



Using behavioral insights to make firms more energy efficient: A field experiment on the effects of improved communication



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ABSTRACT

The Dutch government provides annual, detailed, energy-efficiency feedback to individual companies that have signed a voluntary agreement to increase their energy efficiency. However, only about 14% of all companies actually download their dedicated report containing this feedback. To increase the assumed positive effect of the feedback, the Dutch government aims to increase this download rate. Drawing upon insights from behavioral economics, the present study investigates the effects of alternative emails, inviting to download the feedback report, on 505 companies' download behavior, in a randomized controlled field experiment with two treatment groups and one control group. The download rates for our treatment groups are more than three times higher compared to the control group. Survey results indicate that the follow up behavior does not differ between the respondents who were nudged and those who were not. Moreover, we found indications that downloading the report induces the energy coordinators to consider energy-saving measures. More generally we have shown that policy targeting energy saving of firms can benefit from using behavioral insights. Relatively small changes in the implementation of specific interventions can have large influences on the effectiveness of the policy.

1. Introduction

The Energy Efficiency Directive of the European Union gives clear targets to the member states to reduce CO₂ emission levels. In the Netherlands, for non-ETS² sectors, this CO₂ emission reduction goal is 16% for the period between 2005 and 2020 (Daniëls et al., 2014). To contribute to this goal, the Dutch government and 1100 companies³ signed a voluntary agreement.⁴ These companies have a relatively high energy usage and differ largely with respect to their activities, production processes, energy usage, size, and energy efficiency. Companies who joined the agreement commit to making an Energy Efficiency Plan (EEP). Each plan contains energy-saving measures that should improve energy efficiency by 8% in 4 years—an average of 2% per year. In return, eligible companies can get a tax reduction. Monitoring of the

energy-efficiency improvements occurs annually, and each company is obliged to provide data. Based on this data, an annual dedicated company report is made by RVO.nl, an agency of the Dutch government that provides detailed feedback to the individual company regarding its energy efficiency. The report also contains anonymous scores of companies in the same sector and a sector average as a benchmark to which energy-efficiency improvements can be compared.

The provision of individual feedback is based on the assumption that it helps the companies to improve their energy efficiency. The assumption is based on a broad literature that shows that individuals move toward more energy-efficiency behavior when provided with feedback (see e.g., Darby (2006)). Of course, the feedback can only be effective if company representatives responsible for energy efficiency actually read their dedicated reports. When reports are available, the

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² ETS = The EU CO₂ emissions trading system.

³ In fact, these are 1100 business units that individually function as a company. More business units can be a part of one larger company.

⁴ This agreement concerned the MJA3 agreement (in Dutch: Meerjarenafspraak Energie-Efficiëntie 2001–2020)

companies receive an email that invites them to download the report from a password-protected website. However, only about 14% of all companies actually download their reports.⁵ To increase the assumed feedback effect on energy-efficiency improvement, the Dutch government wants to increase the report download rate.⁶

Drawing upon insights from behavioral economics, the research described here aims to investigate how the invitation email can be improved to substantially increase the number of report downloads. We established the effect by a controlled natural field experiment (randomized controlled trial). Moreover, we also monitored the feedback effect with a survey, asking the companies if and how they have used the reports to improve their energy efficiency (follow-up behavior). To the best of our knowledge, this study is one of the first natural field experiments specifically targeting the energy-efficiency behavior of company representatives.

We find that the download rates are more than three times higher for our treatment groups compared with the control group. The survey results indicate that we do not need to worry that the nudges did trigger respondents to download the report who subsequently do not do anything with it. We do indeed not find any significant differences regarding relevant follow-up behavior between the respondents who were nudged and those who were not nudged. Moreover, we find that downloading the report induces the energy coordinators to consider more energy-saving measures.

2. Theoretical background and hypotheses

Most of the research in behavioral economics on how to “nudge” individuals to adopt more energy-efficient behavior has focused on private consumers. Without doubt, consumers constitute a key target group for policymakers that aim for energy conservation. Abrahamse et al. (2005), for example, report that in the U.S., in 2003, private households were responsible for an estimated 1214.8 million metric tons (MMT) of U.S. energy-related CO₂-emissions, equivalent to 21% of the total. OECD figures on household contributions to total energy usage generally range between 15% and 20% (Biesiot and Noorman, 1999). While these figures suggest that private households are an important target group, they also show that organizations, including private firms, are important as well. The industrial sector accounted for around 26% of total final energy consumption in the EU-28 in 2012 (Ademe, 2015). However, decision makers and representatives of firms, such as managers and energy coordinators, receive comparatively little attention in behavioral economics research, despite the fact that they represent an important target group when it comes to energy efficiency. This omission may be due to the fact that bounded rationality within organizations has been only incompletely absorbed in the economics of organization literature (see Bromiley (2009)), and thus also within the field of behavioral change and nudging.

Research in behavioral economics has shown that behavioral changes are positively associated with the provision of a limited amount of relevant and targeted information, as well as specific and timely feedback (see, e.g., Fischer (2008), Darby (2006)). Regarding consumer responses to different forms of information and feedback about their energy use, the Energy Demand Research Project (EDRP), conducted by AECOM Building Engineering and Ofgem (June, 2011) in the U.K., shows promising results. In the EDRP, four energy providers each conducted trials on the impact of various interventions, with the majority directed at stimulating energy conservation, and others aimed at shifting use from peak to off-peak periods. The effect of

generic advice and historic feedback on energy consumption was not always seen, and when it was seen the reduction in [median] consumption was up to 5%. Information on energy conservation was most effective when provided in simple, short statements, and (repeatedly) over a period of time—minimal information but well-presented and easy to absorb. Therefore, the authors of the report concluded that, “advice should be provided but the details of delivery (e.g., clarity, quantity of information, timing) and combination with other interventions, are critical” (p. 167). The same conclusions applied to the provision of historic usage feedback.

