

# Gas demand at the sunset? Persistent and transient impacts of the crisis on the Italian gas demand

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## Context:

- The Russian-Ukrainian war triggered unprecedented gas and electricity price surges and highlighted vulnerabilities in energy supply chains.
- The crisis reignited concerns about energy security and sustainability

## Relevance:

- How did industries, households, and energy producers adapt to extreme price volatility?
- Are observed consumption changes temporary or indicators of structural evolution?

# Gas Market Background

## Prices

- Stable and low prices before autumn 2021.
- Sharp price increases starting late 2021, driven by a post-COVID economic rebound and geopolitical tensions, peaking at €300/MWh (TTF) in August 2022.
- Prices decreased during winter 2022/2023 due to high storage levels but remained above pre-crisis levels throughout 2023.

Despite several measures introduced in most European countries to protect end consumers from high gas prices, at least part of this price signal was passed to the retail segment, with different magnitude and timing depending on the supply contracts signed by each consumer.

# Gas Demand Reduction

## **(Mixed) Impacts of the Energy Crisis**

- Mild weather, price signals, and government campaigns reduced European gas consumption.
- The EU surpassed its 15% gas savings target, achieving an 18% reduction during winter 2022/2023.

It is unclear what share of this demand reduction will last over the next years, witnessing a structural change in natural gas consumption, and what will bounce back to pre-crisis levels, net of the impact of changing weather and economic conditions.

## Scope

Assessment of natural gas demand reduction in Italy following the energy crisis.

## Segments Analyzed

- Gas-fired power generation.
- Gas-intensive manufacturing.
- Households and small and medium-sized enterprises (SMEs).

## Goals

Measure actual gas savings in each segment, accounting for:

- Weather conditions.
- Economic dynamics.
- Evaluate the likelihood of demand reduction persisting over the long term/Shed light on the nature of the demand reduction (structural vs. transient).

## Literature Main Reference

Based on Ruhnau, O. et al., *Natural gas savings in Germany during the 2022 energy crisis*, Nature Energy 8 621-628, 2023

### Data Sources:

- SNAM: Gas consumption data segmented by industrial, distribution, and thermoelectric sectors (March 2011 to December 2023)
  - Monthly data published by the Italian gas transmission system operator Snam Rete gas for withdrawals of gas-fired power generation, gas-intensive manufacturing, and households and SMEs;
  - Monthly data for heating degree days computed based on Eikon Refinitiv data for average daily temperatures in some Italian macro-regions;
  - Monthly data for industrial production published by Istat.

For now, we do not include gas prices in the model. This decision is connected on the one hand to the difficulties in correctly addressing endogeneity, on the other hand to the risk of incurring measurement errors due to the heterogeneous ways in which wholesale gas prices impact the actual price paid by end customers.

# The Model

$$Consumption_{ti} = \mu_i * crisis\ dummy_t + \alpha_i * covid\ dummy_z + \beta_i * PIMG_t + \gamma_i * HDD_t + \delta_{ni} * monthly\ dummy_n (+ \tau_i * trend_t)$$

- **t** Represents the month. Observations range from March 2011 to June 2023
  - **i** Represents the sector – Italy; Industry; Power; Distribution.
  - **z** Equals 1 from March 2020 to July 2021.
  - **n** Ranges from 1 to 12, representing the months of the year.
- HHD: Heating Degree Days  
PIMG: Industrial production  
 $\delta$  = Seasonal effect (Monthly Dummy)

The dummy variable representing the gas crisis,  $\mu_i$ , is our variable of interest, as it allows us to estimate, ceteris paribus, the impact of the gas crisis for each sector and month.

The dummy variable identifying the crisis months is set to 1 starting in February 2022. Therefore, the coefficient, if the dummy remains equal to 1 up to the most recent observation, represents the structural change induced by the energy crisis on gas consumption.

## Regression Model and Savings Estimation

### OLS Regression with Clustered Errors:

- Adjusts for non-independence among observations.
- Coefficient ( $\mu_i$ ): Represents savings due to the crisis (e.g., price increases, market expectations, supply tensions).

### Counterfactual Scenario:

- Compares observed consumption to a hypothetical scenario without the energy crisis.
- Monthly dummy variables distinguish crisis months (value 1) from non-crisis months (value 0).



## Impact of the Energy Crisis:

- Significant gas savings from **October 2022 to March 2023**.
- Demand reductions often exceeded **1 billion cubic meters (Bcm) per month**.
- Lower but still notable savings were observed between **October and December 2023**.

