (Vienna)	
		15.9467 $/MW (Upper Austria)	
		15.249 $/MW (Styria)	
AZ			
BA	Middle voltage	74,610 $/MW	
	Low voltage	103,920 $/MW	
CZ	Power input HV	34,091 $/MW	
	Power input HV to DSO substation	8,192 $/MW	
	Power input MV	45,455 $/MW	
	Power input MV to DSO substation	11,364 $/MW	
	Power input LV, 3-phase	41 $/MW	
	Power input LV, 1-phase	49 $/MW	
	Power output HV	68,182 $/MW	
	Power output HV to DSO substation	8,192 $/MW	
	Power output MV	36,364 $/MW	
	Power output MV to DSO substation	8,192 $/MW	

MO	Customer category	Connection charge
	Power output LV, 3-phase	41 $/MW
	Power output LV, 1-phase	49 $/MW
DZ	All	Actual costs
EE	Charge in specified area	If connection point up to 400m to 0.4kV substation, fee is based on capacity fee
	Charge in unspecified area	If connection point above 400m to 0.4kV substation, fee is based on actual costs
	Charge for connection to MV and to electricity producer	MV consumer and all producers, fee based on actual costs
GE	All categories	?
HU	HV	Based on needed investment
	HV/MV	37 $/kVA (capacity based charge)
	MV	43.5 $/kVA (capacity based charge) 22.6 $/metre (overhead wire) 30.1 $/metre (cable)
	MV/LV	46.8 $/kVA (capacity based charge)
	LV	11.6 $/kVA (capacity based charge) 15.8 $/metre (overhead wire) 25.3 $/metre (cable) 3.8 $/metre (connector overhead wire) 17.9 $/metre (connector cable)
HR	Load (Zagreb)	250 $ (Up to 30kW)
	Producer	Actual cost
	Load (outside of Zagreb)	198$ (Up to 30kW)
LT	I category	31 (1kW load power upgrade or instalment)
	II category	90 (1kW load power upgrade or instalment)
		38 (for 1m of new electricity grid)
		623 (for project preparation)
	III category	44 (1kW load power upgrade or instalment)
		46 (for 1m of new electricity grid)
		712 (for project preparation)
	IV category	Factual cost for kW and m
		958 (for project preparation)
	V category	Factual cost for kW and m
		2,153 (for project preparation)
LV	Under 100A	702 (connection point from grid 50m, 20A) Depending on location and construction costs (All others)
	Above 100A	Depending on location and construction costs
MD	All customers	Actual cost
MK	Standard connections	Approved minimum simultaneous power
	Non-standard connections	Actual cost
MN	All customers	Actual cost

MO	Customer category	Connection charge
NG	Non-maximum demand	Actual cost
	Maximum demand 1	Actual cost
	Maximum demand 2	Actual cost
	Lifeline	Actual cost
OM	?	?
PE	Single-phase, 2 wire, aerial, below 3kW urban	330$
	Single-phase, 2 wire, aerial, 3-10kW urban	361$
	Three-phase, aerial, below 10kW urban	2,712$
	Three-phase, aerial, 10-20kW urban	2,885$
PK	Residential	Actual cost
	Commercial	Actual cost
	General services	Actual cost
	Industrial	Actual cost
	Bulk	Actual cost
	Agriculture	Actual cost
	Public lighting	Actual cost
	Residential colonies attached to industrials	Actual cost
	Special contracts	Actual cost
PL	Group II	25% of CAPEX
	Group III	25% of CAPEX
	Group IV	53.25 $/kW (overhead, DSO 1) 309.60 $/kW (cable, DSO 1) 119.20 $/kW (overhead, DSO 2) 247.72 $/kW (cable, DSO 2) 35.01 $/kW (overhead, DSO 3) 49.91 $/kW (cable, DSO 3)
	Group V	53.25 $/kW (overhead, DSO 1) 309.60 $/kW (cable, DSO 1) 119.20 $/kW (overhead, DSO 2) 247.72 $/kW (cable, DSO 2) 35.01 $/kW (overhead, DSO 3) 49.91 $/kW (cable, DSO 3)
	Group VI	53.25 $/kW (overhead, DSO 1) 309.60 $/kW (cable, DSO 1) 119.20 $/kW (overhead, DSO 2) 247.72 $/kW (cable, DSO 2) 35.01 $/kW (overhead, DSO 3) 49.91 $/kW (cable, DSO 3)
SK	DD1	65.2263$
	DD2	25.4263$
	DD3	16.0368$

MO	Customer category	Connection charge
	DD4	37.5737$
	DD5	12.1737$
	DD6	12.1737$
	DD7	64.9421$
	DD8	12.1737$
TH	All categories	Based on pre-determined charges for cost of connection, embedded in the use-of-system tariffs
TR	LV 0-15 kW	2.438 $/meter (overhead) 5.244 $/meter (underground)
	LV 15-50 kW	4.137 $/meter (overhead) 7.097 $/meter (underground)
	LV 50-100 kW	5.153 $/meter (overhead) 9.692 $/meter (underground)
	LV >100 kW	9.692 + (capacity -100)x0.6 $/meter
	MV	6.623 $/meter (overhead) 24.777 $/meter (underground)
XK*	35kV	364.58 $ (service) 10.42 $/kW (capacity)
	10kV	187.50 $ (service) 15.63 $/kW (capacity)
	0.4kV	41.67 $ (service) 20.83 $/kW (capacity)

Source: ECA analysis of survey data. Key: ? (no data)

A2 Glossary of terms

Access charge	An access charge is a charge paid by customers for contracted capacity or supply capacity per kW or kVA per period. It may or may not differentiate by time-of-use (eg it may be more expensive in some seasons).
Allocative efficiency	An outcome in which production is aligned with consumers' preferences. Economic theory suggests that allocative efficiency is achieved in electricity markets when the charge paid by a customer reflects the marginal cost of supplying an additional unit of energy to that customer.
Connection charge	The charge for connecting to the electricity network. The charge is used by TSOs and DSOs to pay for the construction and maintenance of assets used to connect the user to the network.
Consumption profile	The hourly profile of an electricity customer's consumption throughout the year. This can be used to see energy and capacity requirements by hourly (or half-hourly) intervals.
Deep charge	Connection charges can be categorised by different depths. Charges can fall into one of two extremes, deep and shallow, or intermediate policies. A deep connection charge covers both local and remote costs of connection, ie it also covers any network expansion cost (the cost for expanding the network to the customer's area) and any remote costs (ie upstream costs to the network).
Demand charge	A demand charge is a charge paid by customers for use of network capacity. It is based on the metered maximum demand in a given time period (eg kW or kVA per period). It may or may not differentiate by time-of-use (eg it may be more expensive in some seasons).
Distance-related pricing	There are several variants of distance-related pricing, including simple distance between generation and load (MW-km), network or contract path (where the incremental flows are modelled for specific generation and load), and point-to-point pricing (which is similar to zonal pricing). This option is mentioned in the literature on network pricing but is seldomly adopted.
Distributed generation and storage	Generators and storage facilities connected to the distribution network.
Dynamic charge	A network use-of-system charge that offers close to real-time price signals.
Economic development zone (EDZ)	Geographical areas that enjoy preferential policies. They are employed as policy instruments to foster economic growth and technological innovation and increase exports and employment.
Electric vehicle (EV)	A vehicle powered by electric motors.

Electromechanical meter	An electromechanical watt-hour meter is a traditional electricity meter. It does not have a digital display and must be read manually by a human meter reader on the property. On a single-phase AC supply, the electromechanical induction meter operates through electromagnetic induction by counting the revolutions of a non-magnetic, but electrically conductive, metal disc which is made to rotate at a speed proportional to the power passing through the meter. The number of revolutions is thus proportional to the energy usage.
Electronic meter	Electronic meters display the energy used on an LCD or LED display. Unlike a smart meter, it still needs to be read manually by a human meter reader, who has to come on to the property to read it.
Embedded cost approach	The embedded cost approach is a method for allocating the cost of service to customers. The embedded cost approach is direct and involves three main steps: (1) splitting costs into functional components (production, transmission, distribution, billing, and customer service); (2) classifying these as demand-related (kW), energy-related (kWh) and customer-related; and (3) allocating these to customer categories based on their load patterns.
Energy charge	An energy charge is a charge paid by the customer for each unit of energy consumed (eg per kWh, per kJ, per MWh, etc).
Expert judgement approach	The expert judgement approach is a method for allocating the cost of service to customers. The expert judgement approach is, in short, the allocation of costs to different customers based on the judgement of the expert performing the calculation, without performing the detailed calculations associated with a well-known, established approach.
Fixed charge	A fixed charge is a constant sum paid by the customer at pre-determined time intervals (eg per day, month, or year) for a service.
Flat charge	Some of the charges within the tariff design can differ according to the time the service was used. For example, the demand charge may be higher during peak hours of the day. If the charge does not follow this principle and is constant over time, then the charge can be defined as a flat charge.
Generators	A power plant or any similar facility that generates electricity with capabilities for delivering energy to the Transmission System or distribution system and which is connected to the Transmission System or distribution system.
Independent power producer (IPP)	Non-utility generators (NUGs) that are typically not owned by the national electricity company or public utility.
Interruptible supply	Interruptible supply means that a customer has agreed to allow the supplier to restrict or discontinue supply of electricity typically for a pre-specified time period.

Locational marginal pricing	This option describes a market arrangement rather than fixed network charges. As with nodal pricing, the market prices at nodes in the system are determined competitively through offers by generators and bids by buyers (suppliers or large consumers) but subject to constraints between nodes, and this leads to different prices at different nodes. The nodes are physically connected to other nodes and with LMP the capacity of those interconnectors is auctioned. The price that network users are willing to pay for using the interconnectors then depends on the wholesale price differentials between the nodes reflecting both the market price of the interconnector capacity and the wholesale price of generation at the nodes.
Long-run marginal cost (LRMC) approach	The LRMC approach attempts to mimic the price that should emerge in a competitive market. It estimates the LRMC for providing power and energy to each consumer group and designs tariffs that reflect marginal costs of supply. The long-run average incremental cost (LRAIC) approach falls into this category - it attempts to estimate the incremental costs for serving an additional unit of capacity.
Nodal pricing	Nodal pricing allows different prices at each node on the system.
Postal pricing	The simplest network charging structure involves unit (kWh) pricing that is uniform across the network. This is known as postal pricing.
Power factor	The ratio of working power, measured in kilowatts (kW), to apparent power, measured in kilovolt amperes (kVA). Therefore, PF = kW / kVA. Reactive power penalties are often imposed when an entity drops below a pre-specified minimum (min) power factor.
Prosumers	Network users who are both electricity consumers and electricity producers.
Reactive power charge	A charge expressed in $/kVArh for reactive power.
Reactive power penalty	A penalty for deviating from a pre-specified power factor. For example, a common formulation is the customer will pay a penalty for dropping below a power factor of x%, where x is contractually agreed.
Self-generator	An entity that generates electricity for its own consumption.
Shallow charge	Connection charges can be categorised by different depths. Charges can fall into one of two extremes, deep and shallow, or intermediate policies. A shallow connection charge only covers the local cost of connection, ie the cost from the boundary of the customer's premises to the nearest distribution/transmission network.
Smart meter	A smart meter is an electronic device that records information such as consumption of electric energy, voltage levels, current, and power factor. Smart meters communicate the information to the consumer for greater clarity of consumption behaviour, and electricity suppliers for system monitoring and customer billing. Unlike an electronic meter, smart meters communicate information on the energy used

	automatically to the utility, meaning a human meter reader does not have to come onto the property to read it manually.
Smart technology	A self-monitoring, analysis, and reporting technology (or smart technology) is a technology that offers interaction and control through use of the Internet. In the context of the electricity sector, a smart technology may receive information from the utility company to automatically switch off during times of high prices (eg a freezer may turn off temporarily if prices spike) or to schedule operation for a time of low prices (eg a washing machine may be scheduled to turn on during the night).
Tariff design	Tariff design defines the type of charges, the grouping of customers and the relative ratio of charges for electricity consumption.
Tariff design methodology	The methodological approach used for defining tariff structures (see definition of tariff design).
Time-of-use charge	Some of the charges can differ according to the time the service was used. For example, the demand charge may be higher during peak hours of the day. In this case, the demand charge is a time-of-use charge, in contrast with a flat charge.
Unbundled	The separation of two parts of the electricity supply chain. For example, if there is a separate TSO and DSO, then system operation of the transmission and distribution networks is unbundled.
Use-of-system charge	A use-of-system (UoS) charge is a charge for using the transmission network or distribution network. The charge is used by TSOs and DSOs to pay for their efficient costs for developing, operating and maintaining these networks.
Vertically integrated	The fusion of two parts of the electricity supply chain, such as generation and transmission or transmission and distribution.
Voltage level of connection	The voltage level of the network at the point where a customer is connected to the grid. For example, an industrial customer may be connected directly to a high voltage transmission line, while a residential customer is likely to be connected to a low voltage distribution network. Customers are often charged different rates based on their voltage level of connection since this affects how much network infrastructure the customer relies on (and must therefore pay for).
Zonal pricing	Zonal pricing aggregates nodes into different zones with uniform prices.

