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Designing natural gas network charges: A proposed methodology and critical review of the Spanish case

Celia Mosácula*, José Pablo Chaves-Ávila, Javier Reneses

Universidad Pontificia Comillas, Escuela Técnica Superior de Ingeniería ICAI, Instituto de Investigación Tecnológica, Santa Cruz de Marcenado 26, 28015, Madrid, Spain

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ABSTRACT

One of the key objectives of regulated charges is to provide efficient price signals to elicit an efficient response by users and maximize social welfare. Nevertheless, current approaches in Europe and elsewhere mainly pursue cost recovery with less attention to economic efficiency. This paper addresses the development of sound and suitable natural gas network charges which should fulfil these and other regulatory principles that have economic and social implications.

Considering the main principles as guiding criteria, we analyse Spain as an illustrative case. Current challenges in the design of natural gas charges are examined, and a novel methodology is proposed.

1. Introduction

The principles of regulated charges design for gas transmission and distribution networks should focus on achieving economic efficiency while ensuring regulated costs recovery. Puller and West (2013) discuss the challenges in evaluating the efficiency of gas retail prices in the context of active consumers.

Concerns have arisen in natural gas charges design. Berrah et al. (2010) remark on the principles and approaches for setting regulated charges for gas transmission and distribution networks consistent with the electricity sector. Borenstein and Davis (2012) highlight the concern with striking a balance between efficiency and wealth distributional considerations. Puller and West (2013) and Hirschhausen et al. (2012) state the importance of the economic efficiency criterion on gas cost-allocation. However, when referring to the establishment of a methodology to allocate costs, some researchers propose different approaches to the design of gas network charges, focusing specifically on transmission network charges and the implementation of entry-exit models to allocate costs, with the main motivation of recovering costs (ACER, 2013a; Alonso et al., 2010; Apolinário et al., 2012; Bermúdez et al., 2013; Vos et al., 2013), but with less explicit attention to the economic efficiency criterion in cost allocation.

Most approaches widely used allocate regulated costs through volumetric charges only, or in a fewer number of cases, through fixed or capacity charges (i.e., €/kW/days) applied in relation to the maximum individual peak load (AF-Mercados et al., 2015), but without strictly following the economic efficiency criterion. Furthermore, in some countries as in Spain, there is no transparent methodology established to allocate regulated costs to final users.

According to the economic theory, economic efficiency is understood as designing the method of costs allocation to contribute to the maximization of social welfare within the sector. Thus, short-term and long-term efficiency are key objectives to promote optimal system usage (Meeus et al., 2013; MIT, 2016).

The cost allocation of network infrastructure is widely studied in the electricity sector. This is driven in part by the penetration of distributed energy resources. In fact, the elasticity of prosumers with regard to economic signals stresses the relevance of economic efficiency in order to avoid inefficient investments and operation of distributed resources, cross-subsidies between different customers or even grid defection (Abdelmotteleb et al., 2016; Brown and Faruqui, 2014; Faruqui, 2016; MIT, 2016; Pérez-Arriaga et al., 2013).

However, the design of gas network charges should also follow the same regulatory principles that apply in the electricity industry as they have similar characteristics (i.e. they share natural monopoly characteristic). Due to the interrelation between gas and electricity (independently of the fact that, the gas storage capacity is superior in the gas infrastructures), the way of establishing the charges in both network industries would affect the competitiveness of one sector with respect to the other (Hecking, 2015; Ofgem, 2015; Posner, 1968).

Mosácula et al. (2017) further explored the interrelations between these energy carriers. Natural gas and electricity are substitute fuels when providing end-services (such as heating, cooking, etc.), and therefore, the charges design of both services would potentially impact

* Corresponding author.
E-mail addresses: celia.mosacula@iit.comillas.edu (C. Mosácula), jose.chaves@iit.comillas.edu (J.P. Chaves-Ávila), javier.reneses@iit.comillas.edu (J. Reneses).

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the consumers choices towards these alternative fuels to satisfy their energy needs.

In countries with overinvested gas facilities, that situation would be more critical, since elastic consumers could suspend their service, worsening the problem of infrastructure under-utilization, which could result in the under-recovery of costs or a rise in charges due to suspension of gas service or gas network defection.

These circumstances call for rethinking the design of gas charges to incentivize the proper behavioural response of network users. Moreover, it is an important concern for policymakers and regulators at the national and regional levels (ACER, 2013b; Sanz Oliva et al., 2018).

This paper aims to fill this gap by proposing a methodology to allocate gas network costs, according to a reasonable balance among the different regulatory principles while sending efficient economic signals to network users. The proposal could be generalised to any gas system, but this paper addresses gas charges determination in Spain in depth and evaluates the ratemaking methodology proposed by the Spanish Energy Commission from an economic efficiency point of view, so as to analyse the main challenges for a specific country.

This paper is organized as follows: section 2 discusses the main cost allocation criteria. Section 3 analyses the current gas tariff system in Spain. Section 4 presents a methodology for gas network cost allocation. Finally, Section 5 draws the conclusions and policy implications.