Ehrhardt-Martinez et al. (2010) present a meta-review of 57 primary studies into household electricity saving in response to various types of feedback performed over the course of the past 36 years in 9 countries including the U.S., Canada, Australia, Japan, and European countries. Overall, they find that significant savings can be achieved. The key message from their meta-analysis is that the type of feedback matters crucially. Some forms of feedback appear to be much more effective than others in generating more substantial energy savings. In particular, the frequency and richness of the feedback seem important. Fischer (2008) and Darby (2006) indicate that regular feedback has the greatest effect. We can conclude that in order to have the desired (positive) effect, information should not only be relevant and provided regularly, it should also be limited, as an overload may induce people to abstain from acting.

To investigate the effect of an improved invitation to gain feedback and the effect of this feedback on follow-up energy-saving behavior, we formulate hypotheses for our randomized controlled field experiment and the survey, both previously mentioned, from a behaviorally enriched, rational-choice framework. We consider downloading behavior as the outcome of a trade-off: if the perceived benefits from downloading the dedicated report are larger than the perceived costs, the respective decision maker should decide to adopt this behavior. We explicitly allow these benefits to include non-monetary benefits and the costs to include cognitive costs and other frictions. The behavioral economics literature provides evidence from various contexts (see, e.g., Haynes et al. (2013), Gleerup et al. (2010)) that simplifying desired behavior can positively influence the likelihood that individuals display such behavior. We therefore hypothesize that if we reduce the perceived costs by making the message of the invitation email clearer and shorter and reducing the effort required to download, download rates should increase. Moreover, by emphasizing the additional informational value of downloading, we aim to increase the (perceived) benefits. This should additionally increase the download rate of the reports.

Hypothesis 1a. *Reducing the perceived costs of downloading by simplifying the message and the process leads to more downloading.*

Hypothesis 1b. *Reducing the perceived costs and increasing the (perceived) benefits from downloading by emphasizing the additional informational value leads to even more downloading.*

Regarding households, a series of U.S. trials have demonstrated that personalized behavioral feedback can help households reduce their energy consumption (Houde et al., 2013; Allcott, 2011). In the same way, we expect that companies that download the dedicated report will stimulate energy-saving behavior. We therefore hypothesize the effects of downloading the dedicated report on energy-saving behavior.

Hypothesis 2a. *Downloading the dedicated report stimulates energy-saving behavior.*

At the same time we would like to ensure that our nudges did not stimulate firms to merely download the report to thereafter ignore it. In this sense, we hypothesize that, for the companies that have downloaded their dedicated report, our nudges (simplifying the message and the downloading process) will not reduce (or increase) follow-up behavior that is relevant for or related to energy saving.

Hypothesis 2b. *Reducing the perceived costs and increasing the*

⁵ For safety reasons the report is not sent by email.

⁶ The low download rates can be caused by several factors, e.g. by the fact that the agreement is not very demanding, or because companies believe not to find much new information in the company report. However, the research described here aims to investigate how communication with the companies can be improved to substantially increase the request for feedback, which can lead to more energy saving.

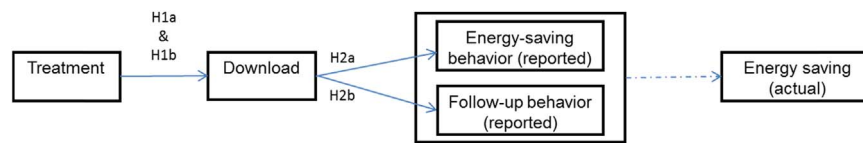


Fig. 1. The hypothesized effects of the interventions.

(perceived) benefits from downloading does not affect follow-up behavior or the motives for downloading.

Additionally, we expect companies that request feedback (i.e., downloaded the report in 2015) to show more energy-saving behavior, which would become visible in higher energy savings in 2015. Unfortunately, due to the short time lapse between providing feedback and measured realized energy savings, it is not possible to establish a causal relation between download behavior and realized energy savings. Any realized energy savings could also be the result of feedback requests of earlier years. This implies that possible differences in actual energy savings can be only an indication of the effectiveness of the requested feedback. For this reason, we do not explicitly pose a hypothesis, but still put the relation between download behavior and realized energy savings subject to closer examination (Fig. 1).

The magnitude of the effects associated with the nudges is an open empirical question, motivating the experiment presented next.

3. Experimental method

To test our hypotheses, we conducted a field experiment (randomized controlled trial). This allowed us to observe a subject in a controlled setting while the subject does not perceive any of the controls as being unnatural and no deception is being practiced (Harrison and List, 2004). We expect that the results of this experiment can be used directly to improve the energy-efficiency policy in the setting of voluntary agreements and possibly other programs, using information to stimulate energy-saving behavior.

We next describe the design of the experiment, the sample, the treatments, and the collection of the data.

3.1. Sample

The experiment participants are the energy coordinators of the companies that signed the voluntary agreement. From all 1100 companies that participated in the voluntary agreement, we selected 639 companies for our experiment, represented by 505 energy coordinators. We limited the experiment to this group because these companies received a standardized dedicated report and an email in which they were invited to download their report. The companies that were not selected received a non-standardized dedicated report as an appendix to an email. The coordinators were not told that they were participants of an experiment.