A3 Questionnaire

Study on Regulatory Approaches of Electricity TSO & DSO Network Tariff Structures among ERRA Member Organizations
Introduction

1 Introduction

This questionnaire has been issued to 32 member organisations (MOs) of the Energy Regulators Regional Association (ERRA). The purpose of this questionnaire is to collect information on MOs' approaches for setting tariff designs for network use-of-system charges and connection charges, but looking also at tariff designs that respond to the latest developments in the sector. The results from this survey will be used to produce a report on this topic that will act as a follow-on study from ERRA's 2020 report on allowed revenue methodologies of MOs.

2 Instructions

Structure of questionnaire (see tabs at bottom of page):
• **Cover:** Front cover.
• **Introduction:** An introductory sheet providing an introduction to the questionnaire, instructions for completing the questionnaire, and a glossary of terms.
• **General:** Questions on the survey participant's details and the overall electricity sector. Instructions on next steps.
• **1-5:** Detailed survey questions.

Step-by-step instructions
1) Read all information in this <Introduction> sheet.
2) Respond to the questions in the <General> sheet. Upon completion of this sheet, this will tell you your next steps.
3) Based on the instructions in the <General> sheet, respond only to questions in the relevant sheets 1-5.

Important guidance:
• Sheets must be completed sequentially.
• Some participants will not have to complete all worksheets. Complete <General> sheet to receive instructions.
• Only provide data in input cells. Do not edit other cells or insert rows or columns.
• There are two types of input cell that participants will encounter:

Dropdown list: Select from the list.
Manual input: Type your response into the cell.

3 Glossary

Access charge	An access charge is a charge paid by customers for contracted capacity or supply capacity per kW or kVA per period. It may or may not differentiate by time-of-use (eg it may be more expensive in some seasons).
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Connection charge	The charge for connecting to the electricity network. The charge is used by TSOs and DSOs to pay for the construction and maintenance of assets used to connect the user to the network.
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Unbundled	The separation of two parts of the electricity supply chain. For example, if there is a separate TSO and DSO, then system operation of the transmission and distribution networks is unbundled.
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Vertically integrated	The fusion of two parts of the electricity supply chain, such as generation and transmission or transmission and distribution.
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Zonal pricing	Zonal pricing aggregates nodes into different zones with uniform prices.

Study on Regulatory Approaches of Electricity TSO & DSO Network Tariff Structures among ERRA Member Organizations
General

1 Respondent details

Country	
Date	
Version	
Name of organisation(s)	
Name of responsible official	
Email of responsible official	
Phone number of responsible official	

2 General questions

2.1 **How many TSOs are there?**
2

2.2 **How many DSOs are there?**

2.3 **Are transmission and distribution vertically integrated or unbundled?**

2.4 **Are the transmission and distribution use-of-system charges unbundled?**

2.5 **Based on your above responses, please use the following instructions for completing the next worksheets.**

In sheet 5, please provide present charges for your TSOs in sections 2,3,8&9 of that sheet. Ignore sections 4&10 in that sheet.

Study on Regulatory Approaches of Electricity TSO & DSO Network Tariff Structures among ERRA Member Organizations
1 - TSO - Use of system

1 Regulations and principles

These questions are about the tariff design (the types of charges, grouping of customers, etc). This is different from the allowed revenues.

1.1 **Who is responsible for *approving* the tariff design for network use-of-system charges?**

If other, please specify here:

1.2 **Who is responsible for *developing* the tariff design for network use-of-system charges?**

If other, please specify here:

1.3 **Do the regulations define the methodology for developing network use-of-system tariff designs?**
This question refers to tariff design elements only and NOT for Allowed Revenues/Revenue Requirements.

If yes, please paste the regulations here or attach the regulations and cite the relevant clauses or chapters:

1.3.1 **Who is responsible for developing those regulations?**

If other, please specify here:

1.3.2 **In the regulations, what are the guiding principles for setting the tariff design for network use-of-system charges?**
Please enter here the principles included in the regulations only and not other principles that may be applied when tariffs are actually designed.

Please select all applicable answers

- [ ] Cost recovery
- [ ] Affordability
- [ ] Equity
- [ ] Allocative efficiency
- [ ] Simplicity
- [ ] Cost reflectivity
- [ ] Avoid cross-subsidies
- [ ] Transparency
- [ ] Security of supply
- [ ] Other

If other, please specify here:

1.4 **What is the methodological approach for setting cost-reflective tariff designs?**
All approaches will probably include an element of expert judgement. Please select 'Expert judgement' only if the other approaches are not used at all.

If other, please specify here:

1.5 **Are there regulations specifying how often the tariff design should be reviewed?**

1.5.1 **According to the regulations, how often should the tariff design be reviewed?**

1.6 **Please use this space to provide further information on the above questions if needed**

2 Customer categories

2.1 What are the drivers for separating charges into customer categories?

Please select all applicable answers

- ☐ Voltage level of connection
- ☐ Consumption profile
- ☐ Cost of supply
- ☐ Billing and metering
- ☐ Zone
- ☐ Other

If other, please specify here:

2.2 How many customer categories do you have for transmission use-of-system charges?

2.3 Please provide the customer categories for use-of-system charges

Please provide details of up to 15 core customer categories by typing in the table below. Details should include the name of the customer category and a short description/definition.
Examples of customer categories: low-voltage (LV) connected, medium-voltage (MV) connected, etc (if customers are separated based on voltage level of connection), or Zone 1, Zone 2, etc (if customers are selected based on zone), or by type (customer type 1, customer type 2, etc).
Do not include special categories that are discussed in Section 6, below (eg electric vehicles, smart technologies, etc).

	Name of customer category	Definition of customer category
1	[Entry 1 - type here and will be copied across below]	

2.4 Please use this space to provide further information on the above questions if needed

3 Locational signals

3.1 What locational signals are used when designing the tariff?

If other, please specify here:

4 Generators versus load

4.1 Are generators and load treated the same?

4.2 What is the split for the recovery of network use-of-system costs between load and generators? Please enter a %.

Load	
Generators	

5 Types of charges

5.1 Which types of charges are in the current tariff design for each customer category or zone?

Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charges / penalties
[Entry 1 - type here and will be copied across below]					

5.2 If there is a fixed charge, how is this charge expressed by time period?

Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Period
[Entry 1 - type here and will be copied across below]	

If other, please specify here:

5.3 If there is a time-of-use energy charge, over what periods do the rates differ?

Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Variation *within* days			Variation *between* days		Variation by season			Other variation	
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods
[Entry 1 - type here and will be copied across below]										

5.4 If there is a time-of-use demand charge, over what periods do the rates differ?

Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Variation *within* days			Variation *between* days		Variation by season			Other variation	
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods
[Entry 1 - type here and will be copied across below]										

5.5 If there is a time-of-use reactive power charges ($/kVArh), over what periods do the rates differ?

Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Variation *within* days			Variation *between* days		Variation by season			Other variation	
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods
[Entry 1 - type here and will be copied across below]										

5.6 If there are reactive power *penalties*, please specify the type of penalty that is applied

Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Min power factor (%)	Penalty
[Entry 1 - type here and will be copied across below]		

5.7 If there is an access charge, is it expressed in terms of kW or kVA?

5.8 If there is an access charge, is this for contracted capacity or supply capacity?

5.9 If there is a demand charge, is it expressed in terms of kW or kVA?

5.10 If there are dynamic charges, please specify what types of charges are used

If other, please specify here:

5.11 Please use this space to provide further information on the above questions

6 Special charges

6.1 Are there charges specific to each of the following groups?

Please select all applicable answers

- ☐ Electric vehicles (EVs)
- ☐ Smart technologies
- ☐ Self-generators or Prosumers
- ☐ Distributed generation and storage
- ☐ Independent power producers (IPPs)
- ☐ Economic development zones (EDZs)
- ☐ Other

If other, please specify here:

1	
2	
3	
4	
5	

6.2 How are these customers identified/defined to be included to these special tariff categories?

Please provide definitions by typing in the right-hand column. Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Definition of special customer category

6.3 For each group, what charges are currently used? Is there an option to have interruptible supply? What is the metering arrangement?

Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charges / penalties	Interruptible supply	Metering arrangement	Type of meter required	Other

6.4 If there is a time-of-use energy charge, over what periods do the rates differ?

Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Variation *within* days			Variation *between* days		Variation by season			Other variation		
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods	Definition of periods

6.5 If there is a time-of-use demand charge, over what periods do the rates differ?

Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Variation *within* days			Variation *between* days		Variation by season			Other variation		
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods	Definition of periods

6.6 If there is a time-of-use reactive power charges ($/kVArh), over what periods do the rates differ?

Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Variation *within* days			Variation *between* days		Variation by season			Other variation		
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods	Definition of periods

6.7 If there is interruptible supply, over what periods is applied (eg when supply is available)?

Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Variation *within* days			Variation *between* days		Variation by season			Other variation		
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods	Definition of periods

6.8 **If there are reactive power *penalties*, please specify the type of penalty that is applied**
Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Min power factor (%)	Penalty

If other, please specify here:

6.9 **If there is an access charge, is it expressed in terms of kW or kVA?**

6.10 **If there is an access charge, is this for contracted capacity or supply capacity?**

6.11 **If there is a demand charge, is it expressed in terms of kW or kVA?**

6.12 **If there are dynamic charges, please specify what types of charges are used**

If other, please specify here:

6.13 **Please use this space to provide further information on the above questions**

7 Losses

7.1 **Are the cost of losses included in the network use-of system charge or recovered through loss factors?**

7.2 **How are losses added in the use-of-system charge?**

7.3 **Please use this space to provide further information on the above questions**

7.4 **What are the voltrage levels operated by the TSO?**

Study on Regulatory Approaches of Electricity TSO & DSO Network Tariff Structures among ERRA Member Organizations
2 - TSO - Connection

1 Regulations and principles

1.1 Who is responsible for *approving* the connection charges policy?

If other, please specify here:

1.2 Who is responsible for *developing* the connection charges policy?

If other, please specify here:

1.3 Do regulations specify how the connection charges policy should be determined?

If yes, please provide a link to the regulations and paste any relevant sections in the space below. The regulations should relate to the tariff design (not the allowed revenue).

