Local Money for Global Climate? Impact of a local energy efficiency subsidy program on energy use and job creation

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Abstract

Subsidy programs for home energy retrofits are a popular tool to reduce CO_2 emissions. Should they be implemented at the national level to leverage economies of scale or at the local level to more finely identify the best opportunities? To examine this question, we evaluate a program introduced in the French department of Essonne and compare its performance to that of its national counterparts. In a difference-in-differences framework, we identify a 8% reduction in residential natural gas use induced by the program, implying a carbon abatement cost of € 44/tCO_2eq. In a triple-difference framework, we further identify a 27% increase in employment in the renovation sector in Essonne, as opposed to non-renovation sectors and neighboring departments, implying about 20 jobs created per million euro spent. Looking more carefully at contractors' origin, we find that households were more likely to hire an Essonian firm than an equally distant one based outside Essonne. Altogether, our results suggest that local programs perform better than their national counterparts, and that a fair share of their benefits are retained locally. This calls for a stronger involvement of local authorities in managing home renovation policies.

1 Introduction[1]

Subsidy programs for home energy retrofits are a widespread policy tool in rich economies. They are typically implemented at the national or state level – e.g., Italy, France, Denmark, Germany, the UK, Massachusetts, Connecticut – and, to a lesser extent, at local or municipal levels – e.g., Baltimore, Chicago, Detroit, Portland (Kerr and Winskel, 2020). Their motivation is to provide households with a range of benefits – chiefly CO_2 emission reductions, but also health improvements, easier access to credit (Eryzhenskiy et al., 2023) and reduced internalities (Allcott and Greenstone, 2012) – while providing a stimulus for the renovation industry. This joint objective raises the question of which level is the most appropriate to roll out home energy retrofit programs – national or local? One could argue that industry stimuli are most effective the wider they are, thus enabling economies of scale. On the other hand, home renovation essentially relies on local contractors. It is moreover a tailored technology akin to a credence good (Giraudet, 2020). Identifying the most cost-effective opportunities thus requires a good understanding of the housing stock, which is arguably best achieved by local agencies. The answer to the scale question is therfore ambiguous.

France provides a good case study to compare the merits of local and national programs, owing to a particularly rich and diversified policy portfolio. Since 2005, a number of programs have been implemented at the national level, including direct subsidies under the *MaPrimeRénov'* (MPR) program, utility-sponsored subsidies under the *Certificats d'économies d'énergie* (CEE) program, zero-interest loans under the *Eco-prêt à taux zéro* (EPTZ) program and value-added tax (VAT) breaks. Total spending on these programs amounted to € 6 billion in 2023. Meanwhile, myriad

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[1]We thank Conseil Départemental 91 and ANAH for providing the program data data and giving us feedback.

programs have been implemented in local jurisdictions. According to the latest count,[2] this includes 1 regional program (the highest-tier jurisdiction[3]), 8 departmental ones (the second-highest), 7 municipal ones and 389 territorial ones (sub-departmental, cross-departmental or cross-regional), if we restrict attention to programs financed by a single jurisdiction. More than 150 programs are co-financed by at least two jurisdictions, most often by a department and a municipality. All these local programs have been much less well documented than their national counterparts, let alone properly evaluated. We are not even aware of any estimate of their aggregate cost, which, with so many programs, each typically costing several million euros a year, could well add up to half to one billion euros a year.

In this context, we evaluate *Prime éco-logis 91* (PEL), a local program implemented in Essonne, one of the 101 French departments. Located in the southern vicinity of Paris, Essonne had a population of 1.3 million in 2019. The program, launched in 2019, has benefited 30,339 households between 2019 and 2022, for a total public cost of € 54.3 million. This amount is similar to that spent by the government in the same department under the MPR program. To investigate all relevant aspects of the scale question, we focus on the impact the program had on two outcomes – energy use and job creation – and compare it to the benchmark obtained with flagship national programs – MPR and CEE. In addition to investigating the scale question, our focus on a local program fills an important research gap in that, given their prevalence, failing to account for their impact may bias evaluations of national programs. Our focus moreover seizes an methodological opportunity, as the spatial limits inherent in sub-national programs tend to make it easier to build a non-treated group than with national programs.

We estimate the impact of PEL on yearly energy use in a difference-in-differences framework comparing municipalities inside and outside Essonne, within a 5-kilometer bandwidth on each side of the border. We find that the treatment group experienced a statistically significant 7.6% reduction in natural gas consumption in 2020 and 2022. In turn, we find a 2% increase in electricity consumption for the year 2021, which may be due to program-induced heat pump adoption. In robustness tests, we check that no such effects were observed with non-residential energy use. Under conventional assumptions, our estimates translate into a public cost of € 44 per ton of avoided CO_2-equivalent emissions – well below the € 250/tCO_2-eq value estimated for France in 2030 (Quinet, 2019) and even below the € 150/tCO_2-eq value estimated by (Wald et al., 2023) for the CEE program.

We estimate the impact of PEL on renovation activity in a triple-difference framework comparing economic activity – measured by firm number and firm size – in the renovation sector versus non-renovation sector, in Essonne versus in neighboring departments. We find a 30 percentage point higher effect on employment in the renovation sector in Essonne, as opposed to other sectors and to neighboring departments. In contrast, we find only a modest effect on the number of firms. Taken together, our estimates imply 1,040 new jobs, hence about 20 per M€ spent. This compares favorably with (Cohen et al., 2024)'s estimate of 1.4 jobs per M€ under the CEE program and is close to the 22 figure obtained by (Popp et al., 2020) with the US Inflation Reduction Act (IRA). Comparing the program's statistics with MPR's Essonne sample in regressions, we find that the share of Essonne-based contractors is 16 percentage points higher in PEL-backed renovations than in MPR-backed ones. This is mainly due to an Essonne-premium effect rather than a proximate effect.

Altogether, our results suggest that the PEL program performs at least as well as the flagship national programs, and that its benefits are retained locally. This could be due to a stronger involvement of local agencies in advertising for the program, in turn due to a closer alignment of incentives between public spending and the revenue from corporate taxes, which accrues locally. This calls for a stronger involvement of local agencies in aministrating subsidy programs. In addition, a more systematic evaluation of the numerous local programs implemented in France is needed.

Our analysis contributes to the vast literature evaluating subsidy programs for home energy retrofits. Besides international studies (Metcalf and Hassett, 1999; Giraudet et al., 2018), this

[2]As gathered from a database assembled by *Agence Nationale pour l'Information sur le Logement* (ANIL).
[3]French Departments are NUTS-3 and French Regions are NUTS-2 in the EU classification.

literature has been substantial in France, including (Nauleau, 2014; Risch, 2020; Chlond et al., 2023; Eryzhenskiy et al., 2023; Wald et al., 2023; Cohen et al., 2024). Our main contribution is to address the scale question, which to our knowledge is unstudied despite its economic importance. To achieve this, we extend the analysis to economic activity, which only a handful papers have done (Cohen et al., 2024).

The rest of the paper is structured as follows. Section 2.1 provides an overview of the program and accompanying ones. Section 3.1 details the demand-side analysis. Section 4 details the supply-side analysis. The final section concludes.