3.2. Treatments

Our treatment variable is the email content that announces the availability of the dedicated report and invites companies to download this report. This independent variable has three conditions: an extended message, a simplified message, and a simplified message plus emphasized additional informational benefits. We randomly assigned the participants to one of the three conditions. The sampling procedure was based on firm sector, size, and energy usage. See Appendix A1 for an extended description of the random assignment. The conditions led to three treatment groups:

1. The control group (T0) received an extended email, similar to that of the email of the previous year, in which the companies were invited to download their report. The email started with an announcement

that the company had fulfilled its obligations and included a general link to the website, from which the dedicated report could be downloaded.

2. Treatment group 1 (T1) received an invitation email that was significantly shorter than the email sent to the control group (T0). In a short email, the main purpose was expressed in the first paragraph, directly followed by an embedded link to the report on the website. By using the deep link, one less click was required to download the report.
3. Treatment group 2 (T2) received the same shortened email of T1. To increase the (perceived) benefits from downloading, we added one sentence to emphasize the additional informational value: “Your company report shows how your company performs, compared to other companies in your sector.”⁷ While a large part of the dedicated report reflects the energy coordinator's own information, the achievements of comparable companies is new information.

See Appendix A2 for the translated texts of all three emails.

3.3. Data and measures

Our data comes from three data sources: (1) monitoring of actual download behavior, (2) a survey to measure follow-up energy-saving behavior, and (3) general company data from a database.

3.3.1. Actual download behavior: monitoring

For this experiment we ensured that each treatment group received a different email invitation. The emails were sent in July 2015. Subsequently, the actual download of the reports was monitored. The actual download behavior is our first main dependent variable. The dedicated reports can be downloaded from a password protected website. Companies receive their username and an annually changing password usually by the second week of January. When all monitoring data of the participating companies are available, the companies are invited by email to download their dedicated report.

For each report download, we registered the date and time. Thus, the download behavior was unambiguously associated with one energy coordinator. If one coordinator was responsible for more than one company, the download of one report was enough to register as “downloaded.” The coordinators were not told that their actual download behavior was monitored.

3.3.2. Reported follow-up behavior and reported energy-saving behavior: survey

The follow-up behavior and energy-saving behavior are our other main dependent variables, which we retrieved from the energy coordinators' responses to an online survey. Two months after the treatment, an email was sent to each participating coordinator with a request to complete a survey.⁸ On the survey, first the (treatment dependent) “inviting to download” email was shown, which the respective respondent had received two months ago. We next asked the respondents to answer seven closed questions in regards to the concerning email, as well as follow-up behavior such as whether they had downloaded their dedicated report, and subsequent actions and

⁷ Translated from Dutch: “Uw bedrijfsrapport vertelt u hoe uw bedrijf op het gebied van energie-efficiëntie presteert ten opzichte van bedrijven uit uw sector.”

⁸ For the exact time line of our data collection see Appendix A3.

motivation. Further, the respondents were asked about their reported energy-saving behavior and their intentions regarding new energy-saving measures. Finally, we requested some additional information about the perceived relative importance of the company energy bill, the size of the company, the sector of the company, and how much time in fulltime equivalent (FTE) the company has allocated to saving energy—all of which we considered relevant control variables for our analysis. The (translated) survey questions are replicated in [Appendix A4](#).

3.3.3. General company data: database

We included general company data as additional control variables. Each year the companies must provide data to comply with the obligations of the voluntary agreement. For a full description of this process, see [Abeelen et al. \(2013\)](#). For the present study, a relevant selection of this data from the years 2015 and 2016 was used, as well as the data on download behavior, and the survey data on follow-up energy-saving behavior. [Appendix A5](#) gives an extended description of the data section.

3.3.4. Measures

To test our hypotheses, we used the collected data from the three different sources for the three treatment groups:

1. To test [Hypothesis 1a](#) (*Reducing the perceived costs of downloading by simplifying the message and the process leads to increased downloading*), we compared the actual download behavior of T0 and T1.
2. To test [Hypothesis 1b](#) (*Reducing the perceived costs and increasing the (perceived) benefits from downloading by emphasizing the additional informational value leads to even more downloading.*), we compared the actual download behavior of T1 and T2.
3. To test [Hypothesis 2a](#) (*Downloading the dedicated report stimulates follow-up energy-saving behavior*), we compared the self-reported follow-up behavior of respondents who downloaded and those who did not.
4. To test [Hypothesis 2b](#) (*Reducing the perceived costs and increasing the (perceived) benefits from downloading does not affect follow-up energy-saving behavior*), we compared the self-reported follow-up behavior between T0, T1, and T2 to those respondents who downloaded the report.

To investigate whether obtaining feedback about energy-saving behavior (i.e., download of the report in 2015) leads to a higher number of realized energy-saving measures in 2015, we compared the actual energy savings of companies that downloaded the report with those that did not.

4. Results

4.1. Validity of the random assignment and response

Before we present the treatment effects of our experiment, we verify the validity of the treatment groups and the responses to the survey. [Table 1](#) presents descriptive statistics for all treatment groups regarding our control variables of firm characteristics from the database and the survey responses.

For the available control variables, the three treatment groups do not differ from each other, neither when considering all companies nor when considering only the survey respondents. One-third of the companies responded to the survey. As shown by the p-values in the fifth column of [Table 1](#), all variables are balanced between the treatment groups and the control group.

4.2. Impact of the nudges on actual download behavior

Our first hypothesis ([H1a](#)) postulates that the reduction of per-

Table 1

Descriptive statistics for the treatment groups and control group.