## No Impact Periods:

- No significant gas savings were detected between **April and September** in both 2022 and 2023.

## Reference Demand:

- Yearly demand for households and SMEs in 2019 was approximately **32 Bcm**.

# Results: Gas Savings for Gas-Intensive Manufacturing

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## Impact of the Energy Crisis:

- Significant gas savings from **February 2022 to December 2023**.
- Demand reductions averaged **0.2 Bcm per month**

## Peak Savings:

- Record reductions between **September 2022 and February 2023**.
- Monthly savings exceeded **250 million cubic meters** during this period.

## Reference Demand:

- Yearly demand for gas-intensive manufacturing in 2019 was approximately **14 Bcm**.

- **Impact of the Energy Crisis:**

- Mixed reactions with only some months showing significant demand reductions.
- Erratic but stronger savings trend observed from **September 2023 onwards**.

- **Monthly Savings:**

- Averaged **0.3 Bcm per month** in the second half of 2023.

- **Reference Demand:**

- Yearly demand for gas-fired generation in 2019 was approximately **25 Bcm**.

- **Sector Dynamics:**

- Higher production costs were offset by higher electricity prices.
- Key drivers: European drought and reduced nuclear production in France during 2022.

All in all, our preliminary results suggest that the gas crisis yielded a demand reduction of around 13 Bcm between February 2022 and December 2023, with the strongest impact between October 2022 and March 2023, when gas demand was around 8 Bcm lower than expected.

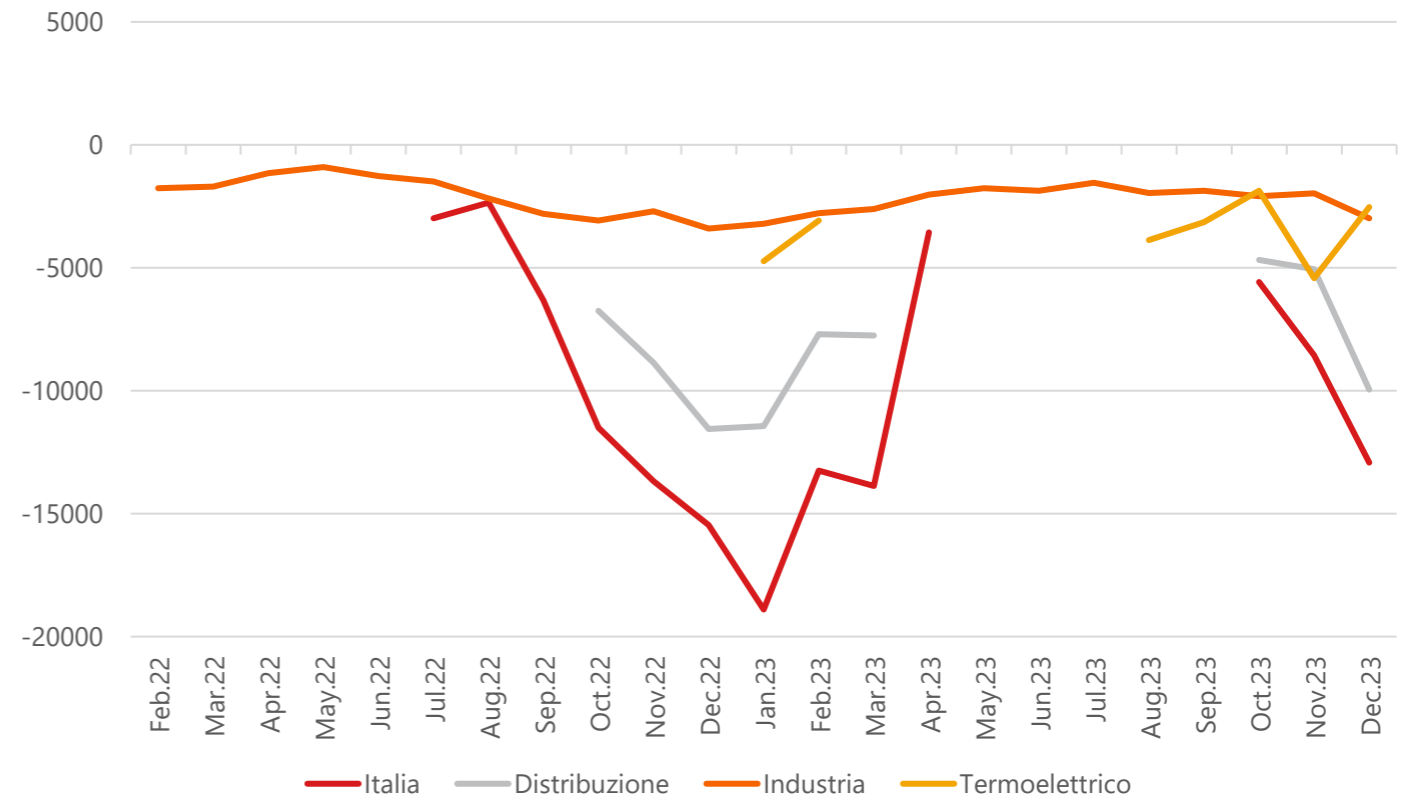
## Sum of energy savings through gas demand – only significant months