2 Background

2.1 The Prime Eco-Logis 91 program (PEL)

Prime Eco-Logis 91 (henceforth PEL) is a subsidy program for home energy retrofit launched by the Departmental Council of Essonne in April 2019. The program provides financial support for investing in insulation measures (window, roof, wall), heating system improvement, ventilation and solar panel installation. The subsidy is ad valorem with a 30% rate. This rate can be applied to a minimum amount of € 3000 and a maximum of € 5400, which places a € 1800 cap on the subsidy amount. Eligibility applies to all owner-occupiers, provided their Essonian residence is their principal one, and irrespective of their income and their dwelling type (singe- versus multi-family). Since 2020, bonuses of up to € 1000 apply to low-income households. Also since 2020, a € (500 bonus applies to renovations that include the replacement of fuel oil heating systems with a low-carbon option.

The program was launched with an active informational campaign carried out by the Departmental Council, involving mailing, billboard advertising and media advertising. This effort has since then been sustained with Espaces France Renov.

Take-up was initially low, with only 6,354 subsidies approved in 2019. It then ramped up with 8,159 subsidies in 2020 and 13,663 in 2021, perhaps spurred by the spike in renovation dynamics that was broadly observed in France during the Covid-19 outbreak. The high share of low-income households among beneficiaries – 21% in early 2020 and 46% in late 2021 – suggests the changes that were introduced in 2020 also played a role. By the end of 2022, 30,339 subsidies had been paid out, with an average amount of € 1,780.

2.2 Overlapping national policies

PEL beneficiaries are allowed to benefit from subsidies granted for the same measures under overlapping national programs. Particularly diversified, the French portfolio of national subsidy programs includes tax credits since 2005, utility-sponsored subsidies under the *Certificats d'économies d'énergie* (CEE) program since 2006, zero-interest loans since 2009, subsidies targeting low-income households under the *Habiter Mieux* program since 2010 and reductions on value-added tax (VAT) since 2014. In 2020, the tax credit and *Habiter Mieux* programs were merged into a single program called *MaPrimeRénov'* (MPR), making it the foremost national program.

In 2021 and 2022 combined, there were 34,685 PEL beneficiaries and 11,213 MPR beneficiaries in Essonne. Despite being three times fewer, MPR subsidies were also about three times bigger – € 23,842 on average, against € 8,600 for PEL. As a result, the two programs had a similar public cost of € 267M for MPR and € 243M for PEL.

2.3 Overlapping local policies

To our knowledge, nine local programs are available in parts or the whole of Essonne alongside PEL.[4] This includes one subsidy program for energy audits that is also available in six other departments from the Ile-de-France region (*Audit énergétique et maîtrise d'œuvre globale de la Métropole du Grand Paris*), one applying to a territory shared between Essone and Seine-et-Marne

[4]As gathered from the ANIL database. It should nevertheless be emphasized that local programs are virtually unstudied in France and that this database may be incomplete.

(*Aide au financement de l'ingénierie à destination des copropriétés Grand Paris Sud Seine Essonne Sénart*) and another one restricted to a territory shared between Essonne and Loiret, a neighboring department that is not part of Ile-de-France (*Aide à la rénovation énergétique du Parc National du Gâtinais*). The six remaining programs are restricted to certain Essonnian municipalities, including Saclay, Evry-Courcouronnes, Palaiseau, Breuillet, Massy and Epinay-sur-Orge.

3 PEL impact on energy use

3.1 Empirical strategy

Identification. We follow a standard difference-in-differences approach comparing energy use in Essonnian municipalities to that of neighboring municipalities outside Essonne, before and after introduction of the PEL program. In an effort to ensure both data reliability and statistical power, we carefully select municipalities to build our treatment and control groups, as detailed hereafter.

Geographical sampling. The Essonne department has a density of 728 inhabitants per square meter as of 2018. It is surrounded by six departments of varying densities – Yvelines (630 inhab./km^2), Hauts-de-Seine (9,159 inhab./km^2), Val-de-Marne (5,719 inhab./km^2), Seine-et-Marne (240 inhab./km^2), Loiret (101 inhab./km^2) and Eure-et-Loir (74 inhab./km^2), all mapped in Figure A1 in the Appendix. Together with the first four, Essonne belongs to the Ile-de-France region, which also includes Paris. To build our control group, we focus on Essonne's two most densely populated neighboring departments within the Ile-de-France region – Hauts-de-Seine and Val-de-Marne.

With this, we select municipalities from either side of the Essonne border within a certain bandwidth, set to 5 kilometers to ensure both statistical power and a fine balance between the treated and control groups. To do so, we use shapefiles for the contours of both municipalities and IRIS, an infra-municipal unit corresponding to neighborhoods of at least 2,000 inhabitants. The data are provided by the National Institute of Geographic and Forest Information (IGN).[5] After adding two municipalities that were too small to be captured by our sampling procedure – Wissous in Essonne and Ablon-sur-Seine in Val-de-Marne – we end up with 21 Essonian municipalities in our treatment group and 29 municipalities in our control group – 10 from Hauts-de-Seine and 19 from Val-de-Marne. Figure 1 depicts our selection. Our dataset is thus a balanced panel of 50 communes observed over 12 years, yielding 600 observations. As detailed in Table B1, it contained 1.3 million inhabitants in 2018, including 0.5 million from Essonne, in turn representing 38% of the department's population.

Energy use data We use data on energy use made publicly available by energy network operators.[6] We focus on yearly data on electricity and natural gas deliveries at the municipality (*commune*) level from 2011 to 2022. We further restrict our sample to deliveries to the residential sector by four major providers that are present throughout the 2011-2022 period, together representing the bulk of deliveries. In placebo tests, we will study whether energy use also varied in other sectors not targeted by PEL, namely agriculture and industry.

