When Words Save Watts

Government Communication and Household Electricity Use

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Introduction

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1. Does government communication influence public attention?
2. Does public attention have an impact on household electricity consumption?

Insights from Literature

- Most of the economic literature on incentives for energy conservation relies on **strictly controlled experiments or theory** ; estimate energy decrease ranging from 2 to 7 %
  (Abrahamse et al., 2005; Delmas et al., 2010; Andor and Fels, 2018; Blasco and Gangl, 2023)

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

Government Communication $\rightarrow$ Public Attention $\rightarrow$ Electricity consumption $\rightarrow$ -1%

Background

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: Regulated Tariff Decisions

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

Notes : 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.

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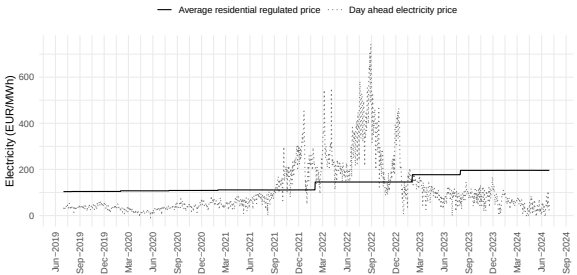

Figure: France Electricity Market and Regulated Prices

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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) + Televised information campaign

Identification Strategy

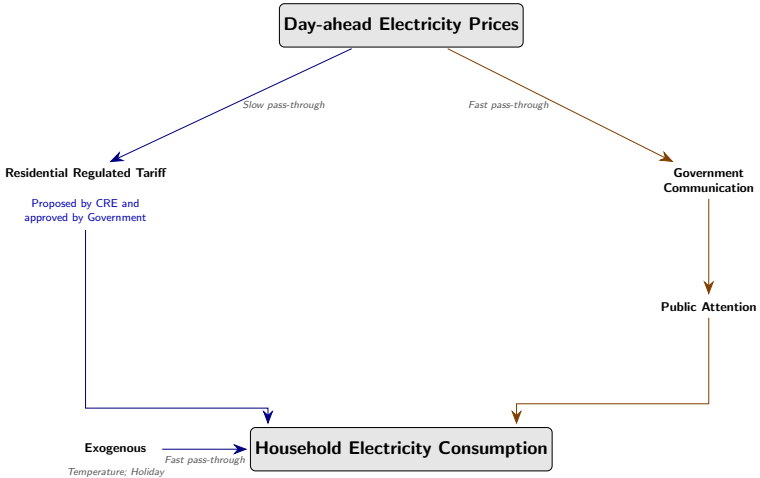


Figure: Directed Acyclic Graph (DAG)

Data

Table: 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

Data

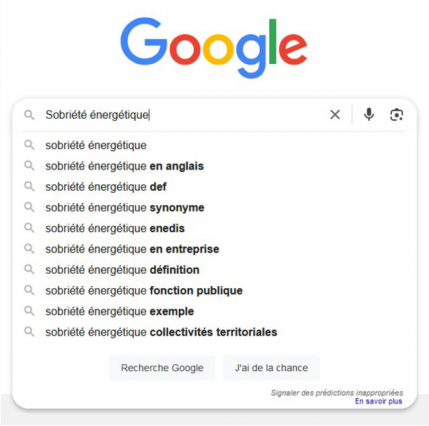
Top Search Queries

Government Communication

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

Public Attention

Daily Google Search Volumes (GSV)



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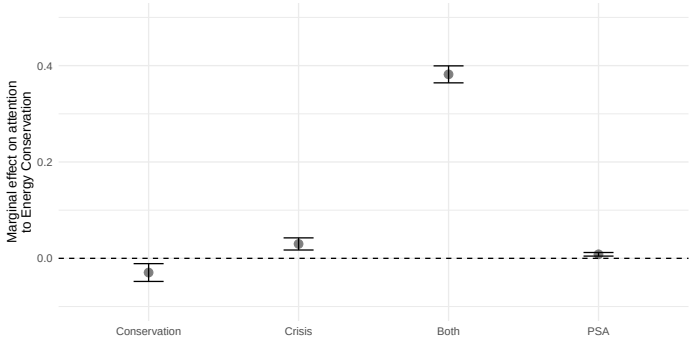