	T0	T1	T2	Total	P
All companies					
N	170	169	166	505	
Average energy usage (in TJ in 2014)	188	177	153	173	0,67 ^a
Average number of employees	126	113	122	120	0,47 ^a
Number of different sectors	21	22	22	22	
Average savings in TJ in 2014	13	11	8	11	0,50 ^a
Survey response					
N	53	54	60	167	
Average energy usage (in TJ 2014)	127	255	157	167	0,15 ^a
Average savings (in TJ 2014)	9	38	3	16	0,66 ^a
Self-reported importance energy bill (H/M/L) (in %)	38/43/19	50/43/7	40/50/10		0,31 ^b
Self-reported no of employees	139	129	130		0,43 ^a
Self-reported existence of shareholders (% yes)	70	72	78		0,57 ^a
Family business (% yes)	40	33	40		0,72 ^a
Self-reported time spend on energy-related activities (h/wk)	3,0	3,2	3,3		0,96 ^a

Superscripts indicate p-values for a) Kruskal-Wallis and b) Pearson tests.

ceived costs of downloading by simplifying the message and the process will lead to an increase in downloading. We therefore expect to see a higher actual download percentage in Treatment T1 compared with T0. The first estimate of interest is the average treatment effect in the download behavior of the experimental contact persons if they received the treatment email of T1 and if they were not treated, respectively ([Gerber and Green; 2012](#)). [Hypothesis 1b](#) postulates that the download rate will be higher by additionally emphasizing the informational value of the report. We therefore expect to see a higher actual download percentage in Treatment T2 compared with T1. The actual download behavior for all companies is based on download registration and shown in [Table 2](#).

The download rate for T1 is more than 3 times compared with T0 ($p < 0.00$, Pearson). [Hypothesis 1a](#), stating that a reduction of perceived costs of downloading is associated with increased downloading, cannot be rejected.

Following our next hypothesis ([H1b](#)), we expect to find that if, additionally, to reduced costs, the perceived benefits from downloading are increased, downloading increases even more. This hypothesis can be rejected, as we find no significant difference in download behavior between T1 and T2 ($p = 0.3$, Pearson). A possible reason for this insignificant result could be that the potential extra positive effect is not homogeneous among all firms and the overall size of the effect therefore is too small to be detectable with our sample size.

Note that a few respondents downloaded the report only after receiving the survey invitation. Their download behavior, however, does not affect these results.

4.3. Impact of nudges on reported follow-up behavior

Before we test [Hypothesis 2a](#), we first test [Hypothesis 2b](#). To do this we analyze the reported follow-up behavior (what did the respondents do with the dedicated report?) and their motives (why?). This analysis

Table 2

Actual download behavior.

Treatment	N	Actual download	Cohen's d
T0	170	24 (14%)	
T1	169	77 (46%)	1.9
T2	166	85 (51%)	2.2
Total	505	186	

Table 3
Response, actual download behavior and self-reported download behavior^a.

Treatment	Total population		Response		Downloaded (actual) survey respondents		Downloaded (actual) self-reported		Not downloaded (actual) self-reported	
	N		N	%	N	%	N	N	N	N
T0	170		53	31	15	28	10	4	24	13
T1	169		54	32	37	69	29	7	8	7
T2	166		60	36	43	72	30	13	12	4
Total	505		167		95		69	24	44	24

^a Six respondents did not give a response on the self-report question because they indicated that they did not receive any mail from RVO.nl (please spell out). It is moreover possible that in some cases, other employees downloaded the report. However, as the survey was sent to the same email address as the invitation email, we attribute all inconsistencies mainly to memory failure and therefore neglect issues of (two-sided) non-compliance.

is based on the survey data.

To evaluate the survey results, we first compare the actual download frequency of the respondents with their self-reported download behavior and the download frequency of all the companies. We find that for all treatments, the actual download frequency of the respondents is much higher than for the total sample of all companies (see Table 3). It is reasonable to assume that the energy coordinators who are more focused on energy topics than the average coordinator are also more likely to respond to our survey. This means that the survey response is not representative regarding this point. In addition to the actual download behavior, Table 3 shows also the self-reported download behavior. It is remarkable that a large part of the responding energy coordinators incorrectly report whether they have downloaded their report.

Because the incorrect reporting is as high for the actual downloaders as for the non-downloaders, it is unlikely that the respondents reported incorrectly on purpose. It is more likely that they simply did not accurately remember their actions. Two months after the invitation email, the energy coordinators were invited to complete a survey (See Appendix A3).

4.3.1. Impact of nudges on perception of the invitation mail

To gain a better view on the direct effects of the nudges, at the beginning of the survey the previously sent email was presented. We asked the respondents whether, at the time, they had read and how they had judged the invitation in terms of its clarity, incentive to read further, taking additional action, length, and information.

About 87% of the respondents reported that they did remember the invitation email, of which 94% reported that they had read the email. About 10% of the respondents did not remember receiving an email, and 4% reported they never received such an email. More respondents in T1 and T2 remembered that they had received the invitation email (Table 4).⁹

Fig. 2 shows that the respondents in T1 and T2 viewed the short invitation email more favorably than the respondents in T0 viewed the long one. Although the differences in the scores on the judged items between T0 and T1/T2 are not always significant,¹⁰ if the ratings for the separate items are combined into one score, the appreciation for the invitation email in T1 and T2 is higher than the email in T0.¹¹

⁹ Pearson Chi² for only the categories “did read the email” and “does not remember anymore”: $p=0.016$.

¹⁰ The scores of T1 and T2 do not differ significantly for any of the items, while T0 and T1 (and T0 and T2 respectively) differ for “too long” with $p=0.012$ ($p=0.027$), and for “inviting to read further” with $p=0.009$ ($p=0.099$). For “inviting to further action” only T0 and T1 differ significantly, with $p=0.049$.