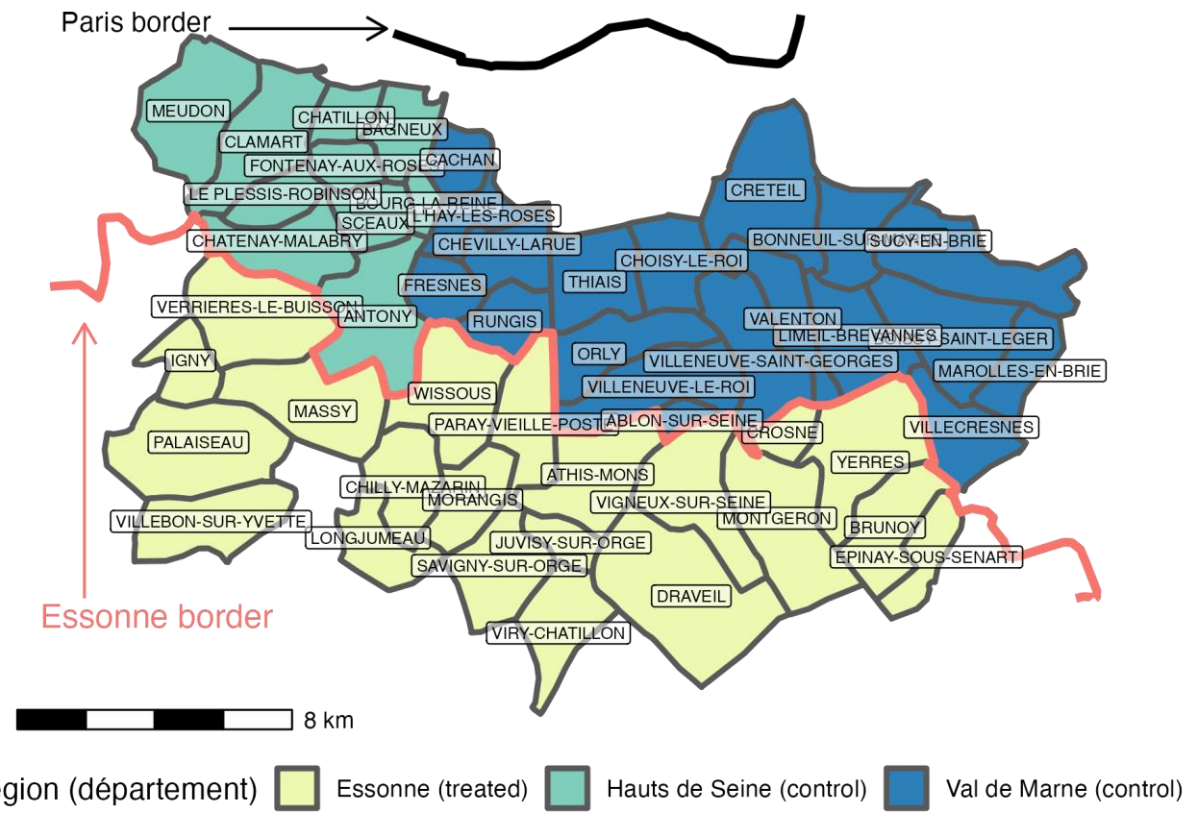
We normalize energy consumption by population at the municipality level, using census data.[7] We use the same data to derive municipalities' time-varying socioeconomic characteristics, including the share of population aged 60 or more, the share of retired population, the unemployment rate, the share of households with two cars or more, the share of vacant housing and the share of social housing. As census data are only available up to 2021 at the municipality level, we use the 2021 value of demographic variables for 2022.

[5] We use the GEOFLA dataset for municipalities and "Contours...IRIS" for IRIS. The latter, provided by IGN, contains the IRIS of all communes with at least 10,000 inhabitants and most communes of 5,000 to 10,000 inhabitants. We compute distances between the residential IRIS contours in Essonne and the control departments. We then constrain the distance to the nearest residential IRIS across the border to 5 km and use all the municipalities that contain at least one such IRIS.

[6] The data are available through Agence ORE *(Opérateurs de Réseaux d'Energie)*.

[7] Census data are made available here by INSEE, the National Statistics Office.

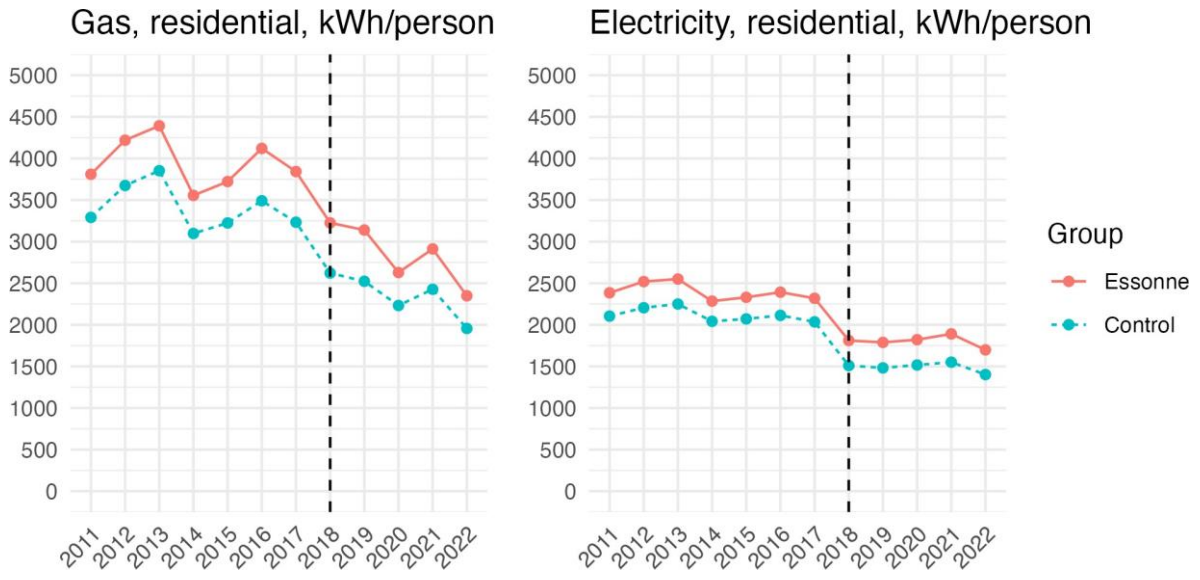
Figure 1: Energy consumption: sample municipalities



Notes: Municipalities around the northern border of Essonne, selected by presence of residential IRIS units in at most 5 kilometers away from the border. See Figure A1 for a map of the whole Essonne and surrounding departments.

Parallel trends. To validate our difference-in-differences approach, we compare trends in energy use in our treatment and control groups in Figure 2. Despite the higher energy use in the treated

Figure 2: Gas and electricity consumption per capita, Essonne vs. control municipalities



Notes: Average energy consumption per capita calculated on municipality-level panel and weighed by municipality population. Data: Agence ORE.

group, the two groups follow parallel trends, both in terms of electricity and natural gas. No clear divergence is observed after 2019, except for a more pronounced dip in natural gas use in Essonnian municipalities in 2020. As we will see later, regressions will confirm the absence of pre-2019 trends and more precisely estimate the post-2019 effects.

Although close to each other, the municipalities of the three departments are not necessarily comparable in their demographic and economic characteristics. As detailed in Table B2, municipalities in our treatment group are in fact less populated, have fewer social housing and more households with two cars or more. Accordingly, they also have a higher electricity and natural gas consumption per capita. These differences do not threaten our identification strategy, which rather relies on the parallel pre-trends assumption. They nevertheless call for including most variables of Table B2 as time-varying controls in our regressions.