**DIMINUIZIONE DEI CONSUMI DI GAS DOVUTI ALLA CRISI ENERGETICA  
PER MACROSETTORE, GWh**

	Italia	Distribuzione	Industria	Termoelettrico
feb-22	-6177	-5556	-1771	
mar-22			-1700	2620
apr-22			-1149	
mag-22			-899	
giu-22			-1265	2986
lug-22	-2989		-1494	
ago-22	-2352		-2185	
set-22	-6325		-2807	-3186
ott-22	-11510	-6757	-3086	
nov-22	-13684	-8863	-2703	-3579
dic-22	-15467	-11561	-3400	
gen-23	-18903	-11442	-3207	-4730
feb-23	-13254	-7702	-2777	-3076
mar-23	-13873	-7753	-2612	
apr-23	-3565		-2030	
mag-23			-1766	
giu-23	-3978		-1872	-1972
lug-23			-1548	
ago-23	-5244		-1960	-3876
set-23			-1872	-3141
ott-23	-5581	-4682	-2090	-1866
nov-23	-8558	-5060	-1976	-5422
dic-23	-12926	-9950	-2985	-2534
<b>Totale</b>	<b>-144383</b>	<b>-79325</b>	<b>-49154</b>	<b>-27776</b>

Fonte: elaborazioni Laboratorio REF Ricerche

## Energy savings with respect to counterfactual scenario – only significant months

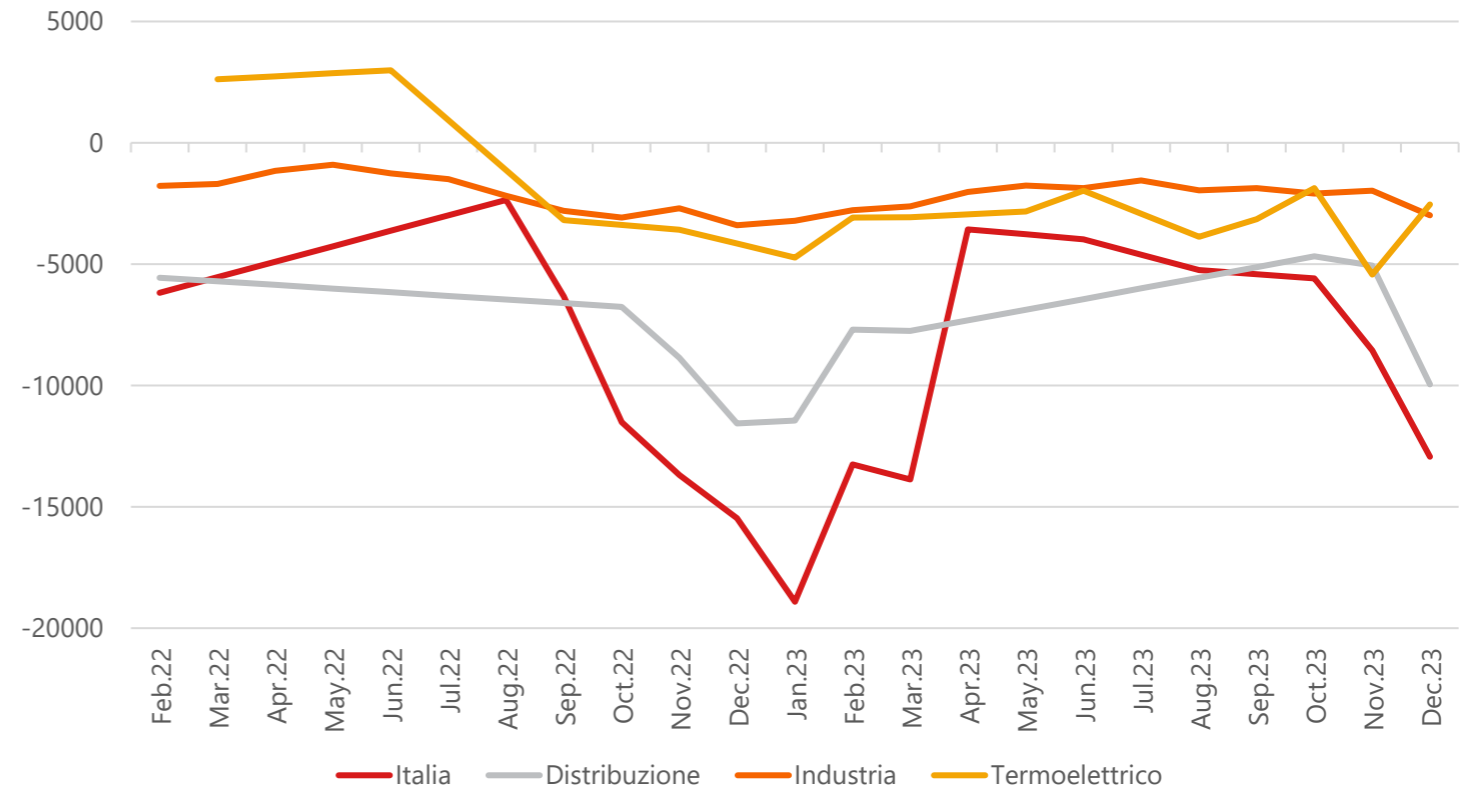


Sum of energy savings through gas demand – not significant months have been filled in

**DIMINUIZIONE DEI CONSUMI DI GAS DOVUTI ALLA CRISI ENERGETICA PER MACROSETTORE, GWh**

	Italia	Distribuzione	Industria	Termoelettrico
feb-22	-6177	-5556	-1771	
mar-22	-5539	-5706	-1700	2620
apr-22	-4902	-5856	-1149	2742
mag-22	-4264	-6006	-899	2864
giu-22	-3627	-6156	-1265	2986
lug-22	-2989	-6306	-1494	928
ago-22	-2352	-6456	-2185	-1129
set-22	-6325	-6606	-2807	-3186
ott-22	-11510	-6757	-3086	-3383
nov-22	-13684	-8863	-2703	-3579
dic-22	-15467	-11561	-3400	-4154
gen-23	-18903	-11442	-3207	-4730
feb-23	-13254	-7702	-2777	-3076
mar-23	-13873	-7753	-2612	-3066
apr-23	-3565	-7315	-2030	-2944
