Behavioral science can aid household participation in gas savings

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Main text:

On February 24th, 2022, the Russian Federation attacked Ukraine by military force. Since then, the conflict has killed thousands of civilians, and displaced millions more. The war has also sent a shock wave through global and particularly European energy systems, especially in the gas sector. Gas prices have spiked following the invasion and supplying Europe with sufficient gas has been and will continue to be a difficult challenge. The threat of a worsening gas shortage poses a major risk of social, political, and economic disaster in Europe. For example, the expert commission of the German government views gas prices as an "existential risk". In addition to supply-side interventions such as the increase in LNG infrastructure, substantially reducing gas demand is Europe's only active mitigation possibility. And indeed, on July 20, 2022, the EU urged countries to reduce gas demand by 15% amid the threat of further Russian cuts. At the same time, member states are specifying their own reduction goals and are developing corresponding policy measures.

Here, we suggest that the behavioral sciences, when including transdisciplinary and experimental methods, can substantially aid this savings effort. Behavioral scientific energy research – a vibrant area of research between academia, the private sector, and governments since the 1970s – already plays an important role in the policy response to promote demand reduction, as evidenced by various efforts orchestrated by governments and implemented at lower levels (e.g., local energy providers). Indeed, behavioral science as a tool to reduce gas demand is particularly relevant for the mitigation of the current supply crisis. Due to the incentives and contracts in the gas markets, gas price-changes frequently reach consumers only with considerable time lag, as gas tariffs give price security over a certain amount of time, for example one year. Billing has also routinely taken months, which may further prevent consumers to adjust their behavior directly to price signals. Quickly changing these market characteristics to more rapidly pass prices through to end-users faces not only significant legal and bureaucratic hurdles, but also political objections as high energy prices can be a crushing burden for many households. Moreover, efforts to save energy have historically prioritized structural energy efficiency measures, which arguably has limited the ability of many households to develop skills and tools to further reduce their energy demand. The immediate reaction of the markets shows this.[1] The high wholesale gas prices in March and April 2022 have led to a 11% decrease of gas demand in the industry and power sectors, compared to only 6% among households. Overall, the current reduction in household demand is far from sufficient to compensate for a complete halt in Russian supply.[2] While the fairly warm winter to date has helped reduce household demand, these savings will need to be sustained or even

increased, even under conditions of significant temperature drops or when price interventions that reduce the burden of very high gas prices on the economy and households are in place.

Behavioral science and energy savings

Behavioral science, we argue, can support the promotion of urgently needed household participation. It should complement other politically or socially acceptable economic incentives to make household consumption more responsive to wholesale price signals. The fact that households reduced gas demand somewhat irrespective of effective price signals in the first months of the war is indicative of the potential of non-price related factors.[1]

Some skepticism regarding the use of behavioral interventions exists. For example, predicting the effect size and scalability of specific behavioral interventions can be challenging. The efficacy of behavioral solutions strongly depends on the local context and effects are often found to be heterogeneous.[3] Furthermore, different types of interventions have provided different effects.[4] That said, interventions aimed at energy savings seldom "backfire" – meaning that they produce effects that go against the directed intention (see Composto & Weber[5], for a review). Pairing behavioral science with transdisciplinary methods (e.g., including local, non-academic energy experts in the trial selection) as well as systematic evaluation of trials can secure evidence-based decision making and acceptance of measures through participative processes.

Which "behavioral" tools are available for policy makers or other decision-makers?

Broadly speaking, behavioral interventions work best when behavior is intuitive and effortless. Besides others, the IPCC has reviewed potential interventions, suggesting that there is high evidence and high agreement that choice architecture (i.e., the systematic application of behavioral science) relevantly shapes energy decisions.[6] In the IPCC framework, some behavioral tools stand out. One way to effectively change behavior is to adjust "***defaults***", referring to the behavioral outcome that happens when no active choice is made. Particularly in the energy domain, changes to defaults have often shown to have strong and persisting effects on households' behavior.[7] Recent research shows that defaults more forcefully affect behavior when they are financially more lucrative or financially less harmful to decision-makers.[8] For instance, reducing the recommended *default* room temperature in offices, factories, and apartment complexes with central heating by only a few degrees, or the target temperature of water boilers used for showering, yields a relevant reduction in gas demand.[9]