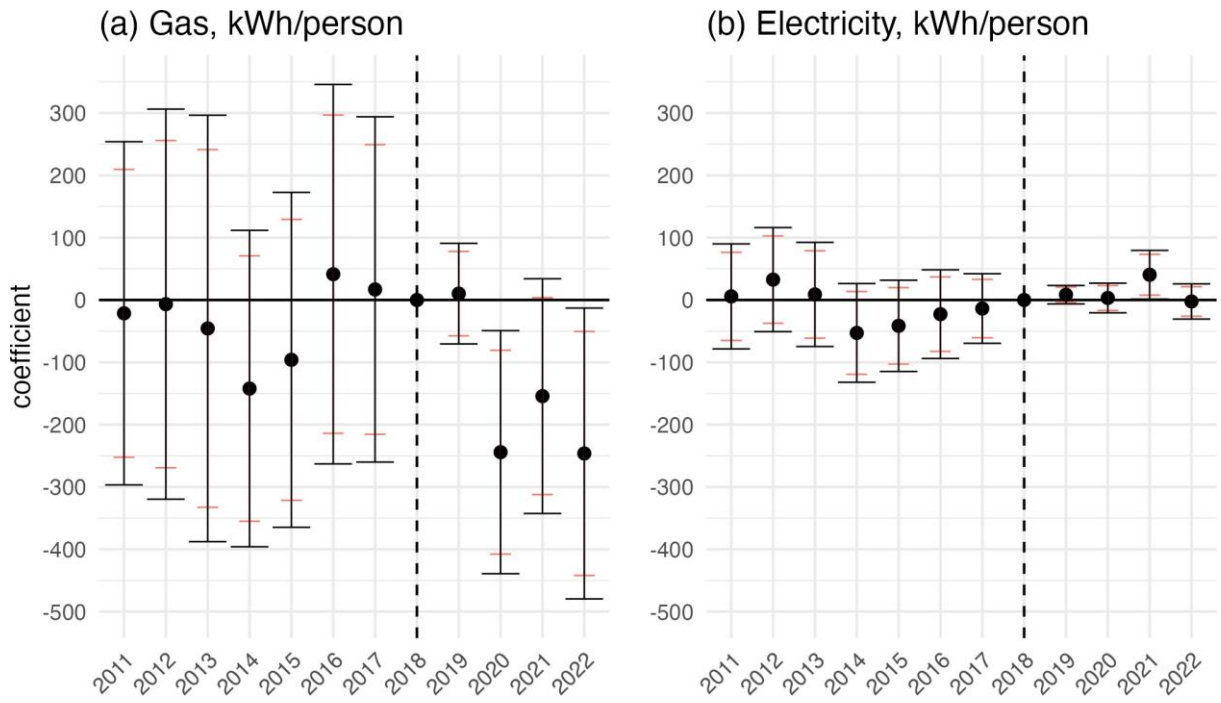
Model. We run regressions with the following difference-in-differences model:

$$Y_{c,t} = \sum_{t=2008} \theta_t(\text{Essonne}_c \times \tau_t) + X'_{c,t}\gamma + \phi_c + \tau_t + \varepsilon_{c,t} \quad (1)$$

where $Y_{c,t}$ measures energy use in municipality c and period t, τ_t is a year dummy (and a year fixed effect, with a slight abuse of notation), ϕ_c is a municipality fixed effect and $X'_{c,t}$ are time-varying controls. The coefficients of interest θ_{2019}, θ_{2020}, θ_{2021}, and θ_{2022} measure the effect of eligibility to PEL on energy consumption. Our framework therefore captures an intention-to-treat effect, rather than a treatment effect.

Figure A2 plots the distributions of the two main outcome variables. Natural gas use is bell-shaped, hence fit for an OLS regression. While the more skewed electricity data would rather lend themselves to a logarithmic transformation, we keep them in levels for the sake of comparability.

Figure 3: Event study: PEL and residential energy consumption



Notes: 95% confidence intervals (black) and 90% confidence intervals (red). Both regressions include time and commune fixed effects. Standard errors are clustered at commune (municipality) level. Time-varying control variables are listed in Table B2. Data: Agence ORE.

3.2 Results

Estimation. The difference-in-differences estimates are depicted in Figure 3. The non-significant coefficients prior to 2019 confirm the assumption of parallel pre-trends for both electricity and natural gas. Outcomes markedly differ across the two fuels after 2019, however. Natural gas use is similar in the two groups in 2019, then 244 kWh lower in the treated group in 2020 (significant at 5%), 154 kWh lower in 2021 (closely missing the 10% level) and 246 kWh lower in 2022 (again significant at the 5% level). The 2020 and 2022 effects represent an 8% decrease in the 3,230 kWh consumption of 2018. Electricity use is more stable across the two groups, save for a 40 kWh higher consumption in the treated group in 2021 (significant at 5%), representing a 2% increase from the 1,920 kWh consumption of 2018. We therefore conclude that the PEL program effectively helped lower natural gas use, while slightly increasing electricity use. The latter effect could be explained by the adoption of heat pumps supported by the program.

Placebo analysis In order to ensure that the differential trends we observe after 2018 are due to PEL, we examine energy use patterns in two sectors that are unlikely to be affected by the program – industry and agriculture.[8] The results exposed in Figure A3 are radically different from those of Figure 2. Both natural gas use and electricity use appear to be on the rise. A surge occurs in 2018 – a year prior to PEL roll-out – and it is in both cases stronger in the control group. In regression analysis, we find no detectable effect of the program.

Implied cost-effectiveness. We now relate our energy savings estimates to public expenditure by the local government. We focus on natural gas only, which is more strongly affected by the

[8]The commercial sector is also included in Agence ORE's dataset. We nevertheless exclude it from our analysis, for it could be indirectly affected by the program. For instance, a rise in the renovation activity induced by the program could plausibly increase commercial energy use.

program and also much more carbon intensive than electricity. We start with a naïve estimate relating expenditure and savings, each summed up over the 2019-2022 period. In the selected municipalities, the government spent € 16.24M in PEL subsidies between 2019 and 2022, hence € 34.45 per capita for a population of 471,218. Meanwhile, adding yearly point estimates yields 654 kWh cumulative savings per capita. We thus obtain a cost of € 53 per MWh saved. To put this number in perspective, the average price of natural gas in France fluctuated between € 78/MWh in 2020 and € 266/MWh in 2022. The so-called "negawatthour" cost is therefore below the megawatthour cost – it is cheaper to save energy than to sell it. Assuming a carbon content of 239 grams of CO_2 equivalent per kWh of natural gas,[9] this is equivalent to 156 kgCO_2eq avoided per person in the first four years of the program, at a cost of € 220 per tCO_2eq.

A more comprehensive approach would assume that the energy savings achieved in one year will persist in the future. Assuming a 16-year lifetime and a 4% discount rate, as is customary under the CEE program, the 654 kWh per capita achieved in 2019-2022 imply 3,673 kWh lifetime discounted savings up to 2038, hence a cost-effectiveness of € 9.4/MWh or € 44/tCO_2eq. This number is in line with the € 44.60/tCO_2eq carbon tax applying to residential natural gas use in France but well below the country's official Social Cost of Carbon of € 250/tCO_2eq for 2024 (Quinet, 2019).

4 PEL impact on the renovation industry

4.1 Renovation activity

Identification. We now assess the impact the program had on renovation activity, focusing on two margins – the number of firms and their size. We implement a triple difference framework exploiting three dimensions – time, department and sector. Specifically, we compare renovation activity (i) before and after PEL introduction (ii) in Essonne versus in neighboring departments and (iii) in the renovation industry versus unrelated sectors.

