INTERNSHIP REPORT

Directorate Generale-Parc National des Forêts

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Paris School of Economics-Ecole d'Économie de Paris (PSE)

Master in Applied Economics-Public Policy and Development

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Cheffe de projet Charte et évaluation à la Direction du Parc National des Forêt

Contents

1. Introduction

I completed a three-month internship at the Parc national des Forêts in Arc-en-Barrois (Haute-Marne), specifically at the directorate of the Parc national des Forêts. Its role is to ensure compatibility between its preservation objectives and the exemplary development project for the area, which is defined and implemented with and by local stakeholders. For instance, during my internship, I primarily focused on evaluating the disutility caused by the installation of wind or photovoltaic infrastructure in the territory of a protected area.I communicated daily with my supervisor, Margaux Jacob, either via Zoom or by email when one of us was teleworking, and we used Google Docs to maintain a shared version of the project. My work initially consisted of three steps over six months. The first step was to develop a methodology and survey, including drafting the questionnaire, informed by a literature review and input from working groups, particularly for selecting relevant attributes, designing the alternatives and choice sets to be presented to participants, and establishing the criteria and process for selecting participants for the survey. The second step involved implementing the survey with support from a specialized company. This collaboration aims to conduct the survey, ensuring accuracy and efficiency in data collection. The third step focused on econometric analysis of the data, which involved analyzing the collected data using econometric methods to estimate disutility, willingness to pay, or willingness to accept compensation (using the choice experiment method). The final step was the preparation of a deliverable, including drafting a report that summarized the key messages and findings of the study, clearly presenting the results and their implications.

However, during the three months, I did not complete all the tasks. The internship can be divided into three phases, each lasting one month: first, reading reports about the Parc national des Forêts to understand how it works and its objectives as well as academic paper to examine the methods used to evaluate the disutility caused by the installation of wind or photovoltaic infrastructure in a protected area. These papers helped me to better understand the context of the study we were going to conduct, and introduced me to the econometric methods used for this type of analysis, particularly the discrete choice experiment. Second, under the guidance and supervision of Margaux Jacob and Tina[1]

[1] Researcher at The INRAE

Rambonilaza, I searched the literature to identify attributes relevant to our study. To discuss the attributes we would use, we organized a meeting in Tina's office at INRAE in Dijon. Afterward, I was in charge of gathering data on these attributes. The goal was then to have a very clear visual representation of the characteristics of these attributes in order to choose carefully the different levels of each attribute. We also aimed to adopt a longitudinal approach by combining data from all available years. Thirdly, we developed the questionnaire which is composed of two sections, one on the respondent's socio-demographic information and the other on the choice experiment. The last part was the most challenging to design. The objective was to determine the number of scenarios for each experiment (wind and photovoltaic). When Tina set the choice set with the software Ngene[2] I attempted to do the same thing with the software R, then we compared the result to select the most optimal solution. Margaux found pictograms to illustrate the attributes, which helped reduce cognitive bias for the respondents.I incorporated my supervisors' feedback. I also design maps that visualize the distribution of wind and photovoltaic infrastructure across each department in France. Additionally, I established the quota criteria and process for selecting participants for the survey. The questionnaire is predicted to be submitted in early September. In the meantime, I began drafting the report, including the introduction, context, literature review, and the design of our methodology.

2. Context

The Parc national des Forêts is the most recent of the 11 French national parks, established by Decree 2019-1132 on November 6, 2019, and located across both Haute-Marne and Côte-d'Or. This national park is dedicated to preserving lowland deciduous forests and enhancing the rich heritage of a rural area. Amid growing environmental concerns and the need to decarbonize economies, there is increasing pressure to expand wind and photovoltaic farms. The European Commission aims for 42.5% of renewable energy in member states' energy mixes by 2030, with France's target set at 40%. However, as of 2021, renewable energy accounted for only 13% of France's primary energy consumption, falling short of the EU's interim goal of 23%. In response, President Macron announced plans to double onshore wind production to 40 GW by 2050, leading to the adoption of the