mag-23	-3771	-6876	-1766	-2823
giu-23	-3978	-6437	-1872	-1972
lug-23	-4611	-5998	-1548	-2924
ago-23	-5244	-5559	-1960	-3876
set-23	-5413	-5121	-1872	-3141
ott-23	-5581	-4682	-2090	-1866
nov-23	-8558	-5060	-1976	-5422
dic-23	-12926	-9950	-2985	-2534
<b>Totale</b>	<b>-176510</b>	<b>-159723</b>	<b>-49154</b>	<b>-41665</b>

Energy savings with respect to counterfactual scenario – not significant months have been filled in



Monthly significance table (red months are not significant)

Sector	Trend	Covid dummy	N° months/23	feb-22	mar-22	apr-22	mag-22	giu-22	lug-22	ago-22	set-22	ott-22	nov-22	dic-22	gen-23	feb-23	mar-23	apr-23	mag-23	giu-23	lug-23	ago-23	set-23	ott-23	nov-23	dic-23	Adj R2
Italy	Yes	Yes	15																								.94212866
Distribution	Yes	Yes	10																								.96692215
Industry	Yes	Yes	23																								.8915048
Power	Yes	Yes	13																								.54366086



# Preliminary Conclusions

## •Preliminary Results:

- Structural changes observed among:
  - Households and SMEs, particularly during the heating season.
  - Gas-intensive manufacturing.
- No evidence of structural changes for gas-fired power generation.

## •Future Analyses:

- Monitor the persistence of these trends over time.
- Investigate drivers behind persistent savings, considering Italy's decarbonization efforts.

## •Exclusions:

- The price elasticity of gas demand is not analyzed due to the extreme price spikes, making point estimates less useful.



**Thank you for your attention.**  
**Happy and grateful for any comment or suggestion.**

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