Scenario analysis of nonresidential natural gas consumption in Italy

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HIGHLIGHTS

- The paper proposes an analysis on natural gas consumption forecasting.
- A validation of the methodology is accomplished obtaining a good level of accuracy.
- GDP, price and temperature elasticities are calculated.
- A scenario analysis is developed by analysing twelve different scenarios.
- In 2030, a natural gas consumption between 32 and 43 bcm is expected in Italy.

ARTICLE INFO

ABSTRACT

Objective: The aim of the present paper is to develop a model for the long term forecasting of nonresidential gas consumption in Italy. The influence of economic and climatic data, as well as the impact of regulatory changes are considered.
Methods: The model is developed by using a regression model and, to this scope, the necessary explaining variables are determined. A successful validation of the model is performed, showing that it guarantees a satisfactory level of accuracy.
Results: Short and long run elasticities are estimated, highlighting that Gross Domestic Product (GDP) per capita has a much greater influence on gas consumption with respect to price. Twenty-four consumption scenarios are presented, underlining that in 2030 nonresidential gas consumption in Italy is expected to be between about 32 and 46 bcm (billions of cubic meters).
Conclusions: It can be concluded that the increase of nonresidential gas consumption is strongly linked to the GDP evolution and according to the GDP growth scenario, nonresidential gas consumption might largely change.
Practice implications: The outcomes of the present analysis can be successfully utilized by energy managers to design appropriate energy management policies. Particularly, the determination of the elasticities has practical relevance in setting up adequate pricing policies, whereas the long term forecast represents a useful support to estimate the volume of the necessary supply contracts and to plan new infrastructures.

1. Introduction

Italy is one of the European countries with the highest share of natural gas in its energy mix. Particularly, it represented the 40% and 38% [1] of the primary energy consumption, in 2010 and 2011 respectively. In 2011, Italy, with its 76 bcm, resulted to be the third consumer of natural gas in EU after Germany (78 bcm) and United Kingdom (83 bcm) [2].

Given these facts, it is of crucial importance to be able to predict gas consumption with a good degree of accuracy, in order to manage supply contracts, indigenous production and infrastructures

planning in an optimal way. To fail one of these three targets would cause instabilities in the Italian energy system, because of the unbalanced energy mix of the country, largely dependent on natural gas.

In terms of market, it is detected that the incumbent operator is ENI, the former state monopolist, with a market share of about 27% of total sells to final customers, then there is ENEL with about 12% of market share and the third operator is Edison with about 11% [2]. Therefore, the first three operators control about the 50% of the market, whereas the first twenty operators represent about the 84% of the market and the remaining 16% is divided by 288 small and very small operators [2]. In light of this, it can be said that the market is very concentrated.

The historical trend of natural gas consumption is reported in Fig. 1, where three main contributions to the total consumption

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Nomenclature

C	consumption, bcm (billions of cubic meters)	*Greek letters*	
GDP	Gross Domestic Product, €	α	regression coefficient
HFO	price of heavy fuel oil, $/t	β_{1-5}	regression coefficients
LE	long run elasticity		
LFO	price of light fuel oil, $/t	*Subscripts*	
k	year index	0	starting point
n	number of observation	e	estimated
P	gas price, €/GJ and $/Mbtu	imp	import
P_{Oil}	oil price, $/bbl	m	referred to month m
t	year	min	minimum
T	temperature, °C	nres	nonresidential
		PC	per capita
		$t-1$	lag of one year

are highlighted, namely thermo electric power plants, residential and nonresidential [3,4].

Natural gas consumption in thermo electric power plants is linked to the electricity market, because it is directly related to the electricity generated in gas fuelled power plants. The amount of generated electricity is set according to the variable costs competition, mainly influenced by fuel prices, of the different plants available on the market.

Residential consumption of natural gas is determined by the demand for heating, sanitary water and cooking facilities in residential buildings. The main consumption drivers are represented by external temperature of the heating season, population and buildings characteristics (i.e. insulation, facilities, etc.).

Nonresidential natural gas consumption represents the usage of natural gas related to economic activities, particularly industry (i.e. manufacturing, food, construction, etc.) and services (i.e. offices, shops, healthcare, etc.). It can be assumed that natural gas consumed in the industrial sector is mainly used in production processes, even though a substantial share difficult to estimate is also utilized for heating purposes (i.e. heating of very large industrial buildings), whereas the consumption in the service sector is substantially due to heating demand.

By analyzing Fig. 1, it is possible to detect that, up to 1995, nonresidential natural gas consumption represented the largest share of the total, whereas after 1995 a sharp increase of thermal power plants consumption is detected. This increase is due to the liberalization of the power generation sector, that allowed many players to enter the Italian market by building a relevant number of combined cycle gas turbines, which boosted consumption of natural gas.

By observing the trend of the last five years, it can be roughly said that 35% of natural gas consumption is due to thermal power

plants, 35% to nonresidential consumption and 30% to residential uses.

The aim of the present paper is to develop a forecasting model for nonresidential natural gas consumption in Italy by utilizing a regression model.

From the above mentioned data, it is detected that nonresidential sector represents a relevant part (~30 bcm, billions of cubic meters, per year) of the total consumption, therefore in order to guarantee the security of supply it is necessary to foreseen accurately the future consumption.

The under or over estimation of the needs can cause relevant economic losses to both final customers and natural gas wholesalers.

In the present case, a regression model is believed to be the optimal choice, because it allows to analyze the impact that external explaining variables of common use (i.e. Gross Domestic Product, price, etc.) have on the consumption, leading to the formulation of a *data light* model (i.e. the cost of data mining is minimized) of practical interest.

Moreover, the use of a regression model has the unquestionable advantage to allow the determination of a consumption equation with a relatively simple structure, which can be easily implemented in more complex planning models (i.e. market simulators).

To the best of authors' knowledge, this represents the first attempt, available in the scientific literature, to analyze in detail natural gas consumption in Italy, focusing on nonresidential sector.

The first object of the present paper is to analyze nonresidential natural gas consumption, estimating the consumption equation by using a regression model.

The second target is to propose an accurate forecasting of natural gas consumption up to the year 2030, developing a scenario
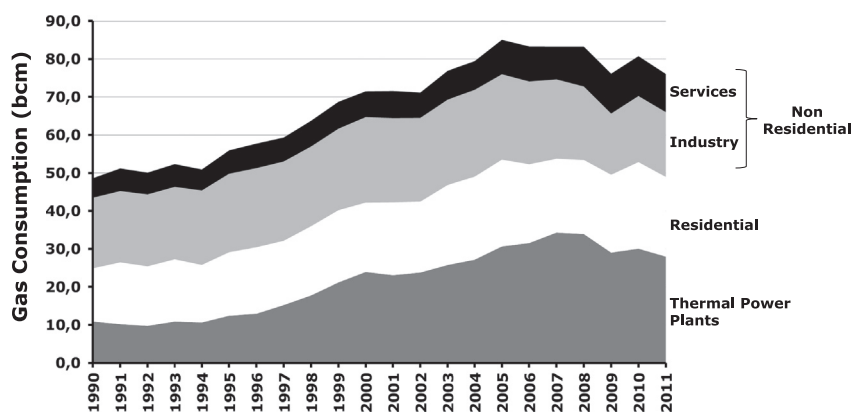

Fig. 1. Historical trend of natural gas consumption in Italy for different sector of usage.