[2] Software for Discrete Choice Experiment

Renewable Energy Production Acceleration Act in March 2023. This act introduces acceleration zones for renewable energy projects but excludes national parks and nature reserves from these zones. Several wind and photovoltaic farms have been authorized within or near the optimal adhesion area of the Forest National Park, with additional projects under consideration. In response, the Park's Board of Directors passed a resolution in 2021 opposing new industrial wind sites and large ground-mounted photovoltaic plants within this area, citing the Park's mission to protect natural, cultural, and landscape heritage. While acknowledging the importance of France's decarbonization goals, the Board believes that such developments are incompatible with the Park's objectives. To reinforce its stance, the Park plans to study the disutility caused by renewable energy installations within protected areas, focusing on how this disutility differs from that in unprotected areas and whether it varies based on the use of the space (e.g., residential vs. tourist areas). This study will be conducted in collaboration with UMR CAESAR of INRAE.

3. Content of My work

A. Literature review

I conducted a literature review on studies focused on evaluating preferences for wind and solar energy, particularly in the context of national parks. This review identified more than twenty studies published over the past two decades, highlighting several key aspects. One of the main conclusions of this review is the importance of "place attachment" in community acceptance of wind energy projects. This concept, described by Altman and Low (1992), refers to the strong emotional bond that residents and visitors can develop with a place, which is particularly relevant in national parks. Devine-Wright and Howes (2010) emphasize that these areas, often considered "exceptional territories," frequently encounter opposition to wind energy projects due to their perceived impact on the natural beauty and identity of the place. Aesthetic perceptions play a crucial role, with varying results depending on geographical and cultural contexts, as shown in studies by Frantál and Kunc (2011), Frantál, Bevk et al. (2017), and Devlin (2005). The location of wind turbines in relation to residential and tourist areas appears to be a determining factor. Numerous studies, such as those by Bishop (2002), Meyerhoff et al. (2010), and Molnarova et al. (2012), emphasize the importance of the distance between wind turbines and both

residential areas and aesthetically sensitive sites, thereby influencing the acceptability of the projects. In France, for example, Westerberg (2012) demonstrated that the distance of offshore wind farms from the coast is a crucial factor for tourists. Furthermore, Brennan et al. (2020) explored issues of distributive and procedural justice, revealing that community acceptance depends on the perception of the benefits and costs of wind energy projects. The impacts of renewable energy on biodiversity in national parks have also been widely discussed. Although the uncertain nature of these impacts complicates their inclusion in analyses, some studies have quantified these effects. For example, Kim et al. (2019, 2021) showed that the negative impact on marine biodiversity can have a deterrent effect on project acceptance, while Klain et al. (2020) quantified uncertainty using attributes that fluctuate between positive and negative levels, revealing a preference for wind farms that minimize biodiversity losses. Finally, the review highlighted tourist preferences regarding renewable energy in national parks. Hearne and Salinas (2002, 2005) demonstrated the importance of meeting visitor expectations in protected areas, while Naidoo and Adamowicz (2005) emphasized that an increase in biodiversity, such as the number of bird species, can enhance the attractiveness of nature reserves for tourists. Moreover, studies such as those by Biénabe and Hearne (2006) and Chaminuka et al. (2015) show a willingness among tourists to pay for biodiversity conservation, underscoring the importance of balancing sustainable development with the preservation of natural resources. This literature review demonstrates that perceptions, location, and environmental impacts are key factors influencing the acceptability of renewable energy projects, particularly in protected areas such as national parks. These elements are essential for guiding planning and management decisions in these sensitive environments.