Figure: Government Communication on Public Attention - Energy Conservation

Attention to Energy Conservation

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

Data

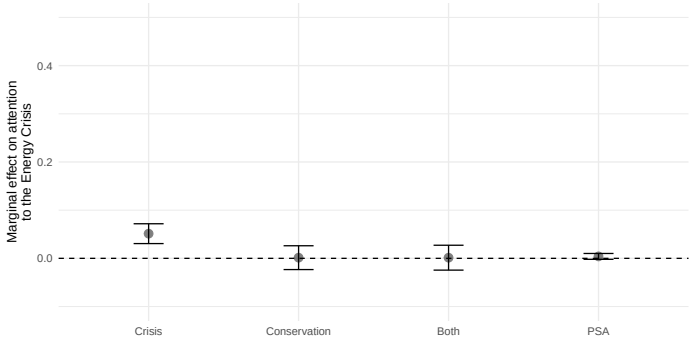

Figure: Government Communication on Public Attention - Energy Crisis

Attention to Energy Crisis

Household paying attention to the crisis because of potential blackout

Data

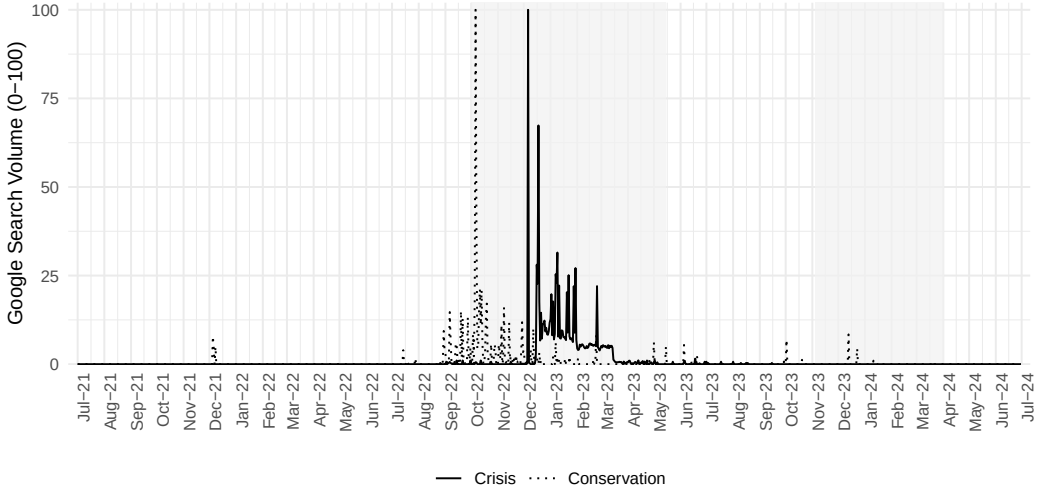

Figure: Daily Attention for Energy Topics

Econometric Framework

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)

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Unit roots and Bound tests | Linear Specification

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- x_{P_e} : Variable part from price (EUR/MWh)
- 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

▸ Unit roots and Bound tests ▸ Linear Specification

Price Elasticity

- **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: 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	

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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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Attention Estimate

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

Table: Estimates - Conservation and Crisis Attention

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Variable	Elast.	Wh/day	Elast.	Wh/day
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Panel. Attention Effects				
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)
Crisis	0.0016^{**}	-22.1^{**}	0.0016^{**}	-46.9^{***}
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- **Margins of adjustment for households**
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  - Elasticity is significant and homogeneous across groups
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- **Attention to Crisis (Blackout)**
  - Elasticity is significant and homogeneous across groups
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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: 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^{***}
	(0.0005)	(8.9)	(0.0003)	(11.6)
R^2	0.986		0.986	
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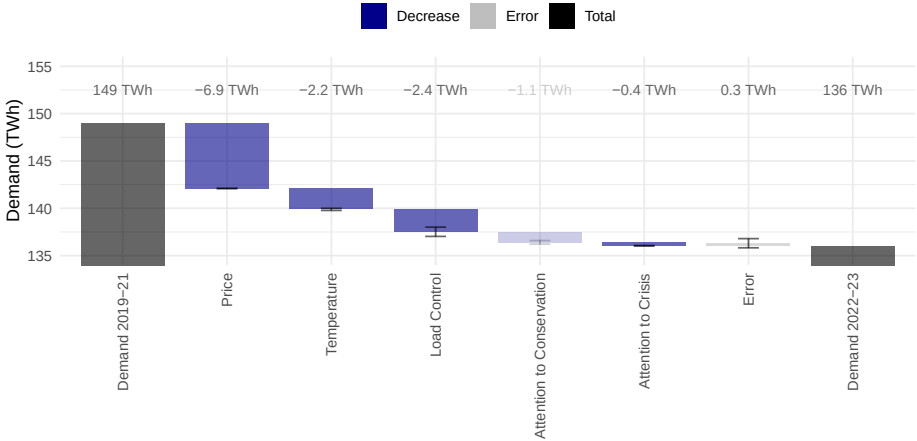

