When Words Save Watts

Government Communication and Household Electricity Use

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Motivations

Figure 1: French Prime Minister wearing a winter jacket

Figure 2: Incentives for Energy Conservation

France Residential Electricity Consumption

- Residential sector account for 40% of France total electricity consumption
- Residential electricity consumption dropped by 10% (10 TWh) between 2019-21 and 2022-23

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To what extent can **government communication** shape household electricity consumption ?

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Insights from Literature

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- A smaller share of empirical literature study **large-scale natural experiments** that derive from energy crisis; estimate energy decrease ranging from 2 to 8 %
  - Reiss and White (2008) (*California energy crisis 2000-01*)
  - He and Tanaka (2023) (*Fukushima nuclear accident 2011*)
  - Jamissen et al. (2024) and **?** (*European energy crisis 2022-23*)

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This paper : France during the *European energy crisis 2022-23*

Government Communication → Public Attention → Electricity consumption

Background

Residential Electricity Market in France

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- 2022-23 : A single electricity retailer covers 93% of the market (*Enedis*)
- Two types of electricity retail prices:
  - **Regulated Tariff**: 62%
  - **Market-based Tariff**: 38%

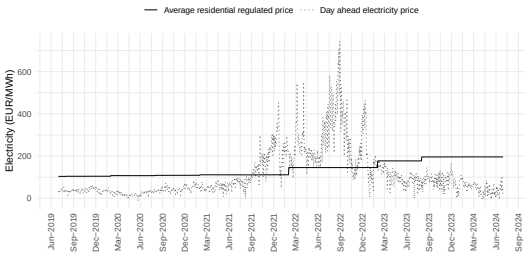

Figure 3: France Electricity Market and Regulated Prices

Government Reaction to the Energy Crisis

Context

Russo-Ukrainian war + Corrosion issues in the nuclear fleet $\rightarrow$ Supply constraints and price volatility

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Monetary: A tariff shield

Table 1: Regulated Tariff Decisions

Period	Observed Prices (€/MWh)	Recommened Prices (CRE) (€/MWh)
2019-21	98	98
2022-23	183 (+88%)	253 (+160%)

Notes : This table only shows variable prices represented the per-MWh energy charge. Observed prices reflect actual tariffs applied to consumers, incorporating the government's tariff shield. Regulated prices (CRE) show the Energy Regulatory Commission's recommended tariffs absent intervention. Percentages in parentheses indicate changes relative to the pre-crisis period.

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Non-Monetary : Load control and Communication

- **Load control:** *Enedis* has been authorised to remotely control the water heaters in 4 million households (12% of contracts) ▸ Load Control
- **Communication:** Public appeal from government members (350 public statements in 2 years)

Preview of Results

1. **Communication → Attention**
   - Attention responds strongly to **crisis framing** (e.g. blackout risk and economic uncertainty)
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   - Higher attention leads to **measurable reductions** in consumption
   - Only households with sufficient **flexibility margin** adjust consumption
   - Effects remain **modest** compared to price and temperature

▸ Decomposition

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Quantitative Insight

In the context of France 2022 energy crisis,
communication reduced electricity consumption by 1%

Identification Strategy

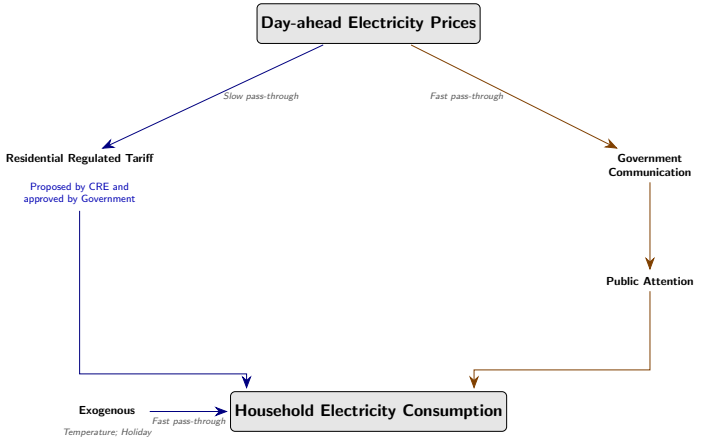


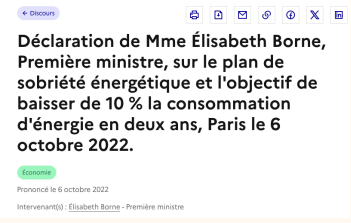
Figure 4: Directed Acyclic Graph (DAG)