1.3.1 Who is responsible for developing those regulations?

If other, please specify here:

1.3.2 In the regulations, what are the guiding principles for the connection charges policy?

Please enter here the principles included in the regulations only and not other principles that may be applied when connection charges are actually designed.

Please select all applicable answers

- [ ] Cost recovery
- [ ] Affordability
- [ ] Equity
- [ ] Allocative efficiency
- [ ] Simplicity
- [ ] Cost reflectivity
- [ ] Avoid cross-subsidies
- [ ] Transparency
- [ ] Security of supply
- [ ] Other

If other, please specify here:

1.4 Please use this space to provide further information on the above questions

2 Customer categories

2.1 What are the drivers for separating charges into customer categories?

Please select all applicable answers

- [ ] Voltage level of connection
- [ ] Capacity requirement
- [ ] 3-phase versus 1-phase connection
- [ ] Distance from grid
- [ ] Type of customer
- [ ] Other

If other, please specify here:

2.2 How many customer categories do you have for transmission connection charges?

2.3 Please provide the customer categories for connection charges

Please provide details of up to 15 core customer categories by typing in the table below. Details should include the name of the customer category and a short description/definition.
Examples of customer categories: low-voltage (LV) connected, medium-voltage (MV) connected, etc (if customers are separated based on voltage level of connection), or Zone 1, Zone 2, etc (if cus
If all customers are treated the same (ie if there are no customer categories), simply provide one customer category called "all customers".

	Name of customer category	Definition of customer category
1		

2.4 Please use this space to provide further information on the above questions

3 Deep or shallow charges

3.1 For each customer category, is the charge deep or shallow?
Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Depth	Comment describing the depth of charge
-		
-		

3.2 If the customer pays for the connection assets, do they remain the owner of that asset, or is ownership transferred to the TSO? Who pays for the maintenance of the line?
Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Customer pays for line?	Ownership transferred to TSO?	Who pays for maintenance ?
-			

3.3 Please use this space to provide further information on the above questions

4 Payment method

4.1 **What approach is used for the payment of connection charges?**
Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Costs coverage	If other please specify here
-		

4.2 **Do the connection charges allow for sharing of costs as more customers connect to the asset? If yes, is there a time limit after which customers are no longer required to participate**
Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Cost sharing	Time limit
-		

4.3 **Please use this space to provide further information on the above questions**

5 Generators versus load

5.1 **Are generators and load treated the same?**

Study on Regulatory Approaches of Electricity TSO & DSO Network Tariff Structures among ERRA Member Organizations
3 - DSO - Use of system

1 Regulations and principles

These questions are about the tariff design (the types of charges, grouping of customers, etc). This is different from the allowed revenues.

1.1 **Who is responsible for *approving* the tariff design for network use-of-system charges?**

If other, please specify here:

1.2 **Who is responsible for *developing* the tariff design for network use-of-system charges?**

If other, please specify here:

1.3 **Do the regulations define the methodology for developing network use-of-system tariff designs?**
This question refers to tariff design elements only and NOT for Allowed Revenues/Revenue Requirements.

If yes, please paste the regulations here or attach the regulations and cite the relevant clauses or chapters:

1.3.1 **Who is responsible for developing those regulations?**

If other, please specify here:

1.3.2 **In the regulations, what are the guiding principles for setting the tariff design for network use-of-system charges?**
Please enter here the principles included in the regulations only and not other principles that may be applied when tariffs are actually designed.

Please select all applicable answers

- [ ] Cost recovery
- [ ] Affordability
- [ ] Equity
- [ ] Allocative efficiency
- [ ] Simplicity
- [ ] Cost reflectivity
- [ ] Avoid cross-subsidies
- [ ] Transparency
- [ ] Security of supply
- [ ] Other

If other, please specify here:

1.4 **What is the methodological approach for setting cost-reflective tariff designs?**

If other, please specify here:

1.5 **Are there regulations specifying how often the tariff design should be reviewed?**

1.5.1 **According to the regulations, how often should the tariff design be reviewed?**

1.6 **Please use this space to provide further information on the above questions if needed**

2 Customer categories

2.1 What are the drivers for separating charges into customer categories?

Please select all applicable answers

- ☐ Voltage level of connection
- ☐ Consumption profile
- ☐ Cost of supply
- ☐ Billing and metering
- ☐ Zone
- ☐ Other

If other, please specify here:

2.2 How many customer categories do you have for distribution use-of-system charges?

2.3 Please provide the customer categories for use-of-system charges

Please provide details of up to 15 core customer categories by typing in the table below. Details should include the name of the customer category and a short description/definition.
Examples of customer categories: low-voltage (LV) connected, medium-voltage (MV) connected, etc (if customers are separated based on voltage level of connection), or Zone 1, Zone 2, etc (if customers are selected based on zone), or by type (customer type 1, customer type 2, etc).
Do not include special categories that are discussed in Section 6, below (eg electric vehicles, smart technologies, etc).

	Name of customer category	Definition of customer category
1	[Entry 1 - type here and will be copied across below]	

2.4 What type of meter is installed for the majority of the customers in each category?

To ensure questionnaire simplicity, metering information for HV connected customers is also requested in this question. If necessary, please confer with the TSO.

2.4.1 LV connected

2.4.2 MV connected

2.4.3 HV connected

2.5 Within each category, what proportion (%) of customers have each type of meter?

Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

	Customer category (following the categories entered in 2.3)	Electro-mechanical meter without time-of-use capabilities	Electro-mechanical meter with time-of-use capabilities	Electronic meter without time-of-use capabilities	Electronic meter with time-of-use capabilities	Smart meters
1	[Entry 1 - type here and will be copied across below]					

2.6 How many customers are in each category?

Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

	Customer category (following the categories entered in 2.3)	Number of customers
1	[Entry 1 - type here and will be copied across below]	

2.7 Please use this space to provide further information on the above questions if needed

3 Locational signals

3.1 What locational signals are used when designing the tariff?

If other, please specify here:

4 Generators versus load

4.1 Are generators and load treated the same?

Generators also pay for the use of the network to deliver electricity?

4.2 What is the split for the recovery of network use-of-system costs between load and generators? Please enter a %.

Load	
Generators	

5 Types of charges

5.1 Which types of charges are in the current tariff design for each customer category?

Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charges / penalties
[Entry 1 - type here and will be copied across below]					

5.2 If there is a fixed charge, how is this charge expressed by time period?

Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Period
[Entry 1 - type here and will be copied across below]	

If other, please specify here:

5.3 **If there is a time-of-use energy charge, over what periods do the rates differ?**
Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Variation *within* days			Variation *between* days		Variation by season			Other variation	
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods
[Entry 1 - type here and will be copied across below]										

5.4 **If there is a time-of-use demand charge, over what periods do the rates differ?**
Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Variation *within* days			Variation *between* days		Variation by season			Other variation	
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods
[Entry 1 - type here and will be copied across below]										

5.5 **If there is a time-of-use reactive power charges ($/kVArh), over what periods do the rates differ?**
Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Variation *within* days			Variation *between* days		Variation by season			Other variation	
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods
[Entry 1 - type here and will be copied across below]										

5.6 **If there are reactive power *penalties*, please specify the type of penalty that is applied**
Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Min power factor (%)	Penalty
[Entry 1 - type here and will be copied across below]		

5.7 **If there is an access charge, is it expressed in terms of kW or kVA?**

5.8 **If there is an access charge, is this for contracted capacity or supply capacity?**

5.9 **If there is a demand charge, is it expressed in terms of kW or kVA?**

5.10 **If there are dynamic charges, please specify what types of charges are used**

If other, please specify here:

5.11 **Please use this space to provide further information on the above questions**

6 Special charges

6.1 Are there charges specific to each of the following groups?

Please select all applicable answers

- ☐ Electric vehicles (EVs)
- ☐ Smart technologies
- ☐ Self-generators or Prosumers
- ☐ Distributed generation and storage
- ☐ Independent power producers (IPPs)
- ☐ Economic development zones (EDZs)
- ☐ Other

If other, please specify here:

6.2 How are these customers identified/defined to be included to these special tariff categories?

Please provide definitions by typing in the right-hand column. Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Definition of special customer category

6.3 For each group, what charges are currently used? Is there an option to have interruptible supply? What is the metering arrangement?

Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Fixed charge	Energy charge	Demand charge	Access charge	Reactive power charges / penalties	Interruptible supply	Metering arrangement	Type of meter required	Other

6.4 If there is a time-of-use energy charge, over what periods do the rates differ?

Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Variation *within* days			Variation *between* days		Variation by season			Other variation		
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods	Definition of periods

6.5 If there is a time-of-use demand charge, over what periods do the rates differ?

Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Variation *within* days			Variation *between* days		Variation by season			Other variation		
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods	Definition of periods

6.6 If there is a time-of-use reactive power charges ($/kVArh), over what periods do the rates differ?

Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Variation *within* days			Variation *between* days		Variation by season			Other variation		
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods	Definition of periods

6.7 If there is interruptible supply, over what periods is applied (eg when supply is available)?

Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Variation *within* days			Variation *between* days		Variation by season			Other variation		
	Is applied?	Number of periods	Definition of periods	Is applied?	Definition of periods	Is applied?	Number of seasons	Definition of seasons	Is applied?	Definition of periods	Definition of periods

6.8 If there are reactive power *penalties*, please specify the type of penalty that is applied

Customer category names are automatically provided from question 6.1 - please do no edit names in the left-hand column.

Special customer category (following the categories entered in 6.1)	Min power factor (%)	Penalty

If other, please specify here:

6.9 **If there is an access charge, is it expressed in terms of kW or kVA?**

6.10 **If there is an access charge, is this for contracted capacity or supply capacity?**

6.11 **If there is a demand charge, is it expressed in terms of kW or kVA?**

6.12 **If there are dynamic charges, please specify what types of charges are used**

If other, please specify here:

6.13 **Please use this space to provide further information on the above questions**

7 Losses

7.1 **Are the cost of losses included in the network use-of system charge or recovered through loss factors?**

7.2 **How are losses added in the use-of-system charge?**

7.3 **Please use this space to provide further information on the above questions**

7.4 **What are the voltrage levels operated by the DSO?**

Study on Regulatory Approaches of Electricity TSO & DSO Network Tariff Structures among ERRA Member Organizations
4 - DSO - Connection

1 Regulations and principles

1.1 Who is responsible for *approving* the connection charges policy?

If other, please specify here:

1.2 Who is responsible for *developing* the connection charges policy?

If other, please specify here:

1.3 Do regulations specify how the connection charges policy should be determined?

If yes, please provide a link to the regulations and paste any relevant sections in the space below. The regulations should relate to the tariff design (not the allowed revenue).

1.3.1 Who is responsible for developing those regulations?

If other, please specify here:

1.3.2 In the regulations, what are the guiding principles for the connection charges policy?

Please select all applicable answers

- ☐ Cost recovery
- ☐ Affordability
- ☐ Equity
- ☐ Allocative efficiency
- ☐ Simplicity
- ☐ Cost reflectivity
- ☐ Avoid cross-subsidies
- ☐ Transparency
- ☐ Security of supply
- ☐ Other

If other, please specify here:

1.4 Please use this space to provide further information on the above questions

2 Customer categories

2.1 What are the drivers for separating charges into customer categories?

Please select all applicable answers

- ☐
- ☐ Voltage level of connection
- ☐ Capacity requirement
- ☐ 3-phase versus 1-phase connection
- ☐ Distance from grid
- ☐ Type of customer
- ☐ Other

If other, please specify here:

2.2 How many customer categories do you have for distribution connection charges?

2.3 Please provide the customer categories for connection charges

Please provide details of up to 15 core customer categories by typing in the table below. Details should include the name of the customer category and a short description/definition.
Examples of customer categories: low-voltage (LV) connected, medium-voltage (MV) connected, etc (if customers are separated based on voltage level of connection), or Zone 1, Zone 2, etc (if cus
If all customers are treated the same (ie if there are no customer categories), simply provide one customer category called "all customers".