¹¹ To combine the ratings for the separate items, we added up the scores for the positive items (clarity, inviting to read further, inviting to further action) and we subtracted the score for the negative items (too long, not containing enough information). With respect to the average score for this new variable, t -tests reveal that T0 and T1 (and T2, respectively) differ significantly: $p=0.004$ ($p=0.016$, respectively), while the scores of T1 and T2 do not differ significantly, $p=0.51$.

Table 4

Answers of the question: have you read the invitation email?

Treatment	Did read the email	Did not read the email	Does not remember anymore	Never received such an email	Total
T0	39	1	11	2	53
T1	46	3	2	3	54
T2	52	4	3	1	60
All	137	8	16	6	167

4.3.2. Relation nudges and follow-up behavior or motives to download

To verify that our nudges did not stimulate firms to merely download the report and thereafter ignore it, we asked those respondents who downloaded the report what they subsequently did with it. The answer options ranged from “nothing (yet)” to “forwarded it” to colleagues or management, respectively, to “discussed it” with colleagues or management. We interpret these answers as an indication of increasing commitment to follow-up behavior. Fig. 3 shows that respondents in T1 and T2 answered that they more frequently forwarded the report to or to have discussed it with management.¹² A Kruskal-Wallis test reveals that this difference is not statistically significant for either of the two answers ($p=0.78$).

As multiple answers were possible, we created three new variables: (1) one indicating the sum of positive answers to the question, labeled as “positive,” excluding only option “nothing (yet);” (2) one indicating the sum of positive answers to “forwarded it to management” and “discussed it with management” labeled as “reported to management;” and (3) one indicating the sum of positive answers to “forwarded it” to colleagues or management and “discussed it” with colleagues or management, labeled as “reported action.”

Table 5 shows the results of an OLS regression for each of the three variables, controlling for size, total energy costs and sector. We find only a weak effect of T1, and no effect of T2.

We also asked the respondents who indicated to have downloaded the report about their motives. Fig. 4 shows the answers. The first two answers, as well as the sixth, capture a company's rather defensive motive to check the report for its correctness and to ensure that the company meets the minimum criteria (DEFENCE). The fourth and fifth answers capture the company's motive in comparing its performance to an internal or external benchmark (COMPARING). The third and seventh answers capture a company's motive to understand and discuss

¹² Keep in mind that in about 20% of the (mostly smaller) companies, the function of the energy coordinator is assigned to a member of the management. In such cases, the option to forward or discuss the report with management is not a valid option, as we do not know if forwarding and discussing with management is necessary or desirable. This depends on the management organization of the company.

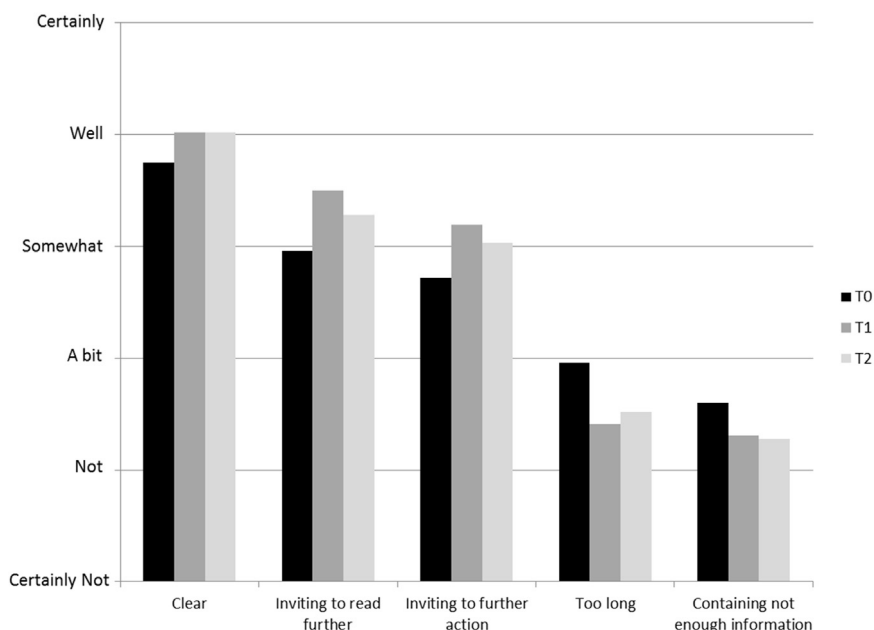


Fig. 2. Opinions of the energy coordinators regarding the invitation email.

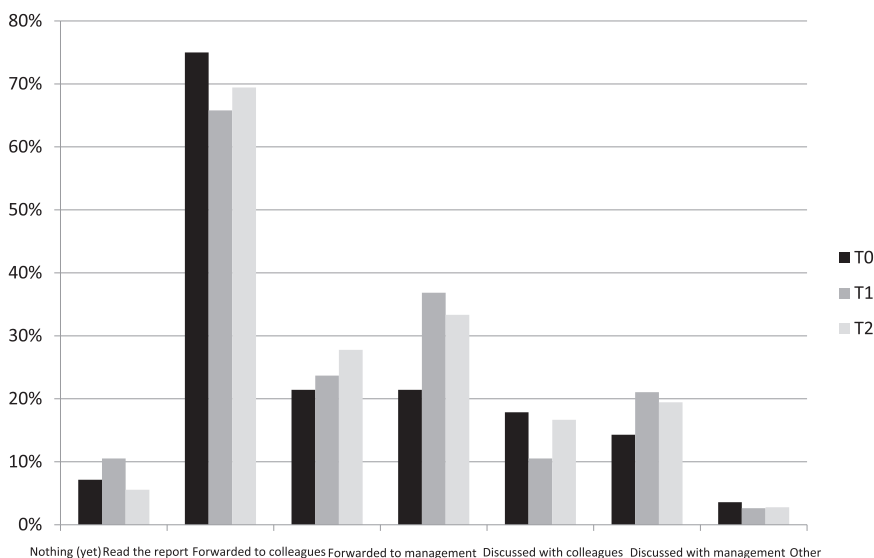


Fig. 3. The energy coordinators' answers on follow-up behavior regarding the report.

its energy-saving policy (UNDERSTANDING), the eighth and ninth answers capture a curiosity motive (CURIOSITY).