B. Survey Design

One of the most important phases of my internship was my participation in designing the questionnaire alongside Professor Tina and Margaux. The questionnaire aimed at evaluating individuals' preferences for renewable energy infrastructure (REI) in French national parks, particularly wind and solar energy. As this was a national panel survey, we used quota sampling to ensure a representative sample of the French population. In the practical implementation of the survey, respondents first answered questions related to their socio-demographic situation (section 1) and their knowledge of the energy transition

(section 2). They were then invited to participate in choice experiments (section 3). Specifically, after explaining the objectives of France's climate policy and ongoing infrastructure projects, participants were asked to choose between different development options that would maximize their utility. The survey also explored their tourist practices and opinions on the impact of REI on national parks. The data collected will be analyzed econometrically to identify respondents' preferences and assess the potential impacts on their well-being, providing valuable insights for public policy analysis regarding the preservation of natural spaces. The purpose of the design is to limit the cognitive load on respondents. The method involves having respondents choose among alternatives that differ on a small number of attributes to increase the validity and reliability of their responses. The objective is to ascertain the preservation value of natural and cultural heritage in the face of the negative externalities of energy infrastructure, specifically by seeking to reveal the willingness to pay (WTP) to avoid such infrastructure. Since, in most cases, the areas where renewable energy (RE) infrastructure is located are sparsely populated rural areas, the focus is primarily on non-use and recreational values, targeting the French population that has either visited natural spaces or is likely to do so in the future for recreational purposes. There are essentially two practices related to national parks: day visits and overnight stays. In this current context, there is no reference situation (status quo) because we are not evaluating a public policy but rather an opt-out option (choosing neither option, essentially staying home). The key attributes we defined for the DCE, with input from experts and based on existing literature, are as follows:

- **Duration of Stay**: This attribute assesses how long tourists wish to stay, with levels ranging from one night to a week. This variation allows us to compare short stays (typically weekend trips) with longer stays, which are often concentrated in specific tourist regions. The goal is to analyze how the perceived value of a stay changes with its duration. Data show that the average length of stay varies by month and region, affecting the perceived value based on the length of the stay.
- **Accommodation Location:** This attribute examines the location of accommodations relative to national parks. Defined levels are,

- ➢ Immediate Proximity to National Parks: Accommodations located inside or near the parks benefit from privileged access to preserved natural landscapes, often with higher prices due to increased demand.
- ➢ Distance from Parks: Accommodations farther away, in surrounding rural or urban areas, are generally less expensive and offer economic benefits while reducing pressure on park ecosystems.

❖ **Presence of RE Infrastructure Nearby**:

➢ Wind Turbines: We defined several levels of distance between wind turbines and national parks to assess the impact on biodiversity and find a balance between wind development and conservation. Distances vary from 1 to 30 kilometers, based on current norms and regulations.

➢ Solar Panels: For photovoltaic installations, distance levels are determined based on visibility and co-visibility with historic monuments, with a minimum distance of 500 meters to avoid visual or spatial interference.

❖ **Dominant Feature of the Tourist Location**: This attribute examines the type of landscape or environment around tourist accommodations. The levels are:

➢ Mountain: Accommodations in mountainous regions offering spectacular landscapes and various outdoor activities.

➢ Forest: Accommodations in forested areas providing immersion in nature with activities such as hiking and wildlife observation.

➢ Agricultural Zones: Accommodations in agricultural areas offering agrotourism experiences.

➢ Built and Historical Heritage: Accommodations in areas rich in historical and cultural heritage.

❖ **Average Price per Night per Person**: This attribute varies the cost of accommodation to analyze its impact on tourist preferences. Levels range from 25 to 50 euros per night, reflecting the average expenses of tourists based on accommodation type.

The key scenario assumes that "you are planning a Nature & Heritage stay with people of your choice and need to select commercial accommodation for it. In the following, we will present different scenarios describing the environment of your accommodation for the

duration of your stay, from which you must choose the one you prefer." Each scenario is defined by several attributes:

Table 1: Recap of attributes and they levels

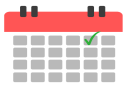
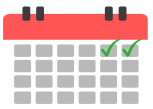
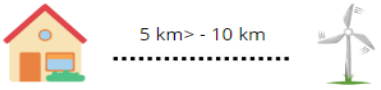
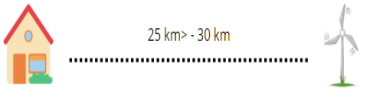
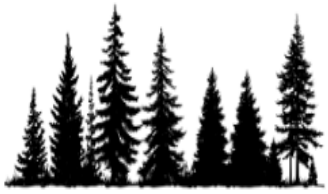
Attributes	Level	Nature	Parameters
Length of stay	3	Qualitative ordinal	2
Location of accommodation	6	Quantitative continuous	1
Presence of Wind or Solar within a certain radius	6	Quantitative continuous	1
Dominant characteristic of the vacation spot	4	Qualitative nominal	3
Average price per night per person in commercial accommodation	6	Quantitative continuous	1