	Name of customer category	Definition of customer category
1		

2.4 Please use this space to provide further information on the above questions

3 Deep or shallow charges

3.1 For each customer category, is the charge deep or shallow?
Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Depth	Comment describing the depth of charge
-		

3.2 If the customer pays for the line, do they remain the onwer of that asset, or is ownership transferred to the DSO? Who pays for the maintenance of the line?
Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Customer pays for line?	Ownership transferred to DSO?	Who pays for maintenance ?
-			

3.3 Please use this space to provide further information on the above questions

4 Payment method

4.1 What approach is used for the payment of connection charges?

Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Costs coverage
-	

4.2 Do the connection charges allow for sharing of costs as more customers connect to the asset? If yes, is there a time limit after which customers are no longer required to participate

Customer category names are automatically provided from question 2.3. Please do not edit the names in this table.

Customer category (following the categories entered in 2.3)	Cost sharing	Time limit
-		

4.3 Please use this space to provide further information on the above questions

5 Generators versus load

5.1 Are generators and load treated the same?

5.2 What is the split for the recovery of network use-of-system costs between load and generators? Please enter a %.

Load	
Generators	

Study on Regulatory Approaches of Electricity TSO & DSO Network Tariff Structures among ERRA Member Organizations

5 - Present charges

Please complete this worksheet for a maximum of three TSOs and a maximum of three DSOs. You should prioritise TSOs and DSOs with the highest consumption. Leave any irrelevant sections blank.
To expand a section, please click on the [+] icon on the left-hand side of the relevant section.

1 Exchange rate

This worksheet requires data in United States dollars (USD). If you are converting values from a local currency, please provide your local currency below and provide details on the exchange rate you have assumed.

1.1 What is your local currency?

1.2 Please provide the exchange rate, if applicable, that you used to calculate the $ amounts below

1USD= Local currency

2 TSO #1 use-of-system charges

Please provide transmission use-of-system charges for up to a maximum of 15 customer categories. Please also provide a minimum of four categories covering low voltage (residential, commercial and small industrial) and high voltage (large industrial)

	Customer category	Fixed charge *$/customer/period*		Energy charge *$/kWh*			Demand charge *$/ [awaiting data] /month*			Access charge *$/ [awaiting data] /month*	Reactive power charge *$/kVArh/month*		
				Flat rate	Time-of-use rate		Flat rate	Time-of-use rate		Flat rate	Flat rate	Time-of-use rate	
		$ amount	/ period	$ amount	period	$ amount	$ amount	period	$ amount	$ amount	$ amount	period	$ amount
	Example	*5*	*/ month*		*00.00-15.00, Monday-Friday*	*3*	*2*	*00.00-15.00, Monday-Friday*	*3*	*2*		*00.00-15.00, Monday-Friday*	*3*
2.1			/										

5 DSO #1 use-of-system charges

Please provide distribution use-of-system charges for up to a maximum of 15 customer categories. Please also provide a minimum of three categories covering residential, commercial and small industrial.

	Customer category	Fixed charge *$/customer/period*		Energy charge *$/kWh*			Demand charge *$/ [awaiting data] /month*			Access charge *$/ [awaiting data] /month*	Reactive power charge *$/kVArh/month*		
				Flat rate	Time-of-use rate		Flat rate	Time-of-use rate		Flat rate	Flat rate	Time-of-use rate	
		$ amount	/ period	$ amount	period	$ amount	$ amount	period	$ amount	$ amount	$ amount	period	$ amount
	Example	*5*	*/ month*		*00.00-15.00, Monday-Friday*	*3*	*2*	*00.00-15.00, Monday-Friday*	*3*	*2*		*00.00-15.00, Monday-Friday*	*3*
5.1			/										

8 TSO #1 connection charges

Please provide transmission connection charges for up to a maximum of 15 customer categories. We provide an example from a fictitious TSO.

Customer category	Charge ($)

Example	*Customer category*	*Charge ($)*
	Non-distribution licensee, > 2MVA	*1000*
	Non-distribution licensee, ≤ 2MVA	*500*
	Distribution licensees	*400*

11 DSO #1 connection charges

Please provide distribution connection charges for up to a maximum of 15 customer categories. We provide an example from Tanzania.

Customer category	Charge ($)

Example	*Customer category*	*Charge ($)*
	Single phase connection within 30 meters, urban	*124*
	Single phase connection within 30 meters, rural	*69*
	Single phase connection within 70 meters, one pole, urban	*200*
	Single phase connection within 70 meters, one pole, rural	*131*
	Single phase connection within 70 meters, two poles, urba	*270*
	Single phase connection within 70 meters, two poles, rural	*176*
	Three phase connection within 30 meters	*353*
	Three phase connection within 70 meters, one pole	*484*
	Three phase connection within 70 meters, two poles	*634*

A4 Country fact sheets

A4.1 Albania

Variable	Response	
Regulator details		
Name of regulatory Authority:	Albanian Energy Regulatory Entity	
General		
Number of TSOs	1	
Number of DSOs	1	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other	✓	
Equity		
Simplicity		
Affordability	✓	
Security of supply	✓	✓
Allocative efficiency		✓
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	LRMC	LRMC
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓

Drivers for separating charges into consumer categories		
Other	-	
Cost of supply	-	
Billing and metering	-	
Type of customer	-	
Demand profile	-	
Zone	-	
Voltage level of connection	-	✓
Number of customer categories	1	3
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electronic
	Medium Voltage	Electronic
	High Voltage	Electronic
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	x
Period over which it is applied	-	-
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Demand charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	-
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	x	✓
Flat?	-	✓
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-

Reactive power penalties?	✓	x
Min power factor	-	90%
Special tariff designs		
	Transmission	**Distribution**
Other	-	-
Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	400, 220, 150, 110 kV	35, 20, 10, 6, 0.4 kV
How are losses added in use-of-system charge?	Transmission tariff covers electricity purchases to cover transmission losses. Distribution losses considered in revenue requirements of the DSO	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	TSO	DSO
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability	✓	✓
Simplicity		
Equity		
Allocative efficiency		
Avoid cross-subsidies		
Security of supply	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	x
Drivers for separating charges into consumer categories		
Other	-	-
3-phase versus 1-phase connection	-	-

Type of customer	-	-
Voltage level of connection	-	-
Distance from grid	-	-
Capacity requirement	-	-
Number of customer categories	1	1
Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Deep	Deep
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	Customer	Customer
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	✓	x
Time limit	<1 year	-
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	✓
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		
Based on actual cost		✓
Other	✓	

A4.2 Algeria

Variable	Response	
Regulator details		
Name of regulatory Authority:	Commission de Régulation de l'électricité et du gaz "CREG"	
General		
Number of TSOs	1	
Number of DSOs	1	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Embedded in the end-user tariff	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government	✓	✓
Regulator	✓	✓
Guiding principles for tariff design		
Other		✓
Equity	✓	✓
Simplicity		-
Affordability		-
Security of supply		-
Allocative efficiency		-
Avoid cross-subsidies		✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	LRMC	LRMC
Regulation specifies frequency of tariff design review?	✓	✓
Frequency	Other (>1 year)	Other (>1 year)
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	-
Drivers for separating charges into consumer categories		
Other	-	-
Cost of supply	-	-
Billing and metering	-	-

Type of customer	-	-
Demand profile	-	-
Zone	-	-
Voltage level of connection	-	-
Number of customer categories	1	-
Type of meter installed for majority of customers connected to:	**Low Voltage**	-
	Medium Voltage	-
	High Voltage	-
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	-
Share Load	100	-
Share Generator	0	-
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	-
Period over which it is applied	-	-
Energy charge?	✓	-
Flat?	✓	-
Time-of-use?	x	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Demand charge?	x	-
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	-
Access charge?	x	-
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	x	-
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	-
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in tariff	Included in tariff
Voltage levels operated	400, 220, 60 kV	30, 10, 5.5, 0.42, 0.23 kV
How are losses added in use-of-system charge?	Monetary amount for losses summed with other charges and divided by quantiles to obtain single variable T tariff by kWh	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Government	Government
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability		
Simplicity		
Equity	✓	✓
Allocative efficiency	✓	✓
Avoid cross-subsidies		
Security of supply		✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery		✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
3-phase versus 1-phase connection		✓
Type of customer		✓
Voltage level of connection	✓	✓
Distance from grid	✓	✓
Capacity requirement	✓	✓
Number of customer categories	2	3

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Mix	Mix
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	Customer	Customer
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	Amortised over time	Amortised over time
Cost sharing:		
Same for all categories?	✓	x
Cost sharing?	✓	✓
Time limit	>10 years	>10 years
Outliers:	x	✓
Cost sharing?	-	✓
Time limit	-	1-5 years
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	✓
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		✓
Based on actual cost	✓	
Other		

A4.3 Armenia

Variable	Response	
Regulator details		
Name of regulatory Authority:	Public Services Regulatory Commission of RA	
General		
Number of TSOs	1	
Number of DSOs	1	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other	✓	
Equity	✓	✓
Simplicity	✓	✓
Affordability	✓	
Security of supply	✓	✓
Allocative efficiency		✓
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	
Transparency	✓	
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Embedded	LRMC
Regulation specifies frequency of tariff design review?	✓	✓
Frequency	<2 years	<2 years
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	
Cost of supply	-	
Billing and metering	-	

Type of customer	-	
Demand profile	-	
Zone	-	
Voltage level of connection	-	✓
Number of customer categories	1	4
Type of meter installed for majority of customers connected to:	**Low Voltage**	Smart
	Medium Voltage	Smart
	High Voltage	Smart
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	x
Period over which it is applied	-	-
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Demand charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	-
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	220kV and above	110 kV and below
How are losses added in use-of-system charge?	T and D losses included in tariffs as cost of purchased electricity	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability		✓
Simplicity		✓
Equity		✓
Allocative efficiency		✓
Avoid cross-subsidies		
Security of supply		
Cost-reflectivity	✓	✓
Transparency		✓
Cost recovery		✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	
3-phase versus 1-phase connection	-	
Type of customer	-	✓
Voltage level of connection	-	✓
Distance from grid	-	
Capacity requirement	-	
Number of customer categories	1	5

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Deep	Deep
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	x	✓
Who pays for maintenance	Customer	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	x	x
Time limit	-	-
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		✓
Based on actual cost	✓	
Other		

A4.4 Austria

Variable	Response	
Regulator details		
Name of regulatory Authority:	E-Control	
General		
Number of TSOs	2	
Number of DSOs	>3	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government	✓	
Regulator		✓
Guiding principles for tariff design		
Other		
Equity		
Simplicity	✓	✓
Affordability		
Security of supply		
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Embedded	Embedded
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
Cost of supply		
Billing and metering		

Type of customer		
Demand profile	✓	✓
Zone	✓	✓
Voltage level of connection	✓	✓
Number of customer categories		
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electromechanical
	Medium Voltage	Electronic
	High Voltage	Electronic
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Zonal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	96	90
Share Generator	4	10
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	✓
Period over which it is applied	-	Per year
Energy charge?	✓	✓
Flat?	✓	x
Time-of-use?	x	✓
Periods on which rates differ		
Between days	-	
Between seasons	-	✓
Within day	-	✓
Demand charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	kW	kW
Access charge?	x	✓
Expressed in KW or KVA?	-	kW
For contracted or supplied capacity?	-	Contracted
Reactive power charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	✓	✓
Min power factor	90%	90%
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	✓
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Recovered through factor losses	Recovered through factor losses
Voltage levels operated	Ultra HV (380, 220 kV) and transformation from ultra HV to HV	HV, MV and LV
How are losses added in use-of-system charge?	Losses covered in a separate "grid loss charge" expressed in terms of kWh.	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability		
Simplicity	✓	✓
Equity		
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Security of supply		
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
3-phase versus 1-phase connection		
Type of customer		
Voltage level of connection	✓	✓
Distance from grid	✓	
Capacity requirement	✓	✓