In Fig. 4, it is shown that respondents in T1 and T2 more frequently indicate to have downloaded for internal and external comparative reasons, but also out of curiosity. In the figure, respondents in T1 also indicated a defensive motive (Option 6) but a Wilcoxon rank sum test reveals that this difference in the control treatment is not statistically significant (Prob > |z| = 0.12).

The regression presented in Table 6 confirms the finding that companies in Treatment 1 and 2 show some tendency to use the report more for internal and external comparison than the control group even if we control for size, total energy costs, and sector, while no significant difference exists with respect to the other motives. While the email in T2 explicitly emphasized the possibility of using the report for comparing company results to other companies in the same sector, T1 did not include such a statement. However, different from T0, both emails explicitly emphasized the sector report in bold letters. Without any further experimentation, inferences about causal effects unfortunately remain speculative.

Table 5
OLS regression results for follow-up behavior.

	Positive	Reported to management	Reported action
T1	0.513 (2.23)*	0.304 (2.42)*	0.420 (2.40)*
T2	0.286 (1.33)	0.185 (1.85)*	0.262 (1.62)
Size	0.001 (1.05)	-0.000 (0.27)	0.001 (1.37)
Costs electricity	0.000 (0.46)	-0.000 (0.25)	0.000 (0.60)
Costs natural gas	-0.000 (1.04)	-0.000 (1.69)*	0.000 (0.10)
Sector dummies	Yes	Yes	Yes
Constant	0.582 (0.76)	0.208 (0.52)	-0.045 (0.09)
R ²	0.13	0.16	0.17
N	167	167	167

Heteroskedasticity-consistent estimator of variance; session dummies incl.

* p < 0.1.
* p < 0.05.

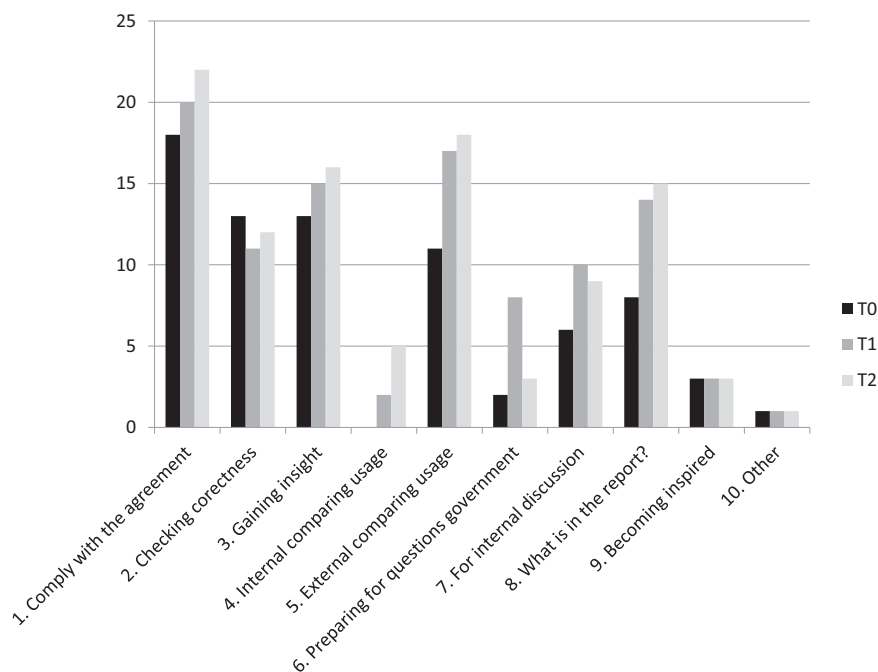


Fig. 4. Reasons for downloading the report according to the energy coordinators.

Summarizing the results from this section, in the case of respondents who have downloaded the report, we do not find large differences in follow-up behavior between the three treatments. We found neither significant differences between the treatments regarding the immediate action triggered by the report, nor regarding the motives to download the report, with the exception of the companies in Treatment 1 and 2 that use the report more for internal and external comparative purposes than the control group. We conclude that not enough strong evidence exists to fully reject [Hypothesis 2b](#): Reducing the perceived costs and increasing the (perceived) benefits from downloading does not affect follow-up behavior or the motives for downloading.

4.4. Impact download on reported energy-saving behavior

To test our [Hypothesis 2a](#), we analyzed the reported energy-saving behavior of the respondents. To gain a perspective on changes in energy-saving behavior from the downloaded report, we asked all respondents what kind of activities they initiated in new energy-saving measures. [Fig. 5](#) shows the answers, which ranged from “Yes, discussed with management,” on the furthest left to, “No, and not planning to do,” on the furthest right, with several decreasingly committing options in between. As multiple answers were possible for this question, we made a new variable, “New measures,” that had value 1 if Option 0 (“No, and not planning to do”) or Option 1 (“No, but I think I will”) was chosen, a value of 2 if Option 2 was chosen, 3 if Options 3 and 2 or 1 were chosen, and so on, up to 8 if Option 8 and any lower option was chosen. This variable thus considers only respondents’ highest commitment. The respective scores for these variables for both—the companies who actually downloaded the report as well as the companies that did not—are presented in [Fig. 5](#).