Focus on Government Communication

Top Search Queries

Government Communication

Daily collection of public speeches from www.vie-publique.fr + Public Interest Advertisement from *Institut National de l'Audiovisuel*


Discours

Déclaration de Mme Élisabeth Borne, Première ministre, sur le plan de sobriété énergétique et l'objectif de baisser de 10 % la consommation d'énergie en deux ans, Paris le 6 octobre 2022.

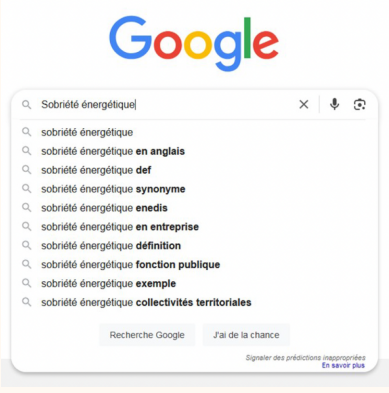
Economie

Prononcé le 6 octobre 2022

Intervenant(s) : Elisabeth Borne - Première ministre

Public Attention

Daily Google Search Volumes (GSV)



Attention Formation - Energy Conservation

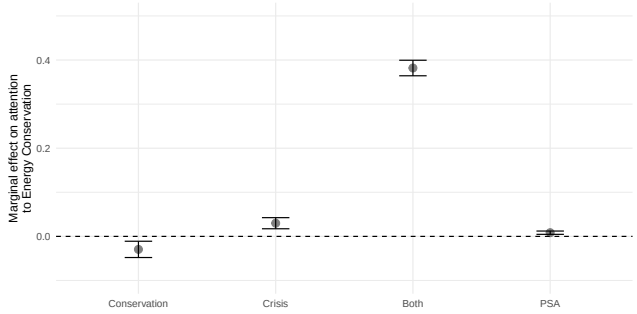


Figure 5: Government Communication on Public Attention - Energy Conservation

Attention to Energy Conservation

Household paying attention on how to save energy because of economic uncertainty

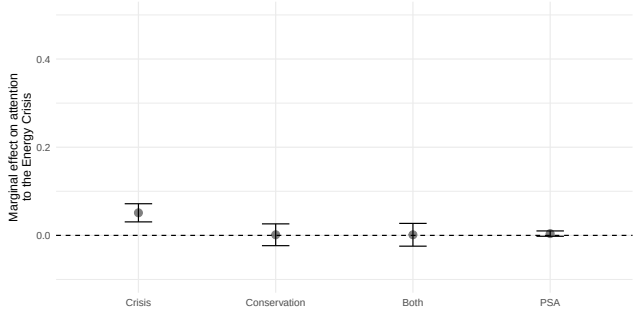


Figure 6: Government Communication on Public Attention - Energy Crisis

Attention to Energy Crisis

Household paying attention to the crisis because of potential blackout

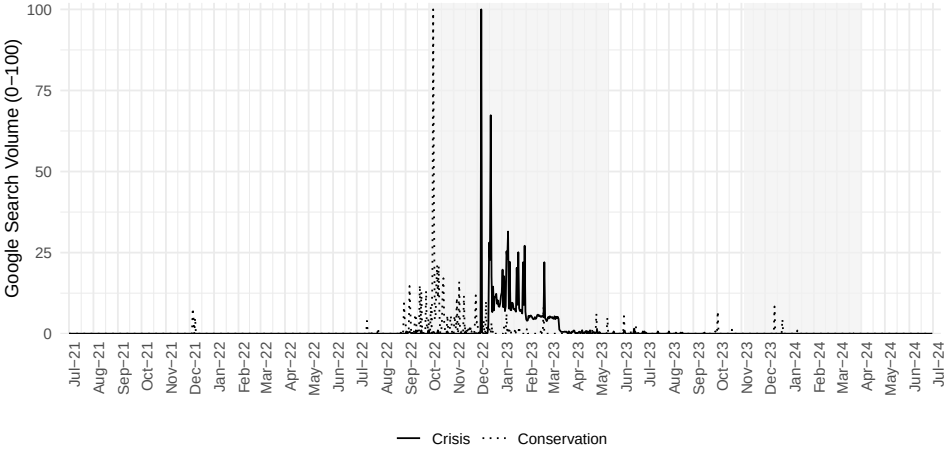


Figure 7: Daily Attention for Energy Topics

Empirical Framework

Table 2: Average Annual Electricity Consumption

	Base		ToU	
	2019–2021	2022–2023	2019–2021	2022–2023
Panel A. Aggregate Consumption				
Total consumption (TWh)	51.0	49.9	97.7	85.0
Number of contracts (millions)	17.6	18.0	14.5	14.6
Consumption per contract (MWh)	2.9	2.8	6.7	5.8
Panel B. End-Use Composition (%)				
Heating	25		48	
Hot water	35		24	
Refrigeration	21		10	
Cooking	10		6	
Other appliances	9		12	

- Two representative households ▸ Tariff by profiles
  → Base profile have a constant €/MWh tariff within a day
  → ToU profile have a bi-variate €/MWh tariff within a day

RECM (Restricted Error Correction Model)

$$\Delta e_{i,t} = \underbrace{\phi_i \left(e_{i,t-1} - \sum_{j=1}^{k} \theta_j x_{j,i,t-1} \right)}_{\text{Correction towards long-term equilibrium}} + \underbrace{\sum_{s=1}^{p-1} \lambda_i \Delta e_{i,t-s}}_{\text{Inertia of } e} + \underbrace{\sum_{j=1}^{k} \sum_{l_j=0}^{q_j} \delta_{j,l_j} \Delta x_{j,i,t-l_j}}_{\text{Short-term effects of } x_j} + \epsilon_{i,t} \quad (1)$$