2. Cost allocation criteria

This section discusses the main regulatory principles that should govern tariff design, as well as the existing alternatives to allocate regulated costs. The main business activities of the natural gas industry (procurement, transmission, distribution, and retail services) are regulated in different ways depending on the different countries. Supply and retail activities are subject to competition in several parts of the world, whereas infrastructure access may be completely or partially regulated, or even liberalized, to some extent. Final gas tariffs are comprised of different components from both regulated and non-regulated activities. For instance, energy costs in liberalized systems (i.e., from natural gas procurement or extraction) are determined in markets, while network activities are regulated natural monopolies and costs are allocated through regulated charges. The former are the focus of this paper and we refer henceforth to the design of charges as we do not enter into details on how costs from competitive activities are allocated to end-users.

2.1. Regulatory principles of tariff design

The fundamental regulatory principles to be followed when designing gas network charges are shown in Fig. 1. Nevertheless, other ratemaking principles might be borne in mind as well (AF-Mercados et al., 2015; Borenstein, 2016; Pérez-Arriaga et al., 2013).

In this regard, the two main objectives that charges design must meet are focused on raising the money needed to cover the allowed costs of the regulated activities, and sending the right economic signals to each customer to favour the optimal socio-economic use of energy (Pérez-Arriaga et al., 2013). Therefore, ***cost recovery*** and ***economic efficiency*** appear to be the main principles that should govern the design of gas charges. In fact, ***cost recovery*** may be considered as a corollary of the economic efficiency principle as it pursues long-term economic efficiency, that is, the financial viability of the system.

Satisfactory charges design is essential both to promote optimal short-term system usage and to guide efficient long-term demand response. We differentiate between ***short-term efficiency***, which refers to efficient operation and market prices equal to short-term marginal costs, and ***long-term efficiency***, which involves cost savings in the long term, but in certain cases applying higher charges to consumers in the short term.

Economic efficiency also pursues the ***cost-reflectiveness*** and ***equity***

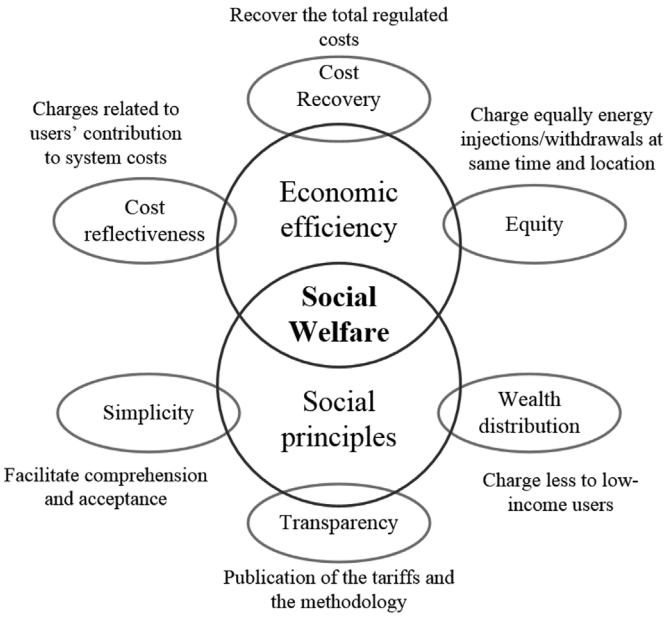

Fig. 1. Tariff design fundamentals.

principles for cost allocation. The first principle means that network users should be charged in accordance with their contribution to the costs of the network system. Much like Borenstein (2016), we relate equity (that can adopt different meanings depending on different points of view) to the idea of "fairness across customers with different consumptions levels". Following this principle, gas injections or withdrawals carried out at the same time and location should be charged equally in order to pursue short and long-term economic efficiency.

Economic efficiency should be complemented with additional criteria related to ***social principles*** that may introduce differences depending on consumer categories based on, for instance, their size or income. In this sense, the ***wealth distribution principle*** refers to the notion of "fairness across customers of different levels of wealth" (Borenstein, 2016) and the idea that low-income consumers should be charged lower charges (Borenstein, 2012).

Another criterion that should be borne in mind is ***transparency,*** which refers to the publication of charges and a clear and understandable description of the methods used to establish them.

Moreover, the ***simplicity principle*** aims to facilitate public comprehension and acceptance of charges.

The difficulty of simultaneously meeting all of the principles is well-known when trying to reach a satisfactory charges design (Pérez-Arriaga et al., 2013). In fact, it may be the case that social and political considerations have a strong impact on the final implementation of charges. Nevertheless, the final aim of the charges design should be to reach a reasonable trade-off among economic efficiency and social concerns to maximize social welfare (Fig. 1).

2.2. Methodologies to allocate costs based on the regulatory principles

The different approaches to allocate regulated costs can be classified into two groups:

- Approaches that mainly pursue cost recovery.
- Approaches based on economic efficiency criteria.

2.2.1. Cost allocation approaches that pursue cost recovery as a main objective

The most widely used approaches in gas network ratemaking are mainly based on the cost recovery principle, allocating the regulated costs through volumetric charges only, or less frequently, through fixed