Source: Own production, (2024)

Technically, we present 8 parameters and 2 alternatives (with the latter being an opt-out), meaning it does not take the lowest level of the attributes typically used to construct the status quo situation. The minimum number of choice sets required for the feasibility of our design must have enough degrees of freedom. We calculate it as follows: $S_{min} = \frac{K}{J-1} = \frac{8}{2-1}$, where K is the number of parameters and J is the number of alternatives, with $S_{min} = 8$, i.e., 8 choice situations. In practice, the number of choice sets must be divisible by the number of levels of each attribute, and more choices are needed to minimize information bias. Therefore, a minimum of 12 choice sets would be consistent because 12 is divisible by 2, 3, 4, and 6. Proceeding with 12 choice situations leads us to split them into two blocks. Furthermore, we decided to associate the "National Park" variable with distance to the accommodation. Essentially, the willingness to accept the distance from RE infrastructure is significantly higher for accommodations located near or within national parks. To generate the design, we used the software Ngene (ChoiceMetrics, 2018), which searched for the most efficient partial profile design within this candidate set based on the D-error criterion and

the Federov algorithm. Then, we got 12 choices from a set of experiments for the two infrastructures, one for the windshore and one for the solar. I tried to find the same result by using R code. This gives a similar result as from Ngene. An example of choice experiment set, is the following:

Table 2: Example of choice set

Caractéristique	Séjour A	Séjour B	
Durée du Séjour	 **Un week-end(2 jour, 1 nuit)**	 **Un court séjour (3 jours, 2 nuits)**	
Un hébergement au sein ou à proximité d'un parc national	 **Non**	 **Oui**	
Distance minimale entre le logement et un parc éolien	 **A 10 km**	 **A 30 km**	**Ni l'un ; Ni l'autre**
Paysage dominant	 **Paysage de Forêt**	 **Paysage de Patrimoine bâti**	
Prix du logement	 **40€/nuit/personne**	 **30€/nuit/personne**	

Source:Own production (2024)

4. Conclusion: strengths and Weakness of my experience

I learned quite a lot during my internship. This internship has provided me with significant technical and professional insights. I acquired skills in designing surveys for discrete choice experiments (DCE), which was a new experience for me. I consider this part of the study very important, as it would have allowed me to better understand the practical application of our design. I would have loved to see how the survey was conducted and how the data was treated before applying econometric methods. I was involved in every stage of designing a questionnaire for a discrete choice study aimed at measuring individual perceptions, which greatly enriched both my academic and practical knowledge. This experience also deepened my interest in academic research and strengthened my independence in conducting research. I was responsible for independently researching scientific articles under the guidance of my supervisors, understanding their methodologies, and addressing the issues and objectives related to our study. Preparing presentations on these articles every Monday and Thursday was crucial for establishing the foundations of the study's attributes. Furthermore, I researched data on various attributes, performed descriptive analyses to define the values levels, and created maps using R and Excel software. Beyond the academic aspect, this internship gave me insights into the challenges of ecological transition and the French political measures implemented to meet European Union goals. I gained a deeper understanding of the trade-offs between preserving natural spaces, particularly national parks in France, and the economic, social, and cultural values of these areas. This sparked in me a newfound passion for research in applied econometrics within the field of green economics. Another positive aspect of this internship was the opportunity to interact with specialists in various domains. Ms. Margaux, my supervisor, facilitated my integration into the team and created a very relaxed and motivating work environment. Her immediate availability was a source of strength and motivation for me. Similarly, Professor Tina, who explained theoretical foundations in a clear manner and guided the implementation of methods, provided very enriching supervision. This allowed me to improve my efficiency and critical thinking, enhance the quality of my writing, time

management, and responsiveness. In summary, I conclude this internship with a strong passion for research, particularly for applied econometrics within environmental economics.