- e : Seasonally adjusted electricity consumption for a representative household (kWh/day)

▸ Unit roots and Bound tests ▸ Linear Specification

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- x_{load} : Binary variable equal to 1 during periods of load control implemented by the grid operator
- $x_{load} \cdot x_{m(g)_{k,n}}$: Interaction with attention variables capturing the effect of load control on attention-induced electricity demand adjustments

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- $x_{control}$: fixed part from price (EUR/MWh) (Auray et al., 2019); Heating Degree Days ($15C$); Binary variable for lockdowns

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Main Results

- **Benchmark in the Literature**
  - Residential energy demand is typically found to be **price-inelastic**
  - Consensus range: **[0.25 ; 0.80]** (Hanemann et al., 2013; Auray et al., 2019; Alberini et al., 2019; Frondel et al., 2019; Ewald et al., 2021; Pellini, 2021)

Table 3: Estimates - Price and Temperature

	Base		ToU	
Variable	Elast.	Wh/day	Elast.	Wh/day
Intercept		$4,459^{***}$		$14,236^{***}$
		(939)		(1,610)
Price	0.1624^{***}	-10.9^{***}	0.2112^{***}	-32.8^{***}
	(0.0459)	(3.1)	(0.0347)	(5.4)
Temperature	0.0042	8.0	0.2353^{***}	989.6^{***}
	(0.0323)	(60.9)	(0.0166)	(68.7)
R^2	0.992		0.986	
Observations	1,839		1,839	

Notes : Elasticities represent the ratio of proportional changes in quantity demanded to proportional changes in independent variables; values below 1 in absolute value indicate inelastic demand. Estimates are expressed in Wh/day. Data span July 1, 2019 to June 30, 2024. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Price Elasticity

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- **Results**
  - Estimated elasticities are **lower [0.16 ; 0.21]**
  - Consistent with evidence during energy crisis, accounting for both *monetary and non-monetary* incentives
    (Reiss and White, 2008; Ito et al., 2018; Ruhnau et al., 2023; Jamissen et al., 2024; **?**)

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- **Margins of adjustment for households**
  - Heating
  - Domestic hot water