Renovation industry data. We proceed manually to sort out renovation activity and non-renovation activity. We use yearly panel data on firm count and total employment in 34 sectors, with its sub-sectors listed in Table B3.[10] We select three subsectors to form our "renovation" sector – installation of water and gas supply (NAF Code 43.22A), installation of thermal and AC equipement (43.22B), insulation (43.29A). We select subsectors of the other 33 sectors, to form our "non-renovation" sector. In building these two groups, we have filtered out some subsectors which we think are irrelevant for our analysis. For instance, we omit the "electricity works" subsector from the renovation group, although it belongs to the same NAF 2-digit code (43). In turn, we omit from the non-renovation group some sub-sectors that are likely to be affected by PEL, such as new construction and services provided at home (e.g., beauty, medical services, consulting).

Geographical sampling. We consider the whole of Essonne as our treatment group and the six neighboring departments – Hauts de Seine, Val de Marne, Seine et Marne, Loiret, Eure-et-Loir and Yvelines – as our control group. Depicted in Figure A1, this geographical sampling is broader than that used in the demand-side analysis, where we needed density to precisely estimate energy use [IS THIS THE CASE??? ANYWAY, PLEASE ELABORATE ON THE MOTIVATION].

Model. We run regressions with the following triple-difference model:

$$\begin{aligned} Y_{s,d,t} = \; & \beta_{Triple} \cdot \text{Renovation}_s \cdot \text{Post PEL}_t \cdot \text{Essonne}_d \\ & + \beta_{NonEssonneDiD} \cdot \text{Renovation}_s \cdot \text{Post PEL}_t + \beta_{RenovEssonne} \cdot \text{Renovation}_s \cdot \text{Essonne}_d \\ & + \delta \cdot \text{Post PEL}_t + \varphi_d + \gamma_s + \varepsilon_{s,d,t} \end{aligned} \quad (2)$$

[9] Assuming Higher Heating Value –see ADEME dataset Empreinte for emission factors

[10] The data are made available in open access by *URSSAF*, the Organizations for the Collection of Social Security and Family Benefit. Using INSEE's NAF classification, which is based on 4-digit codes, sectors are identified with the first two digits and subsectors are identified with the last two digits.

where $Y_{s,r,t}$ is either the number of companies or total employment in sector s in department d in period t. The outcomes are averaged over two periods – 2006-2018 (Post PEL$_t$ = 0) and 2019-2023 (Post PEL$_t$ = 1). Department d can take seven values – Essonne and the six neighboring departments. Sector s is one of the 34 sectors listed in Table B3. Renovation$_s$ is equal to 1 for the renovation sector and 0 for the non-renovation one.

Our coefficient of interest is β_{Triple}, which measures the degree to which renovation activity increased in Essonne relative to neighboring departments, which in turn is captured by $\beta_{NonEssonneDiD}$. Both β_{Triple} and $\beta_{NonEssonneDiD}$ are expected to be positive, since all departments were similarly exposed to the MPR stimulus from 2020 on. β_{Triple} is simply expected to be larger due to PEL. $\beta_{RenovEssonne}$ captures specific renovation trends in Essonne, compared to other sectors and other departments for the pre-PEL period. We have no particular expectation about its sign. We cluster standard errors at the sector × department level, since the treatment depends on both of these dimensions.

Results. The regression results are reported in Table 1. Our expectations are confirmed when it comes to workforce – employment significantly increased in the renovation sector after 2019, arguably due to the MPR program, and more so in Essonne, arguably due to PEL. As for the number of firms, we find an overall increase in the renovation sector after 2019, but no additional effect in Essonne. This implies that the PEL program essentially had an effect on the intensive margin of renovation activity. Altogether, our triple difference estimates correspond to a 6.4% increase in the number of firms (significant at 10%) and a 29.9% increase in the total workforce of the renovation sector in Essonne (significant at 1%).

Our estimates imply 1,040 new jobs, hence about 20 jobs per M€ spent. This estimate is in line with Popp et al. (2020)'s estimate of 15 jobs per m$ under the American Recovery Act. It is however much higher than Cohen et al. (2024)'s estimate of 1.4 jobs per M€ spent in the renovation industry under the French CEE program.

4.2 Contractors' origin

Motivation. The previous results suggest that the PEL program had an effect on local employment. We did not necessarily expect such an outcome. On the one hand, the program does not require households to hire local companies. Moreover, even though renovation is by and large a local industry, departments in Ile-de-France are so small relative to the rest of France that ren- ovation firms from that region could operate beyond their department of origin. It is therefore reasonable to expect that PEL has stimulated employment in neighboring departments as well.

On the other hand, we could think of good reasons why a local program may increase activity locally. First, the program administrators may know local firms better and advertise for them. We call it the "Essonne premium" hypothesis. Second, and perhaps more intuitively, consumers may preferably hire proximate firms, which we refer to as the "Proximate hiring" hypothesis.

To check whether PEL specifically created jobs within Essonnian firms and disentangle the two hypotheses, we compare the origin of contactors for renovation works carried out in Essonne under the PEL and MPR programs. Under the "Essonne premium" hypothesis, PEL subsidies are more likely to involve an Essonnian contractor than their MPR counterpart. Under the "Proximate hiring" hypothesis, we expect to see no difference in the origin of contractors between the two programs.

Program data. We use the MPR and PEL datasets, which both provide data at the subsidy level,[11] including information about the works carried out, the zipcode of the household and the zipcode of the contractor. We build on the coarser classification of works built in the PEL dataset, which includes three types of heating systems (gas-based, wood-based, heatpump) and three in- sulation components (window or door, wall, roof). We focus on the 2021-2022 period, as both datasets are less detailed in earlier periods.

[11]The PEL data were provided to us by the program administrator under a research contract. The MPR were made available to us by *ANAH*, the program administrator, under the ADEME-funded projects FRITE and BALOCLI [CHECK].

Table 1: PEL and local renovation sector dynamics: triple DiD

Dependent Variables:	Log(N firms)	Log(N workers)
Model:	(1)	(2)
Variables		
Renovation sector × Post PEL × Essonne	0.042	0.277***
	(0.067)	(0.090)
Renovation sector × Post PEL	0.177***	0.164**
	(0.038)	(0.061)
Renovation sector × Essonne	0.282	-0.106
	(0.200)	(0.259)
Post PEL × Essonne	0.061	-0.096
	(0.061)	(0.079)
Post PEL	-0.004	0.012
	(0.027)	(0.042)
Fixed-effects		
Sector	Yes	Yes
Department	Yes	Yes
Fit statistics		
Observations	473	473
R^2	0.714	0.754
Within R^2	0.004	0.002

Notes: triple difference estimates of regression (2). Sector defined at 2-digit NAF classification, after selection of 4-digit codes within each 2-digit code. Renovation sector: code 43.22 (plumbing, water, gas, heating and cooling installations) and 43.29A (insulation works). Control sectors selected to avoid a priori interference with home renovation. Standard errors clustered at sector × department levels are in parentheses. Data: URSSAF.

Descriptive evidence on the origin of contractors in PEL and MPR is provided in Figure 4. While nearly half of MPR subsidies realized in Essonne involve an Essonian firm, this share is as high as 78% for PEL subsidies. Moreover, while 10% of MPR subsidies involve a contractor from the same municipality as the household, this share goes up to 16% with PEL. This suggests that PEL activated both the "Essonne premium" and "Proximate hiring" channels. We now seek to confirm this insight in regressions with adequate controls.