The only thing I could say to mitigate my experience which was overall very positive, is the lack of time to go through the study. I regret not having had the opportunity to observe the survey process and the subsequent statistical and econometric analysis of the data, which has been postponed to the end of August due to the holiday period affecting the investigation team. I consider this part of the study very important, as it would have allowed me to better understand the practical application of our design. I would have loved to see how the survey was conducted and how the data was treated before applying econometric methods.

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Appendix

Design code on Ngene

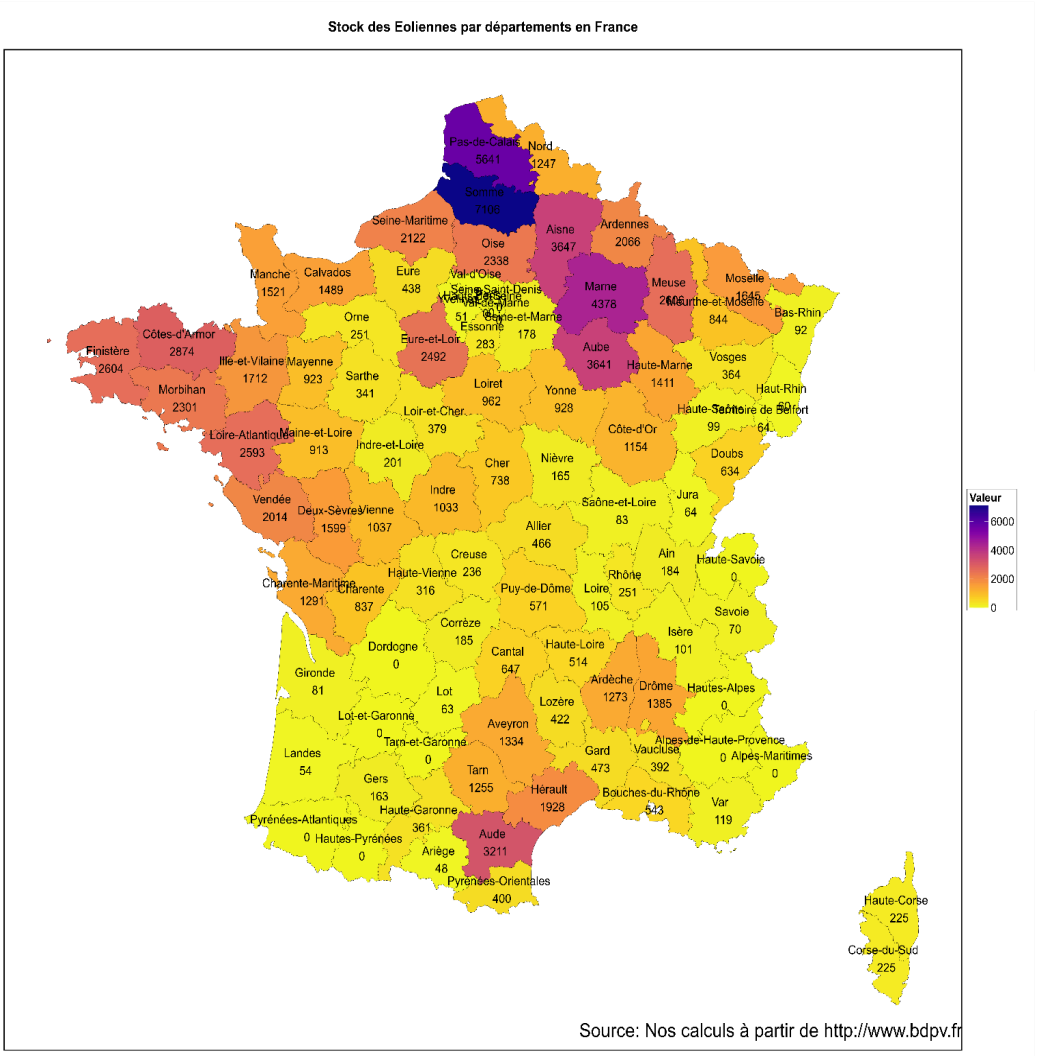
```
Design
;alts=alt1*,alt2*, alt3
;rows=12
;block=2
;eff=(mnl,d)
;alg=mfederov(stop=total(2mins))
;require :
alt1.dist<>alt2.dist,
alt1.cost<>alt2.cost
;model:
U(alt1)=b1.dummy[0.0001|0.0001]*sej[1,2,3]+b2[0.001]*pn[0,1]+b3[0.001]*dist[5
,10,15,20,25,30](1-2,1-2,2-3,2-3,1-2,2-3)
+b4.dummy[0.00001|0.00001|0.0001]*pays [1,2,3,4]+
b5[-0.00001]*cost[25,30,35,40,45,50](1-2,1-2,2-3,2-3,1-2,1-2)
+c1[0.00001]*pn*dist/
U(alt2)= b1*sej+b2*pn+b3*dist+b4*pays+b5*cost+c1*pn*dist/
U(alt3)= a3$
```