Table 4: Estimates - Conservation and Crisis Attention

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Conservation	0.0023	−67.3	0.0102	−661.0
	(0.0305)	(888.1)	(0.0211)	(1,368)
Crisis	0.0015	−38.9	0.0030	−170.3
	(0.0056)	(144.8)	(0.0041)	(224.0)
Panel. Load Control Effects				
Load control	0.0010	−37.8	0.0102***	−857.8***
	(0.0052)	(196.7)	(0.0036)	(299.3)
Panel. Combined Effects				
Conservation	0.0005	−8.3	0.0049	−168.3
	(0.0050)	(76.7)	(0.0035)	(118.8)
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Attention Estimate

- **Margins of adjustment for households**
  - Heating
  - Domestic hot water
- **Attention to Crisis (Blackout)**
  - Elasticity is significant and homogeneous across groups
  - 1 unit of increase in attention reduces consumption by 20 to 50 Wh/day

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- **Attention to Conservation**
  - Base : not significant; low flexibility
  - ToU : large but imprecise effect

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Attention Estimate and Crowding Effect

- Load control systems mechanically reduce consumption (11am - 2pm)
- Model re-estimated excluding load control hours to isolate true behavioral flexibility

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Findings

ToU households show significant and substantial flexibility when not mechanically constrained

Confirmed by heterogeneity analysis: households with less load control respond more significantly to attention ▸ Robustness

Table 5: Estimates - Conservation and Crisis Attention

	Base		ToU	
Variable	Elast.	Wh/day	Elast.	Wh/day
Panel A. Price and Temperature				
Intercept		$3,177^{***}$		$11,294^{***}$
		(719)		(1,208)
Price	0.1640^{***}	-8.1^{***}	0.2436^{***}	-29.1^{***}
	(0.0435)	(2.1)	(0.0277)	(3.3)
Temperature	0.0012	−1.6	0.2523^{***}	816.3^{***}
	(0.0375)	(50.9)	(0.0162)	(52.4)
Panel B. Attention Effects				
Conservation	0.0005	−11.6	0.0051^{***}	-255.5^{***}
	(0.0020)	(48.2)	(0.0014)	(71.4)
Crisis	0.0010^{**}	-19.0^{**}	0.0008^{***}	-34.7^{***}
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Conclusion

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Research Question

To what extent can government communication shape household electricity consumption?

- **Communication framing matters**
  Without a salient crisis framing, attention to conservation gradually declines
- **Flexibility is a necessary condition**
  Only households with a remaining margin to adjust can translate attention into actual savings

Takeaway

Words save watts when salience drives attention and flexibility enables action

Thank you for your attention !

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website : mbruguet.github.io

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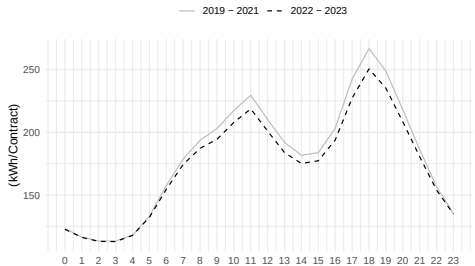
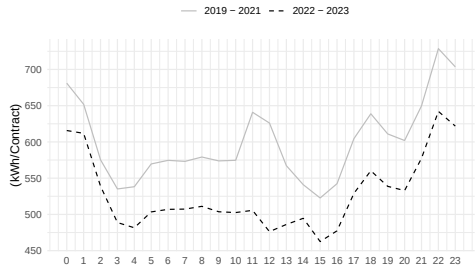