A logit regression is presented in [Table 7](#), with the highest commitment—i.e., given by the value of the variable “New measures,” as a dependent variable and the download as an independent, controlling for size, total energy use and sectors—confirms that respondents who downloaded the report are significantly more likely to report that they discussed new measures with the management ($p=0.098$) and are significantly less likely to answer that they are not planning any new measures ($p=0.079$). This means that, taking into account the higher actual download behavior for T1 and T2, we have no reason to reject

[Hypothesis 2a](#): that is, downloading the dedicated report indeed stimulates energy-saving behavior. There is an indication that downloading the report induces the energy coordinators to consider more energy-saving measures.

4.4.1. Download behavior and measured energy efficiency

As previously mentioned, we cannot establish a causal relation between requesting feedback (downloading the report) and energy savings, but we will give a closer look to the relation between download behavior and realizing energy savings. We compared the realized energy savings of companies that downloaded the report to those that did not.

[Table 8](#) shows the realized energy savings in terajoules in 2015 in Model 1, and the change in realized energy savings from 2014 to 2015, as a ratio between the two (DIFF1514), all estimated robust for all firms in Model 2. Model 3 and Model 4 show the same two estimations controlled for size and energy use for all firms for which all variables are non-missing and well defined. Downloading is weakly positively associated with higher energy-efficiency improvements in 2015, but not with an increase in the ratio. This effect is robust when controlling for other firm specific variables. The treatments did not have an additional significant effect.

5. Discussion

5.1. Several comments should be made with respect to the results

First, regarding the relevant control variables, the three treatment groups do not differ from each other in terms of all companies as well as the survey respondents. However, we found that the actual download frequency of the responding companies is much higher than the download frequency of all the companies.¹³ As previously mentioned, it is reasonable to assume that the energy coordinators who are more focused on energy topics are also more likely to respond to our survey. This means that the survey response is not representative regarding this point and implies that the survey results could be distorted when it comes to motive, follow-up behavior, or energy-saving behavior.

¹³ This is also valid for each treatment group and the control group separately.

Nonetheless, to draw our conclusions, we only compare groups of respondents, which is why we do not expect these possible distortions to affect our conclusions.

Second, it was remarkable that a large part of the respondents from the survey did not remember correctly whether they downloaded their reports. This means that here, observed behavior provides more reliable results than just a survey to detect behavior. We do not think that the incorrect reporting affects our conclusions, as the incorrect reporting is as high for the actual downloaders as for the non-downloaders.

Third, about 20% of the energy coordinators are directly responsible for the energy savings of the company and could be members of the management. In the survey, we asked respondents about their follow-up behavior and energy-saving behavior. For energy coordinators who are part of the management the option to forward or discuss the report with the management are possibly not valid, as we do not know if these actions are necessary or desirable. This means that the follow-up behavior and energy-saving behavior could be underestimated.

Fourth, in the introduction we stated that, in order for information to have the desired (positive) effect, it should not only be relevant and

targeted, but it should also be limited to prevent an overload. Both treatment groups received a shorter invitation email with limited information that was more targeted than the invitation email of the control group. We cannot disentangle which aspect—targeting or the limitation of information—caused the higher download rate.

Fifth, besides the motives addressed in our survey, the energy coordinators' incentive also play a role. However, our conclusions are based on the comparison between two randomly assigned groups. We therefore do not expect that this mechanism will affect our results and conclusions. To confirm this conjecture, we ran a robustness check on our analysis in which we performed a logistic regression, where we regressed the probability to download on all relevant variables that characterize the firm's context (firm size, energy usage, energy efficiency, sector), see Appendix B3. In this robustness check we assume that an individual energy coordinator's incentives (credit for efficiency gains, role in firm) are to a large extent a function of the firm's context.

Finally, The Behavioral Insights Team in the UK (2010) has conducted dozens of RCTs with Government departments that examine ways of making desired behavior easier, e.g. by reducing the 'hassle factor' or simplifying the message. Making a letter easy to understand often results in a 5% or 10% increase in response rates. Compared to this, our result of tripling the download rate from is very high. However, comparative feedback interventions on households lead to a reduction in gas usage of up to 20% (Abrahamse et al., 2005).

Table 6
OLS regression results for motives to download the report.

	DEFENCE	COMPARING	UNDERSTANDING	CURIOSITY
T1	0.141 (0.78)	0.224 (2.41) [*]	0.193 (1.53)	0.141 (1.44)
T2	0.013 (0.08)	0.200 (2.01) [*]	0.110 (0.95)	0.062 (0.65)
Size	0.000 (0.26)	0.001 (2.65) ^{**}	0.000 (0.15)	-0.000 (0.54)
Costs electricity	-0.000 (0.49)	0.000 (1.06)	0.000 (0.83)	-0.000 (0.12)
Costs natural gas	-0.000 (0.67)	-0.000 (2.30) [*]	-0.000 (1.71) [*]	-0.000 (2.33) [*]
Sector dummies	yes	yes	yes	yes
Constant	0.321 (0.86)	0.342 (0.82)	-0.176 (1.20)	0.295 (0.84)
R ²	0.11	0.28	0.20	0.16
N	167	167	167	167

Heteroskedasticity-consistent estimator of variance; session dummies incl.