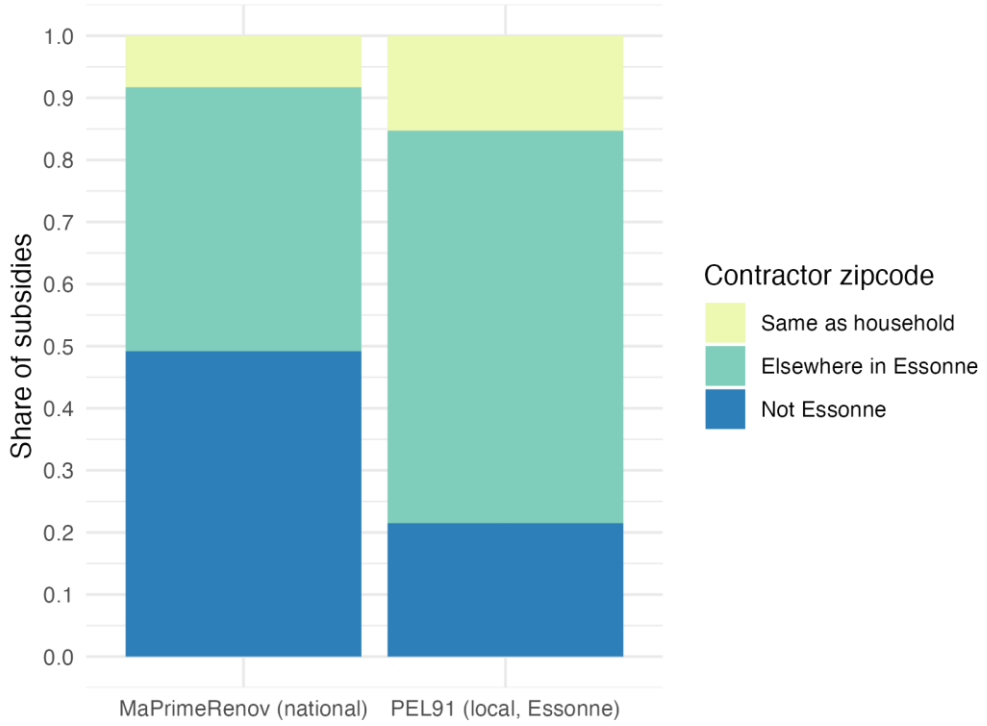
The "Essonne premium" hypothesis. We merge the PEL and Essonian MPR data and regress an "Essonne-based contractor" dummy on a "PEL" dummy. The constant therefore cap- tures MPR subisidies. We consider two model specifications, with and without fixed effects in- teracting municipalities and types of works. The type of work is important to control for since the two programs have entailed markedly different patterns. For instance, heatpump installation accounts for only 6% of PEL-backed works but 20% of MPR-backed ones. In turn, window and door insulation account for 33% of PEL-backed works but only 11% of MPR-backed ones. The municipality is also important to control for to capture income heterogeneity, provided that MPR amounts are more strongly increasing with income than PEL ones. Moreover, the share of non- Essonian contractors would naturally be higher in a program that would be more prevalent in border municipalities, such as the densely populated north of Essonne described above.

The regression results reported in Table 2 lend support to the "Essonne premium" hypothesis. The share of Essonne-based contractors is 28 percentage points (p.p.) higher in PEL-backed renovations than in MPR-backed ones. After controlling for works × municipality fixed effects, this share is still 16 p.p. higher in Essonne. Both estimates are significant at the 1% level.

Proximate hiring within Essonne. The "Essonne premium" implies that a household facing two equally distant firms from two different departments will select that from their own department. But what about two firms located in the same department as the household, but not equally distant from them? Does the program encourage the household to select the closest one?

To investigate this question, we restrict our sample to subsidies backed by an Essonne-based contractor and study whether the contractor is in same zipcode as the household. As reported in Table 2, contractors sharing the same zipcode as the beneficiary are 4.7 p.p. more likely to have backed a PEL subsidy than an MPR one. The effect is however weaker (1.4 p.p.), and also less significant (10% level, against 1%), after controlling for works × municipality. This confirms that PEL beneficiaries primarily hire Essonnian firms, and among them, more proximate ones.

Figure 4: Origin of renovation contractors: national vs. local subsidy



Notes: subsidy-level administrative data of MaPrimeRenov and PEL. Source: ANAH, departmental council of Essonne.

Table 2: Origin of renovation contractors: national vs. local subsidy

Dependent Variables:	Contractor from Essonne		Contractor from same zipcode	
Model:	(1)	(2)	(3)	(4)
Variables				
Constant	0.5076***		0.1487***	
	(0.0131)		(0.0120)	
PEL subsidy	0.2773***	0.1578***	0.0469***	0.0139*
	(0.0109)	(0.0067)	(0.0078)	(0.0063)
Fixed-effects				
Work type-Municipality		Yes		Yes
Sample				
	Full	Full	Only contractors from Essonne	Only contractors from Essonne
Fit statistics				
Observations	44,248	44,248	31,644	31,644
R^2	0.0711	0.2277	0.0021	0.2323
Within R^2		0.0221		0.0002

Notes: subsidy-level administrative data of MaPrimeRenov and PEL. Reference group in all regressions: MaPrimeRenov' (national) subsidies. Fixed effects in columns (2),(4): interaction of work type and municipality of household. Work types: gas heating, wood heating, heatpump, window/door insulation, wall insulation, roof insulation. Heteroskedacity-robust (White) standard errors in parentheses. Sources: ANAH, departmental council of Essonne.

5 Conclusion

We document a strong effect of the Prime Eco-Logis 91 program on both energy use and job creation, which compares favorably with the estimates obtained with overlapping national subsidy programs. Importantly, while the program generates both public and private benefits, a fair share of them is retained locally. This result emphasizes that, due to a lack of economies of scale and significant informational barriers, subsidy programs for home energy retrofits are best managed at the local level. Further research includes using different geographical sampling to build the control group and investigating how information about the program is channeled to prospective renovators.