(a) Winter - base



(b) Winter - ToU

Figure 8: Average hourly load by season and tariff profile

Return

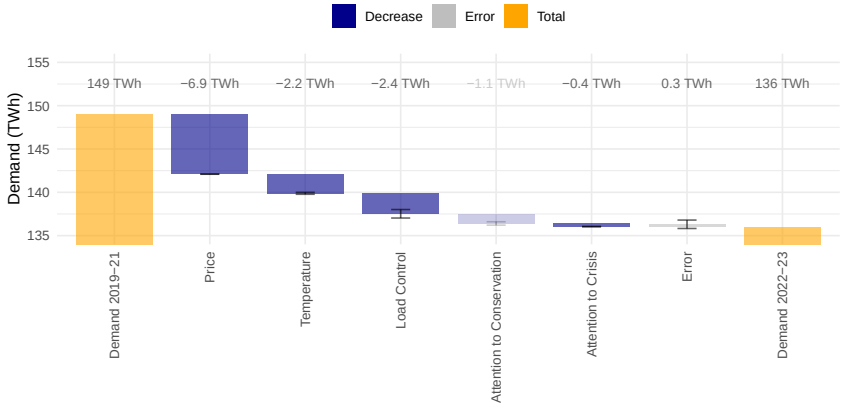


Figure 9: National residential electricity decrease decomposition

Return

Table 6: Top Search Queries related to Energy Conservation and Energy Crisis

Panel A. Energy Conservation	
French	English
sobriété énergétique	energy conservation
plan de sobriété	conservation plan
la sobriété énergétique	energy conservation
la sobriété	conservation
définition sobriété	definition of conservation
sobriété énergétique gouvernement	government energy conservation
sobriété énergétique définition	definition of energy conservation
plan sobriété énergétique	energy conservation plan
plan de sobriété énergétique	energy conservation plan
Panel B. Energy Crisis	
French	English
crise énergétique	energy crisis
crise énergétique européenne france	european and french energy crisis
crise énergétique européenne	european energy crisis
crise énergétique europe	energy crisis in Europe
crise énergétique 2022	2022 energy crisis
la crise énergétique en france	energy crisis in France
la crise énergétique	the energy crisis
crise énergétique pourquoi	why the energy crisis
crise énergétique france	france energy crisis

Return

Table 7: Tariff for base and ToU profiles

	Observed Prices		Recommended Prices (CRE)		
	Variable (€/MWh)	Total (€/MWh)	Variable (€/MWh)	Total (€/MWh)	Fixed (€/Month)
Panel A. Base					
Upstream	98.06	107.12	98.06	107.12	9.05
First period	137.40 (+40.1%)	147.58 (+37.8%)	153.41 (+56.5%)	163.81 (+52.9%)	10.39 (+14.8%)
Second period	170.80 (+74.2%)	181.60 (+69.5%)	314.00 (+220.2%)	324.80 (+203.2%)	10.80 (+19.3%)
Third period	188.70 (+92.4%)	200.11 (+86.8%)	258.13 (+163.2%)	269.54 (+151.6%)	11.41 (+26.1%)
Panel B. Peak/Off-Peak					
Upstream	98.14	109.80	98.14	109.80	11.65
First period	130.35 (+32.8%)	145.92 (+30.7%)	159.26 (+48.7%)	13.35 (+45.1%)	(+14.6%)
Second period	159.15 (+62.2%)	172.79 (+57.4%)	302.35 (+208.1%)	315.99 (+187.8%)	13.64 (+17.1%)
Third period	177.65 (+81.0%)	191.91 (+74.8%)	247.08 (+151.7%)	261.34 (+138.0%)	14.26 (+22.4%)

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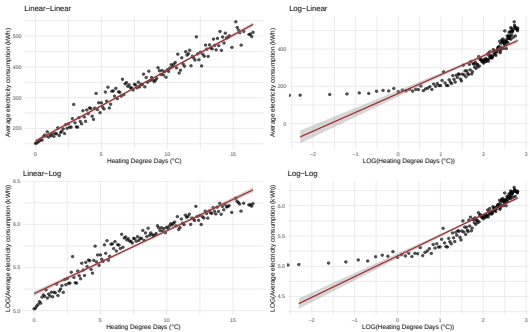

Figure 10: Replicate from Jamissen et al. (2024)

Recover the elasticity from linear-linear

$$\epsilon_{price} = \frac{\partial e_t}{\partial price_t} * \frac{\overline{price}}{\bar{e}} \tag{2}$$

Return

Table 8

	Level - $I(0)$				First Difference - $I(1)$			
	ADF		PP	KPSS	ADF		PP	KPSS
	Lags	*Statistics*	*P-value*	*P-value*	*Lags*	*Statistics*	*P-value*	*P-value*
e_t	9	-7.97***	0.01	0.01	8	-16.69***	0.01	0.1
x_{HDD}	4	-12.22***	0.01	0.10	5	-22.94***	0.01	0.1
x_{price}	1	-0.44	0.49	0.01	1	-30.33***	0.01	0.1
$x_{ml(g)_{con}}$	8	-3.51	0.48	0.02	10	-10.50***	0.01	0.1
$x_{ml(g)_{crisis}}$	10	-5.34***	0.01	0.01	10	-26.09***	0.01	0.1
x_{dry}	1	-2.45	0.24	0.01	1	-30.27***	0.01	0.1

Notes : The lag column represents the number of lags included in the ADF regression, guided by the Akaike Information Criteria.