Design code on R for Solar wind

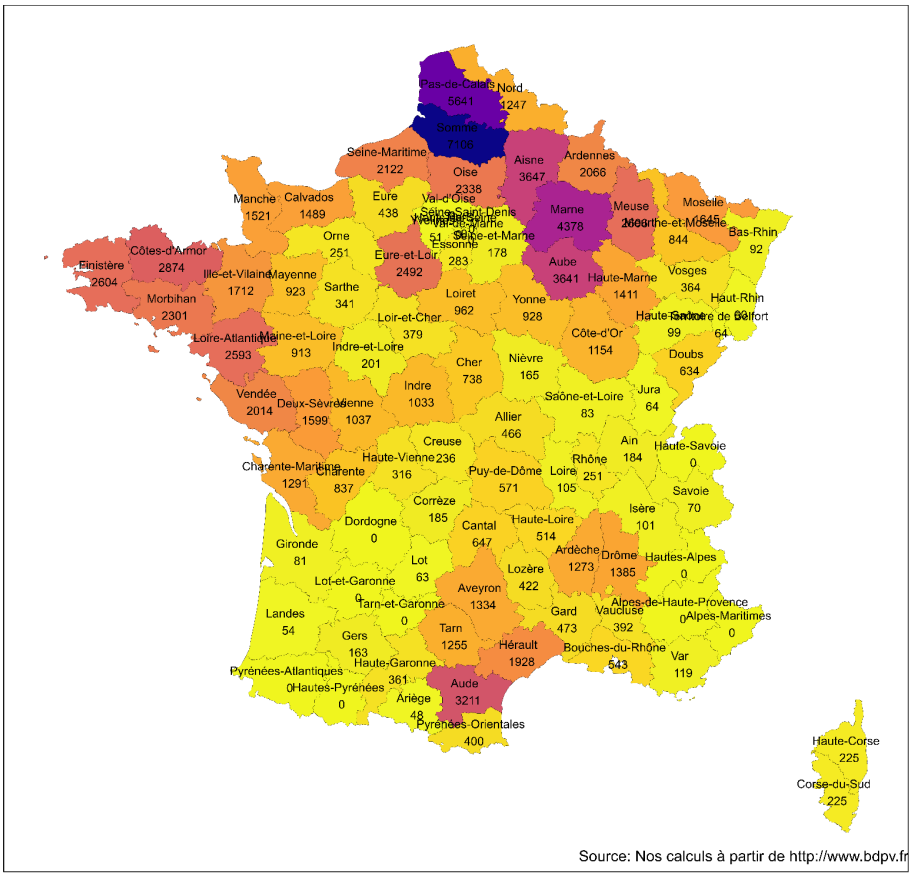
```
# Installer et charger les packages nécessaires
if (!require(AlgDesign)) install.packages("AlgDesign")
if (!require(dplyr)) install.packages("dplyr")
if (!require(openxlsx)) install.packages("openxlsx")
library(openxlsx)
library(AlgDesign)
library(dplyr)

# Définir les niveaux des attributs
levels <- list(
  sej = c(1, 2, 3),       # 1 nuit, 2 nuits, 1 semaine
  pn = c(0, 1),           # 0 = hors aire protégée, 1 = dans aire protégée
  dist = c(1, 1.5, 2, 2.5, 3, 3.5), # En km : 1-5, 6-10, 11-15, 16-20,
21-30, >30 km
  pays = c(1, 2, 3, 4),   # 1 = Montagne, 2 = Forêt, 3 = Zones Agricoles, 4
= Patrimoine bâti
  cost = c(25, 30, 35, 40, 45, 50) # En euros
)

# Créer un design factoriel complet
design_full <- expand.grid(
  sej = levels$sej,
  pn = levels$pn,
  dist = levels$dist,
```