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Table B1: Energy consumption sample: 2018 descriptives by department

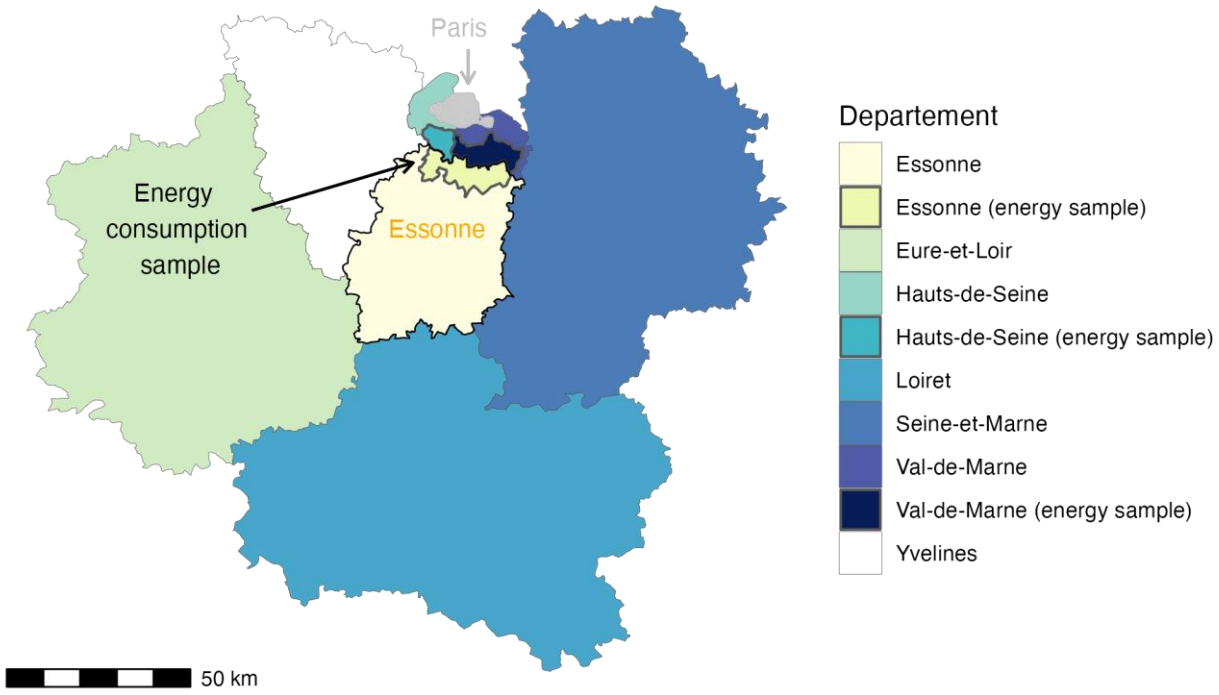
Department	Sample communes, n	Sample population	Share of department pop.
Essonne (treated)	21	470,314	0.38
Hauts de Seine (control)	10	368,906	0.23
Val de Marne (control)	19	489,801	0.36
Total	50	1,329,021	

Table B2: Energy consumption sample: balance of treated and control

	Essonne		Control	
Variable	Mean	Std.Dev.	Mean	Std.Dev.
Population	27333	11962	43164	23309
Older 60 y.o., share	0.21	0.03	0.20	0.03
Unemployment rate, 15 to 64 y.o.	0.11	0.02	0.12	0.03
Households with more than 1 car, share	0.30	0.07	0.21	0.08
Social rental housing, share	0.22	0.08	0.28	0.13
Vacant housing, share	0.06	0.02	0.05	0.01
Electricity per capita, MWh	1.84	0.42	1.55	0.38
Gas per capita, MWh	3.26	1.01	2.80	0.98

A Appendix

Figure A1: Departments included in renovation supply analysis



Geographic scopes of energy consumption analysis and renovation sector dynamics.

Figure A2: Energy spending distributions

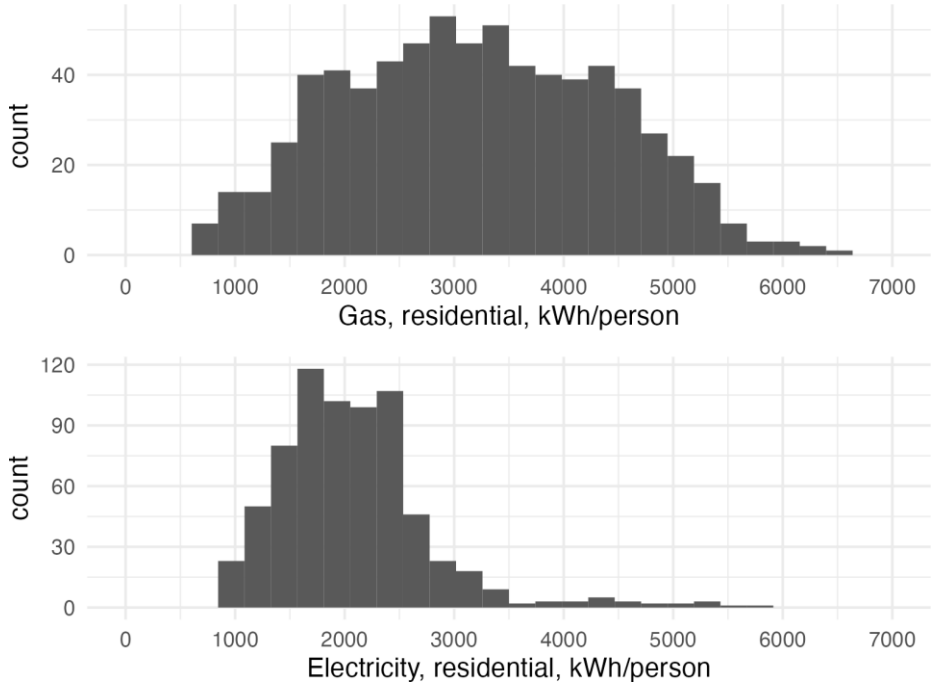


Figure A3: Non-residential sector trends, gas and electricity.