Table 9

	F-statistics	Statistic	Lower-bound $I(0)$	Upper-bound $I(1)$
Base model	6.02	-5.43***	-3.43	-4.98
ToU model	22.73	-12.29***	-3.43	-4.98

Notes : Critical bounds are provided at 1% significance level

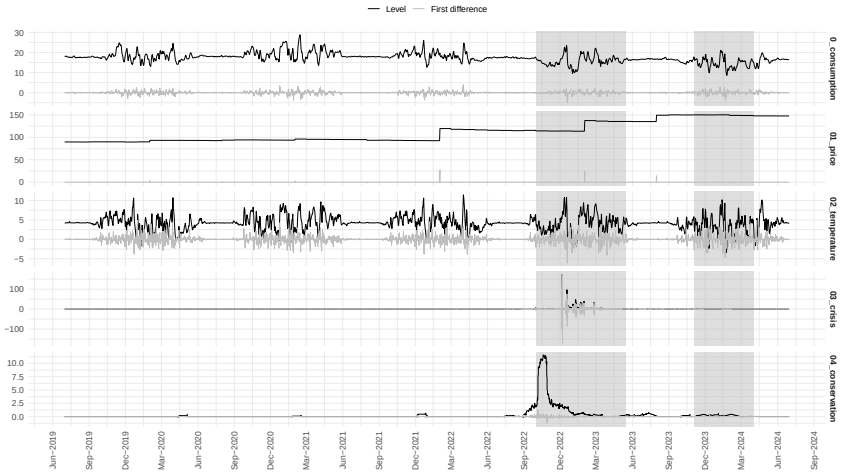

Figure 11: Main Regressors - (Off-Peak)

When an attention variable x_m enters both directly and through interaction with the load-control dummy x_{load}, the specification is:

$$e_t = \ldots + \beta_m x_{m,t} + \beta_{m\times load}\,(x_{m,t} \times x_{dry,t}) + \epsilon_t. \tag{3}$$

Short-run effects:

$$\hat{x}_m = \beta_m \quad (x_{load} = 0), \qquad \hat{x}_{m+load} = \beta_m + \beta_{m\times load} \quad (x_{load} = 1).$$

Long-run effects (RECM multipliers):

$$\hat{x}^{LR}_m = -\frac{\beta_m}{\phi}, \qquad \hat{x}^{LR}_{m+load} = -\frac{\beta_m + \beta_{m\times load}}{\phi}, \tag{4}$$