Number of customer categories	2	5
Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Shallow	Shallow
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	TSO	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	✓	x
Time limit	1-5 years	-
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		✓
Based on actual cost	✓	
Other		

A4.5 Bosnia and Hercegovina (SERC)

Variable	Response	
Regulator details		
Name of regulatory Authority:	State Electricity Regulatory Commission	
General		
Number of TSOs	1	
Number of DSOs	>3	
Vertical integration of transmission and distribution	Intermediate	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity	✓	✓
Simplicity	✓	✓
Affordability	✓	✓
Security of supply	✓	✓
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Embedded	Embedded
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
Cost of supply		✓
Billing and metering		✓

Type of customer	✓	
Demand profile		✓
Zone		
Voltage level of connection		✓
Number of customer categories	3	5
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electromechanical
	Medium Voltage	Smart
	High Voltage	Smart
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	90	100
Share Generator	10	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	x
Period over which it is applied	-	-
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	✓
Periods on which rates differ		
Between days	-	✓
Between seasons	-	✓
Within day	-	✓
Demand charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	✓
Periods on which rates differ		
Between days	-	
Between seasons	-	✓
Within day	-	
Expressed in KW or KVA?	kW	kW
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	x	✓
Flat?	-	✓
Time-of-use?	-	✓
Periods on which rates differ		
Between days	-	
Between seasons	-	✓
Within day	-	
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in tariff	Included in tariff
Voltage levels operated	110, 220, 400 kV	35, 10, 0.4 kV
How are losses added in use-of-system charge?	T Losses included in tariff for system service, D Losses included in use-of-system charge	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability	✓	✓
Simplicity	✓	✓
Equity	✓	✓
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Security of supply	✓	✓
Cost-reflectivity		
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	
3-phase versus 1-phase connection	-	✓
Type of customer	-	
Voltage level of connection	-	✓
Distance from grid	-	
Capacity requirement	-	✓
Number of customer categories	1	2

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Deep	Shallow
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	TSO	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	x	x
Time limit	-	-
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined	✓	✓
Based on actual cost		
Other		

A4.6 Croatia

Variable	Response	
Regulator details		
Name of regulatory Authority:	Croatian Energy Regulatory Agency	
General		
Number of TSOs	1	
Number of DSOs	1	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other	✓	✓
Equity		
Simplicity		
Affordability		
Security of supply		
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Expert judgement and embedded	Expert judgement and embedded
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
Cost of supply		
Billing and metering	✓	

Type of customer	✓	✓
Demand profile		✓
Zone		
Voltage level of connection	✓	✓
Number of customer categories	10	9
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electromechanical
	Medium Voltage	Smart
	High Voltage	Smart
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	✓	✓
Period over which it is applied	Per month	Per month
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	✓	✓
Periods on which rates differ		
Between days		
Between seasons		
Within day	✓	✓
Demand charge?	✓	✓
Flat?	✓	✓
Time-of-use?	✓	✓
Periods on which rates differ		
Between days		
Between seasons		
Within day	✓	✓
Expressed in KW or KVA?	kW	kW
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	400, 220, 110 kV	35, 30, 20, 10, 0.4 kV
How are losses added in use-of-system charge?	T and D losses are part of OPEX	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability		
Simplicity		
Equity		
Allocative efficiency		
Avoid cross-subsidies		✓
Security of supply		
Cost-reflectivity		
Transparency	✓	✓
Cost recovery		✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other	✓	✓
3-phase versus 1-phase connection		
Type of customer	✓	✓
Voltage level of connection		
Distance from grid		
Capacity requirement		
Number of customer categories	3	3

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Deep	Deep
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	TSO	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	✓	✓
Time limit	1-5 years	1-5 years
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined	✓	✓
Based on actual cost	✓	✓
Other		

A4.7 Czechia

Variable	Response	
Regulator details		
Name of regulatory Authority:	Energy Regulatory Office	
General		
Number of TSOs	1	
Number of DSOs	>3	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Embedded in network use-of-system charge	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	x	x
Entity responsible for developing regulations on tariff design methodology:		
Parliament	-	-
Government	-	-
Regulator	-	-
Guiding principles for tariff design		
Other	-	-
Equity	-	-
Simplicity	-	-
Affordability	-	-
Security of supply	-	-
Allocative efficiency	-	-
Avoid cross-subsidies	-	-
Cost-reflectivity	-	-
Transparency	-	-
Cost recovery	-	-
Approach for setting cost-reflective tariff designs	Embedded	Embedded
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	✓
Cost of supply	-	
Billing and metering	-	

Type of customer	-	
Demand profile	-	✓
Zone	-	
Voltage level of connection	-	✓
Number of customer categories	1	30
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electronic
	Medium Voltage	Smart
	High Voltage	Smart
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	✓
Period over which it is applied	-	Per month
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	✓
Periods on which rates differ		
Between days	-	✓
Between seasons	-	
Within day	-	✓
Demand charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	-
Access charge?	✓	✓
Expressed in KW or KVA?	kW	kW
For contracted or supplied capacity?	Contracted	Contracted
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	✓
Min power factor	-	95%
Special tariff designs		
	Transmission	**Distribution**
Other	✓	✓

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	✓
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	400, 220, 110 kV	110, 35, 25, 22, 10, 6, 3, 1.5, 0.4 kV
How are losses added in use-of-system charge?	T losses recovered through the energy charge. D losses added through the energy charge (directly through price for using distribution system operators' networks over 1 kV or indirectly as a part of charge for the electricity quantity distributed on LV).	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	x	x
Entity responsible for developing regulations on tariff design methodology:		
Parliament	-	-
Government	-	-
Regulator	-	-
Guiding principles for tariff design		
Other	-	-
Affordability	-	-
Simplicity	-	-
Equity	-	-
Allocative efficiency	-	-
Avoid cross-subsidies	-	-
Security of supply	-	-
Cost-reflectivity	-	-
Transparency	-	-
Cost recovery	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		✓
3-phase versus 1-phase connection		✓
Type of customer	✓	
Voltage level of connection		✓
Distance from grid		✓
Capacity requirement		

Number of customer categories	2	12
Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Shallow	Shallow
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	TSO	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	x	x
Time limit	-	-
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined	✓	✓
Based on actual cost		
Other		

A4.8 Estonia

Variable	Response	
Regulator details		
Name of regulatory Authority:	Estonian Competition Authority	
General		
Number of TSOs	1	
Number of DSOs	>3	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	TSO	DSO
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity		
Simplicity		
Affordability		
Security of supply	✓	✓
Allocative efficiency		
Avoid cross-subsidies	✓	✓
Cost-reflectivity		
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Embedded	Embedded
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
Cost of supply		
Billing and metering		

Type of customer		
Demand profile	✓	✓
Zone		
Voltage level of connection	✓	✓
Number of customer categories	3	10
Type of meter installed for majority of customers connected to:	**Low Voltage**	Smart
	Medium Voltage	Smart
	High Voltage	Smart
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	✓
Share Load	100	96
Share Generator	0	6
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	✓
Period over which it is applied	-	Per month
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	✓	✓
Periods on which rates differ		
Between days	-	✓
Between seasons	✓	✓
Within day	✓	✓
Demand charge?	x	✓
Flat?	-	✓
Time-of-use?	-	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	
Access charge?	x	✓
Expressed in KW or KVA?	-	kW
For contracted or supplied capacity?	-	Contracted
Reactive power charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	330, 110 kV	35-6, 0.4-0.22 kV
How are losses added in use-of-system charge?	Network charges only cover technical losses, not electricity theft	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	TSO	DSO
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability		
Simplicity		
Equity		
Allocative efficiency		
Avoid cross-subsidies	✓	✓
Security of supply	✓	✓
Cost-reflectivity		
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	
3-phase versus 1-phase connection	-	
Type of customer	-	✓
Voltage level of connection	-	✓
Distance from grid	-	✓
Capacity requirement	-	
Number of customer categories	1	3

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Deep	Mix
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	TSO	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	x
Cost sharing?	✓	✓
Time limit	No time limit	No time limit
Outliers:	x	✓
Cost sharing?	-	x
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		✓
Based on actual cost	✓	✓
Other		

A4.9 Georgia

Variable	Response	
Regulator details		
Name of regulatory Authority:	Georgian National Energy and Water Supply Regulatory Commission	
General		
Number of TSOs	1	
Number of DSOs	2	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament	✓	✓
Government		
Regulator		
Guiding principles for tariff design		
Other	✓	✓
Equity		
Simplicity		
Affordability		
Security of supply	✓	✓
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Embedded	Embedded
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	✓
Cost of supply	-	
Billing and metering	-	

Type of customer	-	
Demand profile	-	✓
Zone	-	
Voltage level of connection	-	✓
Number of customer categories	3	10
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electromechanical
	Medium Voltage	Electromechanical
	High Voltage	Electronic
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	x
Period over which it is applied	-	-
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Demand charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	-
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	500, 400, 330, 220kV	110, 35, 10, 6, 3.3, 0.4, 0.38-0.22kV
How are losses added in use-of-system charge?	For T and D losses regulator sets a percentage of allowed losses and includes purchases of those in the tariff	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability		
Simplicity		
Equity		
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Security of supply	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
3-phase versus 1-phase connection		✓
Type of customer		
Voltage level of connection	✓	✓
Distance from grid	✓	
Capacity requirement	✓	✓

Number of customer categories	2	6
Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Shallow	Mix
Payment for connection asset:		
Same for all categories?	✓	x
Customer pays for line?	x	✓
Ownership transferred to system operator?	-	x
Who pays for maintenance	Customer	Customer
Outliers:	?	✓
Customer pays for line?	?	x
Ownership transferred to system operator?	?	-
Who pays for maintenance	?	DSO
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	x	x
Time limit	-	-
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined	✓	✓
Based on actual cost		
Other		

A4.10 Hungary

Variable	Response	
Regulator details		
Name of regulatory Authority:	MEKH	
General		
Number of TSOs	1	
Number of DSOs	>3	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity		
Simplicity		
Affordability		✓
Security of supply	✓	✓
Allocative efficiency		
Avoid cross-subsidies	✓	
Cost-reflectivity	✓	
Transparency	✓	
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Expert judgement	Expert judgement
Regulation specifies frequency of tariff design review?	✓	✓
Frequency	4 years	4 years
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
Cost of supply		
Billing and metering		✓

Type of customer		
Demand profile		
Zone		
Voltage level of connection	✓	✓
Number of customer categories	3	8
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electromechanical
	Medium Voltage	Electronic
	High Voltage	Electronic
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	✓
Period over which it is applied	-	Per year
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Demand charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	-
Access charge?	✓	✓
Expressed in KW or KVA?	kW	kW
For contracted or supplied capacity?	Contracted	Contracted
Reactive power charge?	x	✓
Flat?	-	✓
Time-of-use?	-	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	✓
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in tariff	Included in tariff
Voltage levels operated	750, 400, 220, 132 kV	132, 32, 20, 10, 0.4 kV
How are losses added in use-of-system charge?	T losses calculated through a recognised quantity for the year and a factor representing inaccuracy of balance. For D losses the cost base of DSOs includes their cost of network losses. There is also an ex post review of the recognised unit price in period t+1 applied. Depending on the result of the review, a post-correction is made on the unit price and the difference is added to the cost base of year t+2.	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability		✓
Simplicity		✓
Equity		
Allocative efficiency		
Avoid cross-subsidies		
Security of supply		
Cost-reflectivity	✓	✓
Transparency		
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	
3-phase versus 1-phase connection	-	
Type of customer	-	
Voltage level of connection	-	✓
Distance from grid	-	