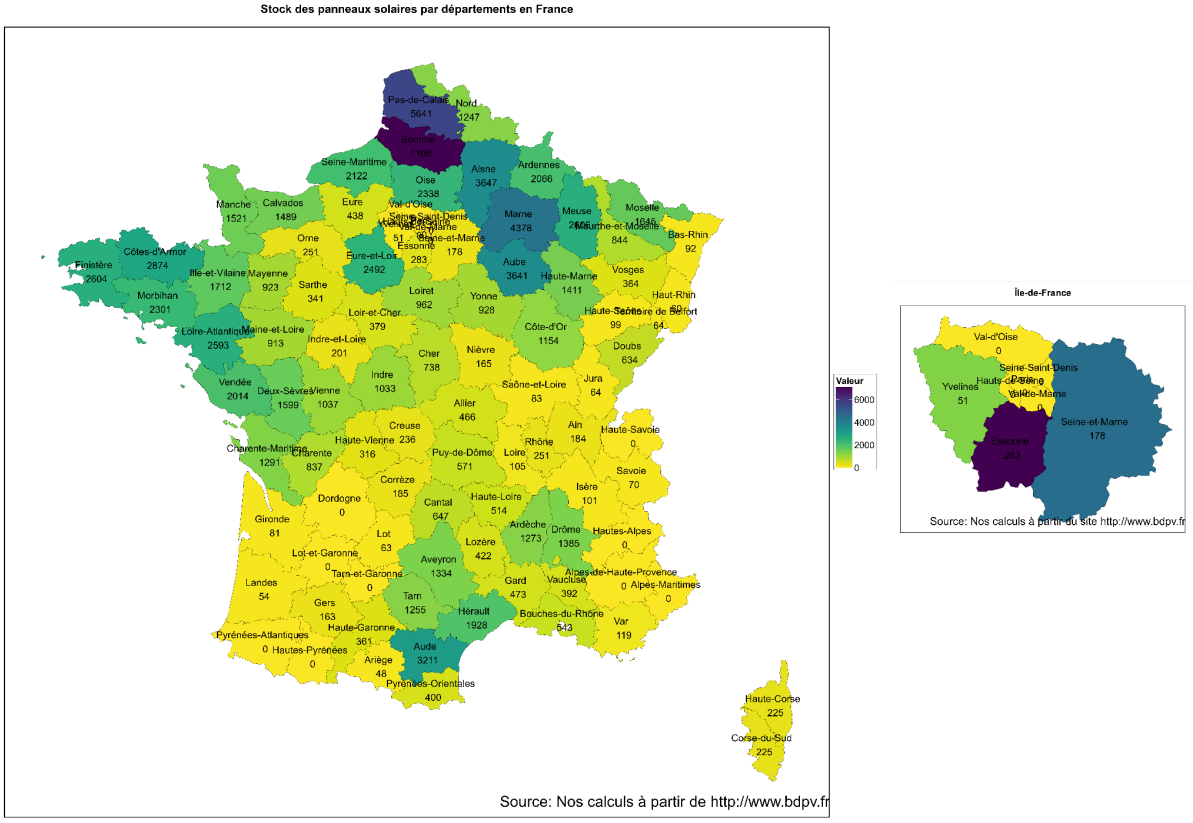
```
  pays = levels$pays,
  cost = levels$cost
)

# Nombre total de combinaisons
total_combinations <- nrow(design_full)

# Nombre d'essais souhaités (12 dans cet exemple)
nTrials <- 12

# Vérifier si nTrials est inférieur au nombre total de combinaisons
if (nTrials > total_combinations) {
  stop("nTrials doit être inférieur ou égal au nombre total de
combinaisons.")
}

# Sélectionner aléatoirement nTrials combinaisons pour la première
alternative
set.seed(123)  # Pour reproductibilité
design_alt1 <- design_full %>%
  sample_n(nTrials)

# Sélectionner aléatoirement nTrials combinaisons pour la deuxième
alternative
design_alt2 <- design_full %>%
  sample_n(nTrials)

# Créer un data frame avec deux alternatives pour chaque choix
design_final <- data.frame(
  ChoiceSet = rep(1:nTrials, each = 2),
  Alternative = rep(1:2, times = nTrials),
  rbind(design_alt1, design_alt2)
)

# Exporter chaque Choice Set dans un fichier Excel distinct
for (i in 1:nTrials) {
  choice_set <- design_final %>% filter(ChoiceSet == i)
  wb <- createWorkbook()
  addWorksheet(wb, paste0("Choice_Set_", i))
  writeData(wb, sheet = 1, choice_set)
  saveWorkbook(wb, file = paste0("Choice_Set_SOL", i, ".xlsx"), overwrite =
TRUE)
}
```