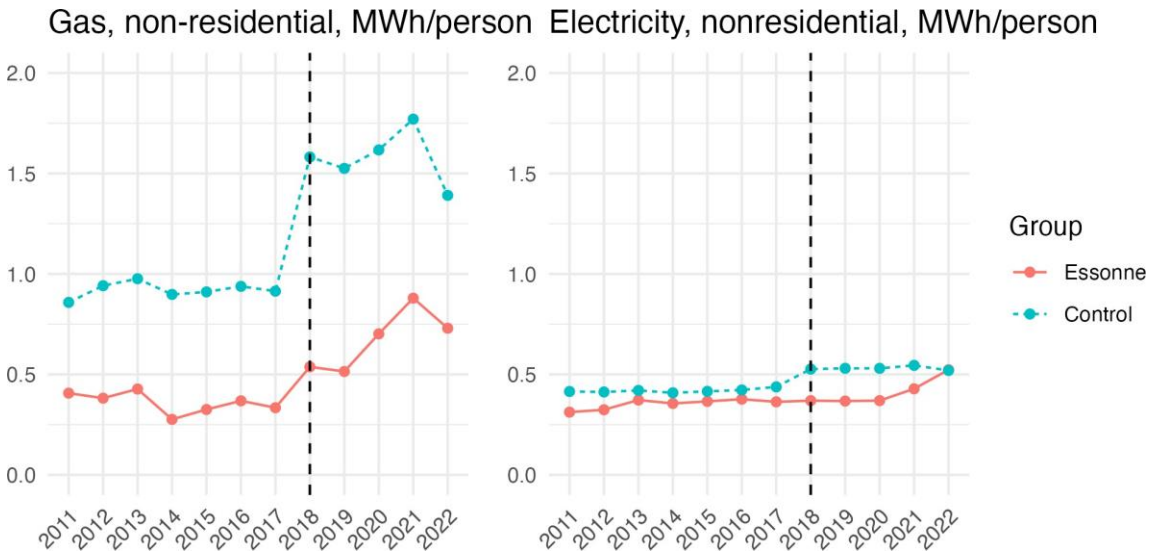


Table B3: Renovation sector dynamics: renovation and control sectors

2-digit code	4-digit NAF code and label	workforce 2008
43 (Renovation)	4322B Installation of thermal and air-conditioning equipment	16474
	4322A Installation of water and gas supply systems in buildings	9912
	4329A Insulation	1946
49	4910Z Interurban passenger railway transport	18814
	4941B Freight transport by road	17611
	4939A Regular passenger land transport	9916
	4932Z Taxi operation	5020
	4941C Rental of trucks with driver	3088
	4939B Other passenger land transport	2823
	4942Z Removal services	2707
	4931Z Urban and suburban passenger land transport	1929
	4950Z Transport via pipeline	827
	4920Z Rail freight transport	22
	4939C Cable transport	0
50	5020Z Sea and coastal freight water transport	270
	5010Z Sea and coastal passenger water transport	226
	5040Z Inland freight water transport	97
	5030Z Inland passenger water transport	88
51	5110Z Passenger air transport	13728
	5121Z Freight air transport	341
	5122Z Space transport	261
52	5210B Warehousing and storage	14438
	5229B Freight forwarding and cargo handling	9048
	5223Z Service activities incidental to air transportation	7451
	5229A Courier activities	6802
	5221Z Service activities incidental to land transportation	3155
	5224B Non-port cargo handling	2913
	5210A Cold storage	2243
	5222Z Service activities incidental to water transportation	76
	5224A Port cargo handling	24
53	5310Z Postal activities under universal service obligation	36035
	5320Z Other postal and courier activities	1545
58	5829C Publishing of other software	13798
	5814Z Publishing of journals and periodicals	11756
	5811Z Book publishing	3164
	5829A Publishing of systems software	2756
	5813Z Publishing of newspapers	1626
	5829B Publishing of development and programming tools	1436
	5821Z Publishing of computer games	858
	5819Z Other publishing activities	567
	5812Z Publishing of directories and mailing lists	140
59	5911A Motion picture, video and TV programme production	6468
	5912Z Motion picture, video and TV programme post-production	4125
	5911C Motion picture production activities	2831
	5914Z Motion picture projection activities	1247
	5920Z Sound recording and music publishing activities	928
	5913A Motion picture distribution activities	564
	5913B Video distribution activities	387
60	6020A Broadcasting of general-interest television programmes	5160
	6020B Broadcasting of thematic television programmes	2409
	6010Z Radio broadcasting	402
61	6110Z Wired telecommunications activities	24032
	6120Z Wireless telecommunications activities	16513
	6190Z Other telecommunications activities	5058
	6130Z Satellite telecommunications activities	732
62	6203Z Computer facilities management activities	7369
	6209Z Other IT and computer service activities	3504
	6202B Third-party maintenance of IT systems and software	3269
63	6391Z News agency activities	646
	6312Z Web portals	407
	6399Z Other information service activities n.e.c.	124
64	6419Z Other monetary intermediation	67845
	6420Z Activities of holding companies	10340
	6492Z Other credit granting	8664
	6491Z Financial leasing	1818
	6430Z Activities of investment trusts	1612
	6411Z Central banking	1515
	6499Z Other fin. service activities, exc. insurance and pensions	437
65	6512Z Other insurance activities	30681
	6511Z Life insurance	6757
	6520Z Reinsurance	63
	6530Z Pension funding	20
66	6621Z Risk and damage evaluation	1326
	6629Z Other auxiliary insurance and pension funding activities	443
	6612Z Security and commodity contracts brokerage	149
	6611Z Administration of financial markets	10
70	7010Z Activities of head offices	48714
72	7219Z Research and development, other nat. sciences and engineering	26357
	7211Z Research and development, biotechnology	1470
	7220Z Research and development, social sciences and humanities	1188
73	7312Z Media representation	8383
	7320Z Market research and public opinion polling	7702
74	7420Z Photographic activities	1696
	7430Z Translation and interpretation activities	777
75	7500Z Veterinary activities	1714
78	7830Z Other human resources provision	6191
	7810Z Activities of employment placement agencies	1189
79	7911Z Travel agency activities	4644
	7912Z Tour operator activities	1428
	7990Z Other reservation service and related activities	1048
80	8010Z Private security activities	34745
	8020Z Security systems service activities	2605
	8030Z Investigation activities	80
82	8220Z Call centre activities	6958
	8230Z Organisation of conventions and trade shows	4200
	8292Z Packaging activities	3298
	8211Z Combined office administrative service activities	3038
	8291Z Collection agencies and credit bureaus	348
84	8430A General social security activities	13030
	8430B Administration of compulsory social security schemes	3712
	8430C Distribution of social security benefits	3692
	8413Z Regulation of and businesses optimization	3659
	8412Z Regulation of healthcare, educational and other soc. services	936
	8423Z Justice	45
	8411Z General public administration activities	8
	8425Z Fire service activities	7
85	8531Z Secondary education	6798
	8542Z Higher education	4640
	8553Z Driving school activities	3155
	8532Z Technical and vocational secondary education	2644
	8520Z Primary education	2039
	8541Z Post-secondary non-tertiary education	47
	8510Z Pre-primary education	38
	8560Z Educational support activities	13
86	8610Z Hospital activities	36402
	8690B Medical and pathological laboratories	4803
	8690A Ambulance services	4208
	8623Z Dental practice	3909
	8690D Activities of nurses and midwives	1137
	8622A Radiodiagnostic and radiotherapy activities	994
	8690F Other human health activities	365
	8622B Surgical activities	285
	8690C Activities of organ and tissue banks	0
90	9002Z Support activities to performing arts	4257
	9004Z Operation of arts facilities	1351
	9003B Other artistic creation	487
	9003A Artistic creation in the field of visual arts	171
91	9102Z Museums activities	225
	9103Z Operation of historical sites and other visitor attractions	197
	9104Z Botanical and zoological gardens and nature reserves activities	110
	9101Z Library and archives activities	76
92	9200Z Gambling and betting activities	1126
93	9321Z Activities of amusement parks and theme parks	15879
	9312Z Activities of sport clubs	11303
	9311Z Operation of sports facilities	1727
	9319Z Other sports activities	1105
	9313Z Activities of fitness facilities	484
94	9411Z Activities of business and employers membership organizations	3592
	9420Z Activities of trade unions	1489
	9412Z Activities of professional membership organizations	864
	9492Z Activities of political organizations	203
95	9511Z Repair of computers and peripheral equipment	4213
	9521Z Repair of consumer electronics	744
	9529Z Repair of other personal and household goods	673
	9522Z Repair of household appliances, home and garden equipment	647
	9523Z Repair of footwear and leather goods	276
	9512Z Repair of communication equipment	263
	9524Z Repair of furniture and home furnishings	241
	9525Z Repair of watches, clocks and jewellery	66
96	9603Z Funeral and related activities	2055
	9601A Wholesale laundries	2026
	9601B Retail laundries	1991
	9604Z Physical well-being activities	785