Capacity requirement	-	
Number of customer categories	1	5
Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Deep	Mix
Payment for connection asset:		
Same for all categories?	✓	x
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	TSO	DSO
Outliers:	x	✓
Customer pays for line?	-	x
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	DSO
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	✓	✓
Time limit	1-5 years	1-5 years
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		✓
Based on actual cost	✓	✓
Other		

A4.11 Kosovo*

Variable	Response	
Regulator details		
Name of regulatory Authority:	Energy Regulatory Office	
General		
Number of TSOs	1	
Number of DSOs	1	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	TSO	DSO
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity	✓	✓
Simplicity	✓	✓
Affordability	✓	✓
Security of supply	✓	✓
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Embedded	Embedded
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
Cost of supply	✓	✓
Billing and metering		

Type of customer		
Demand profile	✓	✓
Zone		
Voltage level of connection	✓	✓
Number of customer categories	5	3
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electronic
	Medium Voltage	Smart
	High Voltage	Smart
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	x
Period over which it is applied	-	-
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Demand charge?	✓	x
Flat?	✓	-
Time-of-use?	x	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	kW	-
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	400, 220, 110 kV	35, 10, 0.4 kV
How are losses added in use-of-system charge?	A particular level of allowed losses is included into the TSO and DSO tariffs	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	TSO	DSO
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability	✓	✓
Simplicity	✓	✓
Equity	✓	✓
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Security of supply	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
3-phase versus 1-phase connection	✓	✓
Type of customer	✓	✓
Voltage level of connection	✓	✓
Distance from grid	✓	✓
Capacity requirement	✓	✓
Number of customer categories	2	3

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Mix	Mix
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	x
Who pays for maintenance	TSO	Customer
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	x	x
Time limit	-	-
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		✓
Based on actual cost	✓	
Other		

A4.12 Latvia

Variable	Response	
Regulator details		
Name of regulatory Authority:	Public Utilities Commission of Latvia	
General		
Number of TSOs	1	
Number of DSOs	>3	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	DSO
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament	✓	✓
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity	✓	✓
Simplicity	✓	✓
Affordability		
Security of supply		
Allocative efficiency		
Avoid cross-subsidies	✓	
Cost-reflectivity	✓	
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Other	Expert judgement
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		✓
Cost of supply		✓
Billing and metering		

Type of customer		
Demand profile		✓
Zone		
Voltage level of connection	✓	✓
Number of customer categories	4	12
Type of meter installed for majority of customers connected to:	**Low Voltage**	Smart
	Medium Voltage	Smart
	High Voltage	Smart
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	96	100
Share Generator	4	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	✓	✓
Period over which it is applied	Per year	Per year
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	✓
Periods on which rates differ		
Between days	-	✓
Between seasons	-	
Within day	-	✓
Demand charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	-
Access charge?	✓	✓
Expressed in KW or KVA?	kW	kW
For contracted or supplied capacity?	Supplied	Contracted
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	✓	✓
Min power factor	99%	99%
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	330,110 kV	20/6, 0.4 kV
How are losses added in use-of-system charge?	According to estimated amount of losses at each voltage level	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Government	Government
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament	✓	✓
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability		
Simplicity	✓	✓
Equity	✓	✓
Allocative efficiency		
Avoid cross-subsidies	✓	
Security of supply		
Cost-reflectivity		
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	✓
3-phase versus 1-phase connection	-	✓
Type of customer	-	
Voltage level of connection	-	✓
Distance from grid	-	
Capacity requirement	-	
Number of customer categories	1	2

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Deep	Mix
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	TSO	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	x
Cost sharing?	x	✓
Time limit	-	No time limit
Outliers:	x	✓
Cost sharing?	-	x
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	✓
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		✓
Based on actual cost	✓	✓
Other		

A4.13 Lithuania

Variable	Response	
Regulator details		
Name of regulatory Authority:	National Energy Regulatory Council (NERC)	
General		
Number of TSOs	1	
Number of DSOs	>3	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	TSO	DSO
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity		
Simplicity		
Affordability		
Security of supply		
Allocative efficiency	✓	✓
Avoid cross-subsidies		
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	LRMC	LRMC
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
Cost of supply		
Billing and metering		

Type of customer		✓
Demand profile		✓
Zone		
Voltage level of connection	✓	✓
Number of customer categories	2	3
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electronic
	Medium Voltage	Electronic
	High Voltage	Smart
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	✓
Period over which it is applied	-	Per month
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	✓
Periods on which rates differ		
Between days	-	✓
Between seasons	-	
Within day	-	✓
Demand charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	-
Access charge?	✓	✓
Expressed in KW or KVA?	kW	kW
For contracted or supplied capacity?	Contracted	Contracted
Reactive power charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	✓
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	330-110 kV, 35-6 kV	35-6 kV, 10-0.4 kV
How are losses added in use-of-system charge?	T and D losses multiplied by market price and this is added to price cap as basic costs	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Government	Government
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government	✓	✓
Regulator	✓	✓
Guiding principles for tariff design		
Other	✓	✓
Affordability		
Simplicity		
Equity		
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Security of supply	✓	✓
Cost-reflectivity		✓
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	
3-phase versus 1-phase connection	-	
Type of customer	-	✓
Voltage level of connection	-	✓
Distance from grid	-	
Capacity requirement	-	✓
Number of customer categories	1	5

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Deep	Deep
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	TSO	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	✓	✓
Time limit	1-5 years	1-5 years
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		✓
Based on actual cost	✓	✓
Other		

A4.14 Moldova

Variable	Response	
Regulator details		
Name of regulatory Authority:	The National Agency for Energy Regulation of the Republic of Moldova (ANRE)	
General		
Number of TSOs	1	
Number of DSOs	2	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity	✓	✓
Simplicity		
Affordability		
Security of supply	✓	✓
Allocative efficiency		
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Embedded	Embedded
Regulation specifies frequency of tariff design review?	✓	✓
Frequency	5 years	5 years
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	
Cost of supply	-	

Billing and metering	-	
Type of customer	-	
Demand profile	-	
Zone	-	
Voltage level of connection	-	✓
Number of customer categories	1	3
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electronic
	Medium Voltage	Electronic
	High Voltage	Electronic
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	x
Period over which it is applied	-	-
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Demand charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	-
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**

Other	-	-
Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	400, 330, 110, 35 kV	110, 35, 10, 0.4 kV
How are losses added in use-of-system charge?	T and D losses considered within the calculation of transport and distribution tariffs by TSO and DSO respectively	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability		
Simplicity		
Equity	✓	✓
Allocative efficiency		
Avoid cross-subsidies	✓	✓
Security of supply	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	x
Drivers for separating charges into consumer categories		
Other	-	-
3-phase versus 1-phase connection	-	-
Type of customer	-	-
Voltage level of connection	-	-
Distance from grid	-	-
Capacity requirement	-	-

Number of customer categories	1	1
Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Shallow	Shallow
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	x	x
Who pays for maintenance	Customer	Customer
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	x	x
Time limit	-	-
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	✓
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		
Based on actual cost	✓	✓
Other		

A4.15 Mongolia

Variable	Response	
Regulator details		
Name of regulatory Authority:	Energy Regulatory Commission of Mongolia	
General		
Number of TSOs	1	
Number of DSOs	>3	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity	✓	✓
Simplicity	✓	✓
Affordability	✓	✓
Security of supply	✓	✓
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Embedded	Embedded
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	
Cost of supply	-	✓
Billing and metering	-	✓

Type of customer	-	
Demand profile	-	✓
Zone	-	✓
Voltage level of connection	-	✓
Number of customer categories	1	7
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electronic & Electromechanical
	Medium Voltage	Electronic
	High Voltage	Electronic
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	✓	✓
Period over which it is applied	Per month	Per month
Energy charge?	x	✓
Flat?	-	✓
Time-of-use?	-	✓
Periods on which rates differ		
Between days	-	
Between seasons	-	✓
Within day	-	✓
Demand charge?	x	✓
Flat?	-	x
Time-of-use?	-	✓
Periods on which rates differ		
Between days	-	
Between seasons	-	
Within day	-	✓
Expressed in KW or KVA?	-	kW
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	-	Included in the tariff
Voltage levels operated	110-220 kV	35-0.4 kV
How are losses added in use-of-system charge?	D losses approved on an annual basis	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	TSO	Regulator
Entity responsible for developing the tariff design	TSO	DSO
Regulation defines method?	✓	x
Entity responsible for developing regulations on tariff design methodology:		
Parliament		-
Government		-
Regulator	✓	-
Guiding principles for tariff design		
Other	?	-
Affordability	?	-
Simplicity	?	-
Equity	?	-
Allocative efficiency	?	-
Avoid cross-subsidies	?	-
Security of supply	?	-
Cost-reflectivity	?	-
Transparency	?	-
Cost recovery	?	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	x
Drivers for separating charges into consumer categories		
Other	-	-
3-phase versus 1-phase connection	-	-
Type of customer	-	-
Voltage level of connection	-	-
Distance from grid	-	-
Capacity requirement	-	-
Number of customer categories	1	1

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Shallow	Shallow
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	TSO	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	?	?
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	x	x
Time limit		
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		
Based on actual cost	✓	✓
Other		

A4.16 Nigeria

Variable	Response	
Regulator details		
Name of regulatory Authority:	Nigerian Electricity Regulatory Commission	
General		
Number of TSOs	1	
Number of DSOs	>3	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	DSO
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity	✓	
Simplicity	✓	✓
Affordability	✓	
Security of supply	✓	
Allocative efficiency	✓	
Avoid cross-subsidies		
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	LRMC	LRMC
Regulation specifies frequency of tariff design review?	✓	✓
Frequency	5 years	5 years
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
Cost of supply		
Billing and metering	✓	✓

Type of customer		
Demand profile		
Zone	✓	✓
Voltage level of connection	✓	✓
Number of customer categories	3	13
Type of meter installed for majority of customers connected to:	**Low Voltage**	?
	Medium Voltage	Electronic
	High Voltage	Electronic
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	x
Period over which it is applied	-	-
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Demand charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	-
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Recovered through loss factors	Included in the tariff
Voltage levels operated	132, 330 kV	33, 11, 0.4kV
How are losses added in use-of-system charge?	D losses by discounting the energy used to derive average tariffs	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	TSO	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator		✓
TSO/DSO	✓	
Guiding principles for tariff design		
Other		
Affordability		
Simplicity	✓	✓
Equity		
Allocative efficiency	✓	
Avoid cross-subsidies		
Security of supply		
Cost-reflectivity	✓	
Transparency	✓	
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
3-phase versus 1-phase connection		✓
Type of customer		
Voltage level of connection	✓	✓
Distance from grid	✓	✓
Capacity requirement	✓	

Number of customer categories	2	4
Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Mix	Shallow
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	x
Who pays for maintenance	TSO	Customer
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	x	x
Time limit	-	-
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		
Based on actual cost	✓	✓
Other		

A4.17 North Macedonia

Variable	Response	
Regulator details		
Name of regulatory Authority:	ENERGY AND WATER SERVICES REGULATORY COMMISSION	
General		
Number of TSOs	1	
Number of DSOs	2	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?		
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity	✓	✓
Simplicity		
Affordability	✓	✓
Security of supply	✓	✓
Allocative efficiency		
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Embedded	Embedded
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	
Cost of supply	-	
Billing and metering	-	