^{*} p < 0.05.
^{**} p < 0.01.
⁺ p < 0.1

6. Conclusions and policy implications

Based on our findings, we draw three main conclusions: First, a reduction of the (perceived) costs of requesting feedback about energy savings leads to a higher request of feedback from companies. The companies that received a shorter adjusted email, taking into account behavioral insights, in which they were invited to receive the feedback, downloaded their reports three times more often than the companies who received the original longer, less-targeted email containing more information. We did not find any effect of emphasizing that the report contains additional information. The companies judged the short invitation email more favorable than the extended email on aspects such as clarity, length, and informational content.

Second, reducing the perceived costs and increasing the (perceived) benefits from downloading does slightly affect the follow-up behavior or the motives for downloading. The companies that were triggered by the shorter email, report the same follow-up behavior (such as reading the report and forwarding or discussing the report with others).

and approximately the same motivation to download compared to the companies who received the long email.

Third, downloading the report induces companies to consider more energy-saving measures. We found that the group that downloaded the

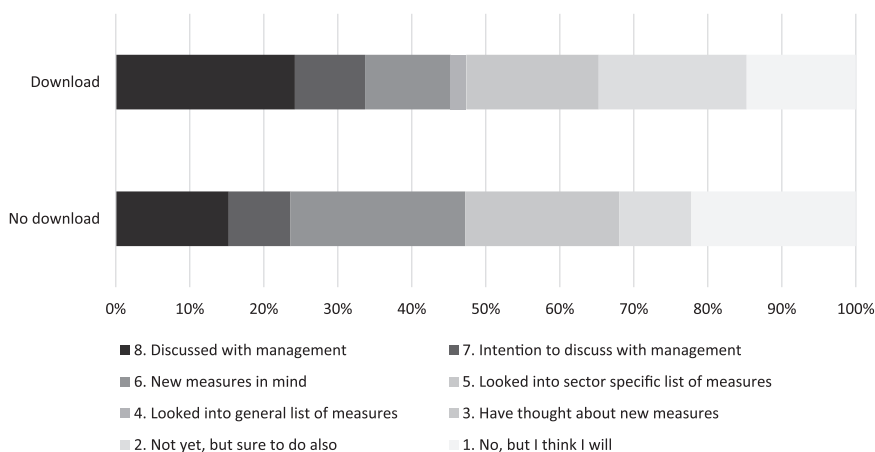


Fig. 5. The energy coordinators' answers on energy-saving behavior.

Table 7
Logistic regression results for positive answers on new measures.

	New measures 1	New measures 2	New measures 3	New measures 6	New measures 7	New measures 8
Download	−0.810 (1.76)+	1.000 (1.51)	−0.209 (0.41)	−1.164 (1.62)	−0.061 (0.10)	0.918 (1.68)+
Treat1	0.483 (0.57)	−0.048 (0.08)	0.704 (1.44)	0.111 (0.21)	0.340 (0.37)	−0.927 (1.08)
Treat2	−0.025 (0.04)	−0.449 (0.80)	1.526 (2.39)*	−0.492 (0.70)	1.057 (1.31)	−0.731 (0.84)
Energy usage	−0.000 (0.17)	−0.003 (2.02) [†]	0.001 (0.43)	−0.000 (0.69)	−0.001 (0.46)	0.004 (1.64)
Result 2015	−0.808 (1.44)	0.016 (0.07)	0.132 (0.68)	−0.322 (0.47)	−0.020 (0.10)	0.000 (0.00)
Size	−0.007 (1.88)+	0.001 (0.42)	−0.005 (1.38)	0.000 (0.06)	0.005 (1.89)+	0.001 (0.39)
Sector Dummies	Yes	Yes	Yes	yes	yes	yes
Constant	−0.323 (0.53)	−0.183 (0.18)	−1.564 (1.21)	0.414 (0.33)	−3.520 (5.76)**	−3.841 (2.64)**
N	136	128	145	136	113	147

Heteroskedasticity-consistent estimator of variance; session dummies incl.

[†] $p < 0.1$.

* $p < 0.05$.

** $p < 0.01$.

Table 8
(OLS) Regression results for realized energy savings in 2015 measured in terajoules.

	Realized measures [TJ] 2015 Model (1)	DIFF1514 [TJ] Model (2)	Realized measures [TJ] 2015 Model (3)	DIFF1514 [TJ] Model (4)
Download	27.494 (1.70)+	−4.962 (1.00)	30.620 (1.88)+	−4.748 (0.93)
Treatments 1 & 2	4.937 (0.51)	2.954 (0.83)	6.493 (0.73)	2.552 (0.60)
Sector Dummies	yes	yes	yes	yes
Size			0.077 (1.20)	0.013 (0.77)
Energy usage			0.127 (2.08)*	−0.022 (1.02)
Result 2015			53.551 (2.29)*	−1.097 (1.44)
Constant	−4.870 (0.36)	7.141 (1.00)	−98.750 (2.70)**	9.114 (1.05)
R^2	0.08	0.03	0.22	0.05
N	505	396	449	350

Heteroskedasticity-consistent estimator of variance; sector dummies incl.

[†] $p < 0.1$.

* $p < 0.05$.

** $p < 0.01$.

report is more likely to consider new energy-saving measures and discusses such measures more often with the management. Based on the available data, we cannot establish a causal relation between requesting feedback (downloading the report) and energy savings, but we found a weak indication that a positive relation exists between downloading the report and higher energy savings.

More generally we have shown that policy targeting energy saving of firms can benefit from using behavioral insights. Relatively small changes in the implementation of specific interventions can have large influences on the effectiveness of the policy. Specifically, improved communication with companies about their energy saving performance, by simplifying the message and removing ‘frictions’, leads to more follow-up behavior to save energy.

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Appendix. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.enpol.2017.05.056](https://doi.org/10.1016/j.enpol.2017.05.056).

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