Mapping of Wind and Solar Stocks


Stock des Eoliennes par départements en France
Pas-de-Calais 5641
Nord 1247
Somme 7108
Seine-Maritime 2122
Aisne 3647
Ardennes 2066
Oise 2338
Manche 1521
Calvados 1489
Eure 438
Val-d'Oise
Seine-Saint-Denis
Marne 4378
Meuse 206
Moselle 1645
Meurthe-et-Moselle 844
Bas-Rhin 92
Orne 251
Essonne 283
Seine-et-Marne 178
Côtes-d'Armor 2874
Finistère 2604
Ille-et-Vilaine 1712
Mayenne 923
Eure-et-Loir 2492
Aube 3641
Haute-Marne 1411
Vosges 364
Sarthe 341
Morbihan 2301
Loiret 962
Yonne 928
Haut-Rhin 50
Territoire de Belfort 64
Loir-et-Cher 379
Loire-Atlantique 2593
Maine-et-Loire 913
Indre-et-Loire 201
Côte-d'Or 1154
Doubs 634
Cher 738
Nièvre 165
Vendée 2014
Deux-Sèvres 1599
Vienne 1037
Indre 1033
Saône-et-Loire 83
Jura 64
Allier 466
Creuse 236
Ain 184
Haute-Savoie 0
Charente-Maritime 1291
Charente 837
Haute-Vienne 316
Puy-de-Dôme 571
Loire 105
Rhône 251
Savoie 70
Corrèze 185
Isère 101
Dordogne 0
Haute-Loire 514
Cantal 647
Gironde 81
Ardèche 1273
Drôme 1385
Hautes-Alpes 0
Lot 63
Lozère 422
Lot-et-Garonne 0
Aveyron 1334
Tarn-et-Garonne 0
Alpes-de-Haute-Provence 0
Alpes-Maritimes 0
Landes 54
Gard 473
Vaucluse 392
Gers 163
Tarn 1255
Hérault 1928
Bouches-du-Rhône 543
Var 119
Haute-Garonne 361
Pyrénées-Atlantiques 0
Hautes-Pyrénées 0
Aude 3211
Ariège 48
Pyrénées-Orientales 400
Haute-Corse 225
Corse-du-Sud 225
Source: Nos calculs à partir de http://www.bdpv.fr
Valeur
6000
4000
2000
0
Île-de-France
Val-d'Oise 0
Seine-Saint-Denis
Paris
Hauts-de-Seine
Yvelines 51
Val-de-Marne 0
Seine-et-Marne 178
Essonne 283
Source: Nos calculs à partir du site http://www.bdpv.fr

Stock des panneaux solaires par départements en FRANCE

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Meuse 2
Moselle 1545
Orne 251
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