Type of customer	-	
Demand profile	-	
Zone	-	
Voltage level of connection	-	✓
Number of customer categories	1	5
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electronic
	Medium Voltage	Electronic
	High Voltage	Electronic
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	x
Period over which it is applied	-	-
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Demand charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	kW	kW
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs		-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	110 kV	110, 35, 20, 10, 6, 0.4 kV
How are losses added in use-of-system charge?	T and D losses one of the components used in determining maximum revenue	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	TSO	DSO
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
TSO/DSO	✓	✓
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability	✓	✓
Simplicity		
Equity		
Allocative efficiency		
Avoid cross-subsidies	✓	✓
Security of supply	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	X	✓
Drivers for separating charges into consumer categories		
Other	-	
3-phase versus 1-phase connection	-	
Type of customer	-	
Voltage level of connection	-	✓
Distance from grid	-	
Capacity requirement	-	✓
Number of customer categories	1	2

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Deep	Mix
Payment for connection asset:		
Same for all categories?	✓	x
Customer pays for line?	✓	x
Ownership transferred to system operator?	x	-
Who pays for maintenance	Customer	DSO
Outliers:	x	✓
Customer pays for line?	-	✓
Ownership transferred to system operator?	-	x
Who pays for maintenance	-	Customer
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	x	✓
Time limit	-	No time limit
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		
Based on actual cost	✓	✓
Other		✓

A4.18 Oman

Variable	Response	
Regulator details		
Name of regulatory Authority:	Authority for Public Services Regulations	
General		
Number of TSOs	1	
Number of DSOs	>3	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government	✓	✓
Regulator		
Guiding principles for tariff design		
Other		
Equity	✓	
Simplicity	✓	✓
Affordability	✓	✓
Security of supply	✓	
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	LRMC	Embedded
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
Cost of supply		
Billing and metering	✓	✓

Type of customer		✓
Demand profile	✓	
Zone		
Voltage level of connection	✓	✓
Number of customer categories	4	12
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electronic
	Medium Voltage	Electronic
	High Voltage	Electronic
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	✓	x
Period over which it is applied	Per year	-
Energy charge?	✓	✓
Flat?	x	✓
Time-of-use?	✓	✓
Periods on which rates differ		
Between days	✓	
Between seasons	✓	✓
Within day	✓	
Demand charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days		-
Between seasons		-
Within day		-
Expressed in KW or KVA?	kW	kW
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Recovered through loss factors	Recovered through loss factors
Voltage levels operated	132 kV	33, 11, 0.415 kV
How are losses added in use-of-system charge?	T losses calculated in setting annual charges, D losses added through metering	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government	✓	✓
Regulator		
Guiding principles for tariff design		
Other		
Affordability		✓
Simplicity	✓	
Equity		
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Security of supply	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
3-phase versus 1-phase connection		
Type of customer		
Voltage level of connection	✓	✓
Distance from grid	✓	
Capacity requirement		
Number of customer categories	1	3

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Shallow	Shallow
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	x
Ownership transferred to system operator?	✓	-
Who pays for maintenance	Customer	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	Mix	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	x	x
Time limit	-	-
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		
Based on actual cost	✓	✓
Other		

A4.19 Pakistan

Variable	Response	
Regulator details		
Name of regulatory Authority:	National Electric Power Regulatory Authority	
General		
Number of TSOs	3	
Number of DSOs	>3	
Vertical integration of transmission and distribution	Intermediate	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity	✓	
Simplicity		
Affordability		✓
Security of supply		
Allocative efficiency		✓
Avoid cross-subsidies		
Cost-reflectivity	✓	✓
Transparency		✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Other	Expert judgement
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	
Cost of supply	-	✓
Billing and metering	-	

Type of customer	-	
Demand profile	-	✓
Zone	-	
Voltage level of connection	-	✓
Number of customer categories	1	8
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electromechanical
	Medium Voltage	Electromechanical
	High Voltage	Smart
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	x
Period over which it is applied	-	-
Energy charge?	x	✓
Flat?	-	✓
Time-of-use?	-	✓
Periods on which rates differ		
Between days	-	
Between seasons	-	✓
Within day	-	✓
Demand charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	kW	kW
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	✓
Min power factor	-	90%
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	660, 500, 220, 132 kV	132, 11, 0.44, 0.22 kV
How are losses added in use-of-system charge?	T losses beyond the allowed threshold are borne by the TSO, for D losses the rate Rs./kWh is adjusted	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	-	Regulator
Entity responsible for developing the tariff design	-	Regulator
Regulation defines method?	-	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament	-	
Government	-	
Regulator	-	✓
Guiding principles for tariff design		
Other	-	
Affordability	-	
Simplicity	-	
Equity	-	✓
Allocative efficiency	-	
Avoid cross-subsidies	-	
Security of supply	-	
Cost-reflectivity	-	✓
Transparency	-	
Cost recovery	-	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	-	✓
Drivers for separating charges into consumer categories		
Other	-	
3-phase versus 1-phase connection	-	✓
Type of customer	-	✓
Voltage level of connection	-	✓
Distance from grid	-	✓
Capacity requirement	-	✓
Number of customer categories	-	9

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	-	?
Payment for connection asset:		
Same for all categories?	-	✓
Customer pays for line?	-	✓
Ownership transferred to system operator?	-	✓
Who pays for maintenance	-	DSO
Outliers:	-	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	-	One payment and amortised over time
Cost sharing:		
Same for all categories?	-	?
Cost sharing?	-	?
Time limit	-	?
Outliers:	-	?
Cost sharing?	-	?
Time limit	-	?
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	-	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined	-	
Based on actual cost	-	✓
Other	-	

A4.20 Peru

Variable	Response	
Regulator details		
Name of regulatory Authority:	?	
General		
Number of TSOs	1	
Number of DSOs	1	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Government
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government	✓	
Regulator		✓
Guiding principles for tariff design		
Other		
Equity		
Simplicity		
Affordability		
Security of supply		
Allocative efficiency		
Avoid cross-subsidies		
Cost-reflectivity		
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Other	LRMC
Regulation specifies frequency of tariff design review?	✓	✓
Frequency	4 years	4 years
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
Cost of supply		
Billing and metering		

Type of customer		
Demand profile		✓
Zone	✓	✓
Voltage level of connection	✓	✓
Number of customer categories	2	2
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electromechanical
	Medium Voltage	Electromechanical
	High Voltage	Electromechanical
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Zonal	Zonal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	x
Share Load	50	90
Share Generator	50	10
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	✓
Period over which it is applied	-	Per month
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	✓
Periods on which rates differ		
Between days	-	
Between seasons	-	
Within day	-	✓
Demand charge?	✓	✓
Flat?	✓	x
Time-of-use?	x	✓
Periods on which rates differ		
Between days	-	
Between seasons	-	
Within day	-	✓
Expressed in KW or KVA?	kW	kW
Access charge?	x	✓
Expressed in KW or KVA?	-	kW
For contracted or supplied capacity?	-	Contracted
Reactive power charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Recovered through loss factors	Included in the tariff
Voltage levels operated	500, 220, 138 kV	22.9, 10, 0.22 kV
How are losses added in use-of-system charge?	T losses incorporated through marginal loss factor. D losses of 5% consumption included in final user rate	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability		
Simplicity		
Equity		
Allocative efficiency		
Avoid cross-subsidies		
Security of supply		
Cost-reflectivity		
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
3-phase versus 1-phase connection		✓
Type of customer		
Voltage level of connection	✓	✓
Distance from grid	✓	
Capacity requirement	✓	✓
Number of customer categories	2	4

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Deep	Deep
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	x	✓
Who pays for maintenance	Customer	Customer
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	Amortised over time	Amortised over time
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	✓	✓
Time limit	>10 years	>10 years
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	✓
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		✓
Based on actual cost	✓	
Other		

A4.21 Poland

Variable	Response	
Regulator details		
Name of regulatory Authority:	Energy Regulatory Office	
General		
Number of TSOs	1	
Number of DSOs	>3	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament	✓	✓
Government	✓	✓
Regulator		✓
Guiding principles for tariff design		
Other	✓	✓
Equity	✓	✓
Simplicity		
Affordability	✓	✓
Security of supply	✓	✓
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	✓
Transparency		
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Embedded	Embedded
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other	✓	
Cost of supply		✓
Billing and metering		✓

Type of customer		✓
Demand profile		✓
Zone		✓
Voltage level of connection		✓
Number of customer categories	2	12
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electronic
	Medium Voltage	Smart
	High Voltage	Smart
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	✓
Period over which it is applied	-	Per month
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	✓
Periods on which rates differ		
Between days	-	
Between seasons	-	✓
Within day	-	✓
Demand charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	kW	kW
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	✓	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	✓
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	750, 450, 400, 220, 110 kV	110-0.4 kV
How are losses added in use-of-system charge?	T and D losses are used to calculate a component of network and distribution fees	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Other	Government
Entity responsible for developing the tariff design	Other	Government
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament	✓	✓
Government		✓
Regulator		
Guiding principles for tariff design		
Other		
Affordability	✓	✓
Simplicity	✓	
Equity	✓	✓
Allocative efficiency	✓	✓
Avoid cross-subsidies		
Security of supply	✓	✓
Cost-reflectivity	✓	✓
Transparency		
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other	✓	
3-phase versus 1-phase connection		
Type of customer	✓	✓
Voltage level of connection		✓
Distance from grid		✓
Capacity requirement		✓
Number of customer categories	7	5

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Shallow	Shallow
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	x
Ownership transferred to system operator?	✓	-
Who pays for maintenance	TSO	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	x
Cost sharing?	x	✓
Time limit	-	No time limit
Outliers:	x	✓
Cost sharing?	-	x
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		✓
Based on actual cost	✓	✓
Other		

A4.22 Slovakia

Variable	Response	
Regulator details		
Name of regulatory Authority:	Regulatory Office of Network Industries	
General		
Number of TSOs	1	
Number of DSOs	3	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity	✓	
Simplicity		✓
Affordability		✓
Security of supply		✓
Allocative efficiency		✓
Avoid cross-subsidies		
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Embedded	Expert judgement
Regulation specifies frequency of tariff design review?	✓	✓
Frequency	5 years	5 years
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	
Cost of supply	-	
Billing and metering	-	

Type of customer	-	
Demand profile	-	✓
Zone	-	
Voltage level of connection	-	✓
Number of customer categories	1	33
Type of meter installed for majority of customers connected to:	**Low Voltage**	Smart
	Medium Voltage	Smart
	High Voltage	Electronic
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	90	92
Share Generator	10	8
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	✓
Period over which it is applied	-	Per month
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	✓
Periods on which rates differ		
Between days	-	
Between seasons	-	
Within day	-	✓
Demand charge?	x	✓
Flat?	-	x
Time-of-use?	-	✓
Periods on which rates differ		
Between days	-	
Between seasons	-	
Within day	-	✓
Expressed in KW or KVA?	-	?
Access charge?	✓	✓
Expressed in KW or KVA?	kW	kW
For contracted or supplied capacity?	Contracted	Contracted
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	✓	✓
Min power factor	95%	95%
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	✓
Self-generators	-	-
EVs	-	✓
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	400, 220 kV	110, 22, 6, 0.4 kV
How are losses added in use-of-system charge?	T and D losses included as use-of-system charge; second energy use tariff charged per kWh of consumption	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability		✓
Simplicity		✓
Equity	✓	✓
Allocative efficiency		✓
Avoid cross-subsidies		
Security of supply		
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
3-phase versus 1-phase connection		✓
Type of customer	✓	✓
Voltage level of connection		✓
Distance from grid	✓	
Capacity requirement	✓	
Number of customer categories	2	10