Figure: National residential electricity decrease decomposition

Conclusion

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

References I

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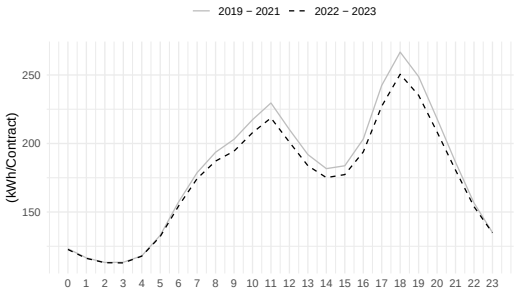
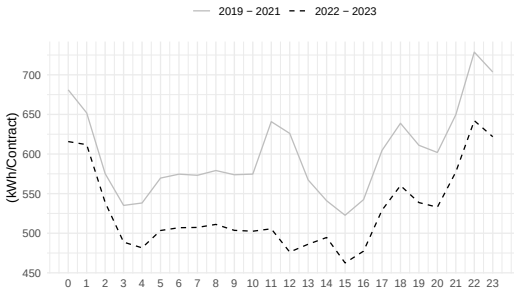
Return



(a) Winter - base



(b) Winter - ToU

Figure: Average hourly load by season and tariff profile

Return

Table: 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: 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%)

Return

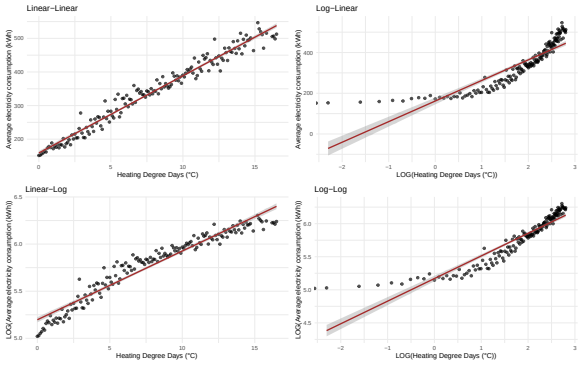


Figure: Replicate from Jamissen et al. (2024)

Recover the elasticity from linear-linear

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

Return

Table

	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
$x_{m(g)_{con}}$	8	-3.51	0.48	0.02	10	-10.50***	0.01	0.1
$x_{m(g)_{crisis}}$	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

	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

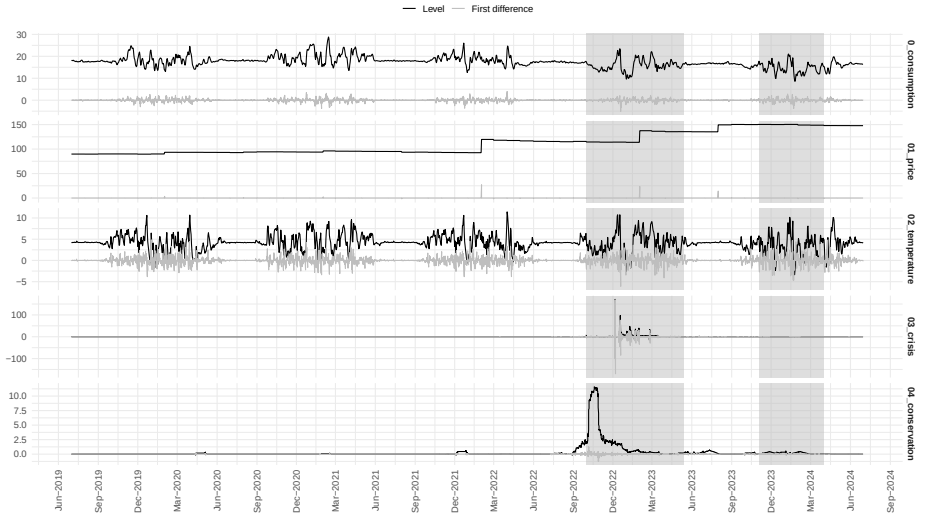


Figure: Main Regressors - (Off-Peak)

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: 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	

Contracted power (kVA)

- Maximum electricity capacity available at any point in time

Table: 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: Dwellings and Household Characteristics

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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: Dwellings and Household Characteristics

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