Standard errors obtained using the delta method

Return

Table 10: Contracted Power - RECM

	ToU - 6 kVA		ToU - 9 kVA		ToU - 12 kVA	
Variable	Elast.	Wh/day	Elast.	Wh/day	Elast.	Wh/day
Panel A. Price and Temperature						
Intercept		12,001***		14,771***		20,828***
		(1,350)		(2,121)		(1,885)
Price	0.1869***	−18.7***	0.1883***	−32.3***	0.1898***	−45.2***
	(0.0294)	(2.9)	(0.0359)	(6.1)	(0.0407)	(9.7)
Temperature	0.2307***	623.9***	0.2466***	1,143.4***	0.2236***	1,441.5***
	(0.0384)	(38.4)	(0.0785)	(78.5)	(0.1206)	(120.6)
Panel B. Attention Effects						
Conservation	0.0194	−811.5	0.0071	−512.2	0.0089	−889.0
	(0.0767)	(766.5)	(0.1561)	(1,560.9)	(0.2386)	(2,386.0)
Crisis	0.0018	−67.8	0.0034	−218.3	0.0036	−319.8
	(0.0013)	(125.6)	(0.0026)	(255.7)	(0.0039)	(390.1)
Panel C. Load Control Effects						
Load control	0.0093***	−506.5***	0.0100***	−931.7***	0.0111***	−1,440.9***
	(0.0031)	(167.8)	(0.0037)	(341.7)	(0.0052)	(521.6)
Conservation	0.0142	660.5	0.0045	361.7	0.0055	611.3
	(0.0781)	(780.7)	(0.1590)	(1,589.6)	(0.2428)	(2,428.2)
Crisis	0.0010	40.2	0.0024	163.8	0.0026	245.8
	(0.0013)	(125.9)	(0.0026)	(256.3)	(0.0039)	(390.9)
Panel D. Combined Effects						
Conservation	0.0069**	−151.0**	0.0040	−150.6	0.0053	−277.6
	(0.0067)	(67.1)	(0.0136)	(135.7)	(0.0208)	(208.2)
Crisis	0.0014***	−27.6***	0.0017***	−54.5***	0.0016***	−74.1***
	(0.0009)	(8.6)	(0.0018)	(17.6)	(0.0027)	(26.8)
R^2	0.983		0.985		0.987	
Observations	1,839		1,839		1,839	

Notes : Elasticities represent the ratio of proportional changes in quantity demanded to proportional changes in independent variables; values below 1 in absolute value indicate inelastic demand. Estimates are expressed in Wh/day/contract. Data span July 1, 2019 to

Contracted power (kVA)

- Maximum electricity capacity available at any point in time

Table 11: Dwellings and Household Characteristics

	Base		ToU		
	6 kVA	9 kVA	6 kVA	9 kVA	12 kVA
Electricity (kWh/year)					
Total	5.1	7.6	12.0	14.8	20.8
Housing type					
Detached House	40.4	88.9	35.7	75.0	100
Appartement	59.6	11.1	64.3	25.0	0.0
Income (€/month)					
< 1 500	8.5	0.0	35.7	16.7	25.0
[1 500;2 500[	38.3	33.3	35.7	16.7	0.0
[2 500;3 500[	23.4	33.3	14.3	50.0	50.0
>= 3 500	29.8	33.3	14.3	16.7	25.0
Children (under 11)					
0	83.3	100.0	84.6	53.8	62.5
1	16.7	0.0	15.4	23.1	12.5
2	0.0	0.0	0.0	15.4	25.0
3+	0.0	0.0	0.0	7.7	0.0

Source : These aggregate are retrieve from Elecdom panel, which is a representative sample of 100 French households.

Contracted power (kVA)

- Maximum electricity capacity available at any point in time
- Higher contracted power allows for more simultaneous electricity usage

Table 11: Dwellings and Household Characteristics

	Base		ToU		
	6 kVA	9 kVA	6 kVA	9 kVA	12 kVA
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3+	0.0	0.0	0.0	7.7	0.0

Source : These aggregate are retrieve from Elecdom panel, which is a representative sample of 100 French households.

Contracted power (kVA)

- Maximum electricity capacity available at any point in time
- Higher contracted power allows for more simultaneous electricity usage
- Low power (6 kVA): Household in a smaller type of housing, with lower-income and no children
- High power (9-12 kVA): Household in a larger type of housing, with higher-income households and 2 to 5 children

Table 11: Dwellings and Household Characteristics

	Base		ToU		
	6 kVA	9 kVA	6 kVA	9 kVA	12 kVA
Electricity (kWh/year)					
Total	5.1	7.6	12.0	14.8	20.8
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Detached House	40.4	88.9	35.7	75.0	100
Appartement	59.6	11.1	64.3	25.0	0.0
Income (€/month)					
< 1 500	8.5	0.0	35.7	16.7	25.0
[1 500;2 500[	38.3	33.3	35.7	16.7	0.0
[2 500;3 500[	23.4	33.3	14.3	50.0	50.0
>= 3 500	29.8	33.3	14.3	16.7	25.0
Children (under 11)					
0	83.3	100.0	84.6	53.8	62.5
1	16.7	0.0	15.4	23.1	12.5
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3+	0.0	0.0	0.0	7.7	0.0

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