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Deep	Mix
Payment for connection asset:		
Same for all categories?	x	x
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	TSO	DSO
Outliers:	✓	✓
Customer pays for line?	✓	x
Ownership transferred to system operator?	x	-
Who pays for maintenance	Customer	DSO
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	x	?
Cost sharing?	✓	x
Time limit	No time limit	-
Outliers:	✓	?
Cost sharing?	x	?
Time limit	-	?
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	✓
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		✓
Based on actual cost	✓	
Other		

A4.23 Thailand

Variable	Response	
Regulator details		
Name of regulatory Authority:	Energy Regulatory Emission (ERC)	
General		
Number of TSOs	1	
Number of DSOs	2	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Embedded in the end-user tariff	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	TSO	DSO
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity	✓	✓
Simplicity		
Affordability	✓	✓
Security of supply	✓	✓
Allocative efficiency		
Avoid cross-subsidies		
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Embedded	Expert judgement
Regulation specifies frequency of tariff design review?	✓	✓
Frequency	5 years	5 years
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
Cost of supply	✓	✓
Billing and metering		✓

Type of customer		
Demand profile		✓
Zone		
Voltage level of connection	✓	✓
Number of customer categories	4	9
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electromechanical
	Medium Voltage	Electronic
	High Voltage	Electronic
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	x
Period over which it is applied	-	-
Energy charge?	✓	✓
Flat?	x	✓
Time-of-use?	✓	✓
Periods on which rates differ		
Between days	-	✓
Between seasons	-	
Within day	✓	✓
Demand charge?	x	✓
Flat?	-	x
Time-of-use?	-	✓
Periods on which rates differ		
Between days	-	✓
Between seasons	-	
Within day	-	✓
Expressed in KW or KVA?	-	kW
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	✓	✓
Min power factor	87.5%	85%
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	✓
EVs	-	✓
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	230, 115-69, 33-11 kV	69, 33-22, 24-12, below 22 and below 12 kV
How are losses added in use-of-system charge?	Average losses for the previous 5 years are used in the tariff calculation for the next 5 years	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	TSO	DSO
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability	✓	✓
Simplicity		
Equity	✓	✓
Allocative efficiency	✓	✓
Avoid cross-subsidies		
Security of supply	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	✓
3-phase versus 1-phase connection	-	✓
Type of customer	-	
Voltage level of connection	-	✓
Distance from grid	-	
Capacity requirement	-	✓

Number of customer categories	-	9
Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	-	Shallow
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	x	✓
Ownership transferred to system operator?	-	✓
Who pays for maintenance	TSO	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	-	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	✓	x
Time limit	>10 years	-
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	✓
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		✓
Based on actual cost	✓	
Other		

A4.24 Turkiye

Variable	Response	
Regulator details		
Name of regulatory Authority:	EMRA	
General		
Number of TSOs	1	
Number of DSOs	>3	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity	✓	✓
Simplicity	✓	✓
Affordability	✓	✓
Security of supply		
Allocative efficiency		
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	Embedded	Embedded
Regulation specifies frequency of tariff design review?	✓	✓
Frequency	3 years	5 years
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other		
Cost of supply		
Billing and metering		

Type of customer		
Demand profile		✓
Zone	✓	
Voltage level of connection		✓
Number of customer categories	2	5
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electronic
	Medium Voltage	Electronic
	High Voltage	Smart
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Zonal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	x
Share Load	50	96
Share Generator	50	4
Types of charges		
	Transmission	**Distribution**
Fixed charge?	x	x
Period over which it is applied	-	-
Energy charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Demand charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	-
Access charge?	✓	✓
Expressed in KW or KVA?	kW	kW
For contracted or supplied capacity?	Contracted	Contracted
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	✓	✓
Min power factor	95% and 98%	99%
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	✓
Self-generators	-	✓
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in the tariff	Included in the tariff
Voltage levels operated	36 and above kV	36 and below kV
How are losses added in use-of-system charge?	T losses included in use-of-system charge, D losses reflected in the tariff as component of the revenue cap	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	Regulator	Regulator
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other	-	
Affordability	-	✓
Simplicity	-	✓
Equity	-	✓
Allocative efficiency	-	
Avoid cross-subsidies	-	✓
Security of supply	-	
Cost-reflectivity	-	✓
Transparency	-	✓
Cost recovery	-	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	
3-phase versus 1-phase connection	-	
Type of customer	-	
Voltage level of connection	-	✓
Distance from grid	-	✓
Capacity requirement	-	✓
Number of customer categories	1	5

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	-	Shallow
Payment for connection asset:		
Same for all categories?	-	✓
Customer pays for line?	-	✓
Ownership transferred to system operator?	-	✓
Who pays for maintenance	-	DSO
Outliers:	-	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	-	One payment
Cost sharing:		
Same for all categories?	-	✓
Cost sharing?	-	✓
Time limit	-	1-5 years
Outliers:	-	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	✓	✓
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined	-	✓
Based on actual cost	-	
Other	-	

A4.25 UAE (Abu Dhabi)

Variable	Response	
Regulator details		
Name of regulatory Authority:	Department of Energy Abu Dhabi	
General		
Number of TSOs	1	
Number of DSOs	2	
Vertical integration of transmission and distribution	Unbundled	
Transmission and distribution use-of-system charges unbundling	Unbundled	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	TSO	DSO
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Equity	✓	✓
Simplicity	✓	✓
Affordability		
Security of supply		
Allocative efficiency	✓	✓
Avoid cross-subsidies	✓	✓
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Approach for setting cost-reflective tariff designs	LRMC	LRMC
Regulation specifies frequency of tariff design review?	x	x
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	x
Drivers for separating charges into consumer categories		
Other	-	-
Cost of supply	-	-
Billing and metering	-	-

Type of customer	-	-
Demand profile	-	-
Zone	-	-
Voltage level of connection	-	-
Number of customer categories	1	1
Type of meter installed for majority of customers connected to:	**Low Voltage**	Electronic
	Medium Voltage	Electronic
	High Voltage	Electronic
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	Postal	Postal
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Share Load	100	100
Share Generator	0	0
Types of charges		
	Transmission	**Distribution**
Fixed charge?	✓	✓
Period over which it is applied	Per year	Per year
Energy charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Demand charge?	✓	✓
Flat?	✓	✓
Time-of-use?	x	x
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	-
Access charge?	x	x
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	x	x
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	x	x
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	Included in tariff	Included in tariff
Voltage levels operated	400, 220 kV	33, 11, 0.4 kV
How are losses added in use-of-system charge?	T and D losses part of pass-through generation and production charges	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Regulator	Regulator
Entity responsible for developing the tariff design	TSO	DSO
Regulation defines method?	✓	✓
Entity responsible for developing regulations on tariff design methodology:		
Parliament		
Government		
Regulator	✓	✓
Guiding principles for tariff design		
Other		
Affordability		
Simplicity		
Equity	✓	✓
Allocative efficiency	✓	✓
Avoid cross-subsidies		
Security of supply		
Cost-reflectivity	✓	✓
Transparency	✓	✓
Cost recovery	✓	✓
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	x	✓
Drivers for separating charges into consumer categories		
Other	-	
3-phase versus 1-phase connection	-	
Type of customer	-	✓
Voltage level of connection	-	✓
Distance from grid	-	✓
Capacity requirement	-	✓
Number of customer categories	1	7

Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Shallow	Shallow
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	Customer	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	Mix	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	x	x
Time limit	-	-
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined		
Based on actual cost	✓	✓
Other		

A4.26 UAE (Dubai)

Variable	Response	
Regulator details		
Name of regulatory Authority:	RSB	
General		
Number of TSOs	1	
Number of DSOs	1	
Vertical integration of transmission and distribution	Vertically integrated	
Transmission and distribution use-of-system charges unbundling	Embedded in the end-user tariff	
Use-of-system		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	-	-
Entity responsible for developing the tariff design	-	-
Regulation defines method?	-	-
Entity responsible for developing regulations on tariff design methodology:		
Parliament	-	-
Government	-	-
Regulator	-	-
Guiding principles for tariff design		
Other	-	-
Equity	-	-
Simplicity	-	-
Affordability	-	-
Security of supply	-	-
Allocative efficiency	-	-
Avoid cross-subsidies	-	-
Cost-reflectivity	-	-
Transparency	-	-
Cost recovery	-	-
Approach for setting cost-reflective tariff designs	-	-
Regulation specifies frequency of tariff design review?	-	-
Frequency	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	-	-
Drivers for separating charges into consumer categories		
Other	-	-
Cost of supply	-	-
Billing and metering	-	-

Type of customer	-	-
Demand profile	-	-
Zone	-	-
Voltage level of connection	-	-
Number of customer categories	-	-
Type of meter installed for majority of customers connected to:	**Low Voltage**	-
	Medium Voltage	-
	High Voltage	-
Locational signals		
	Transmission	**Distribution**
Locational signals used when designing the tariff	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	-	-
Share Load	-	-
Share Generator	-	-
Types of charges		
	Transmission	**Distribution**
Fixed charge?	-	-
Period over which it is applied	-	-
Energy charge?	-	-
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Demand charge?	-	-
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Expressed in KW or KVA?	-	-
Access charge?	-	-
Expressed in KW or KVA?	-	-
For contracted or supplied capacity?	-	-
Reactive power charge?	-	-
Flat?	-	-
Time-of-use?	-	-
Periods on which rates differ		
Between days	-	-
Between seasons	-	-
Within day	-	-
Reactive power penalties?	-	-
Min power factor	-	-
Special tariff designs		
	Transmission	**Distribution**
Other	-	-

Smart techs	-	-
IPPs	-	-
EDZs	-	-
Distributed generation and storage	-	-
Self-generators	-	-
EVs	-	-
Losses		
	Transmission	**Distribution**
How are the cost of losses accounted for?	-	-
Voltage levels operated	-	-
How are losses added in use-of-system charge?	-	
Connection		
Regulations and Principles		
	Transmission	**Distribution**
Entity responsible for approving the tariff design	Government	Government
Entity responsible for developing the tariff design	TSO	DSO
Regulation defines method?	x	x
Entity responsible for developing regulations on tariff design methodology:		
Parliament	-	-
Government	-	-
Regulator	-	-
Guiding principles for tariff design		
Other	-	-
Affordability	-	-
Simplicity	-	-
Equity	-	-
Allocative efficiency	-	-
Avoid cross-subsidies	-	-
Security of supply	-	-
Cost-reflectivity	-	-
Transparency	-	-
Cost recovery	-	-
Consumer categories		
	Transmission	**Distribution**
Multiple consumer categories?	✓	✓
Drivers for separating charges into consumer categories		
Other	-	-
3-phase versus 1-phase connection	-	-
Type of customer	-	-
Voltage level of connection	-	-
Distance from grid	-	-
Capacity requirement	✓	✓

Number of customer categories[7]	14	14
Deep or shallow charges		
	Transmission	**Distribution**
Depth of charge	Deep	Deep
Payment for connection asset:		
Same for all categories?	✓	✓
Customer pays for line?	✓	✓
Ownership transferred to system operator?	✓	✓
Who pays for maintenance	TSO	DSO
Outliers:	x	x
Customer pays for line?	-	-
Ownership transferred to system operator?	-	-
Who pays for maintenance	-	-
Payment method		
	Transmission	**Distribution**
Payment approach	One payment	One payment
Cost sharing:		
Same for all categories?	✓	✓
Cost sharing?	x	x
Time limit	-	-
Outliers:	x	x
Cost sharing?	-	-
Time limit	-	-
Generators versus load		
	Transmission	**Distribution**
Are generators and load treated the same?	x	x
Levels of charges		
	Transmission	**Distribution**
Connection charges are:		
Pre-determined	✓	✓
Based on actual cost		
Other		

[7] Connection charges are escalated in 14 different steps, using cumulative slab rates, relative to capacity increase. For connections charging purposes, 14 different customer categories are considered based on this arrangement.