Another potential entry point for behavioral interventions is improved ***feedback provision*** and reminders. Scientific evidence indicates that real-time feedback and personalized feedback are particularly effective.[10] For example, in-shower devices that display energy-consumption in real-time have been shown to reduce energy-intensive hot water demand. Feedback on gas consumption and costs could be delivered to consumers with remotely readable gas metering devices. In areas with little uptake of smart-metering, appealing to financial savings, including the provision of cost estimates for different consumption scenarios, likely promotes energy savings as many consumers tend to underestimate costs.[11] More immediate feedback allows making behavior more easily observable and recognizable and community or city-wide observation and recognition works more effectively than individual observation.[12]

Lowering the energy demand can be regarded both an injunctive (i.e. what *should* be done) and a descriptive norm (i.e. what the majority *is* currently doing). That said, as gas consumption is a highly private matter, consumption behavior is not readily observable by others, which may undermine normative behavior. Consequently, actively communicating ***social goals and norms*** has previously led to strong energy savings in the short term, and moderate savings in the long term. Studies have suggested that norm interventions work better when the energy bill is higher or when people care about the norm. An increasingly tightening gas crisis may further increase the promise of social norms interventions, since consumers especially like to be part of dynamically emerging norms. For example, norms can be communicated through comparison information, showing consumers how they compare to relevant others (see Andor and Fels[13], for a review, and the references therein).

Reframing the behavioral options so that people care about the consequences further supports behavioral policies. There is vast support regarding the military and civil support of Ukraine and the stopping of the war, as well as for climate action. Re-framing demand-solutions in support of important societal goals may substantially increase households' willingness to save energy. In contrast to being framed as a loss (e.g., car-free Sunday, temporary speed limits, etc.), the saving effort can be framed to support what people care about, among them peace, prosperity, and climate change mitigation. For example, research has found that moral reframing to emphasize "patriotism" can mitigate climate change denial and motivate energy savings.[14]

Feasibility frameworks, transdisciplinary approaches, and experiments can help select behavioral interventions for potential roll-out

A key practical challenge that routinely surfaces is the careful selection of a prospective intervention, while a current crisis creates urgency. This may create a conflict between the need for a rapid roll-out of behavioral change initiatives and the time and resource intensity typically characteristic of academic research. We stress that this conflict may actually increase the need for partnerships that we propose here and that local gas suppliers often have a strong interest in relying on evidence from the behavioral sciences. We suggest that the process of intervention selection includes assessments of feasibility, transdisciplinarity, and proper evaluation, ideally per causal identification.

First, we suggest that standardized feasibility analyses should precede prospective interventions. This approach can follow existing frameworks adopted from behavioral science and climate change mitigation research.[15] For example, Nielsen et al.[15] suggest a tripartite framework that involves technical potential, initiative feasibility, and behavioral plasticity. Technical potential refers to the maximum energy demand reduction if the opportunity is fully realized. Initiative feasibility refers to the likelihood that a change agent will adopt and implement the initiative. Behavioral plasticity measures the extent to which the target of a mitigation initiative, as implemented, responds to it as intended. By using this framework, the most impactful prospective behavioral interventions are fielded first and the order of testing follows the overall demand reduction potential.

Second, feasibility will likely depend on the local contexts. Thus, we suggest that the selection of behavioral interventions is the result of transdisciplinary exchanges. The methods, including local stakeholder involvement and knowledge co-creation, can substantially reduce the risk that behavioral interventions do not reach their full potential in a given community. Existing transdisciplinary frameworks can aid this process. For example, Lawrence et al.[16] provide a starting point on how to include transdisciplinary methods in applied research tasks.

Third, initiatives that pass a feasibility analysis and stake-holder exchange should be evaluated, for example through randomized-controlled trials (RCTs). In an RCT, a randomly selected part of the study population is exposed to the behavioral intervention, while a control group serves as a comparison standard against which the effectiveness of the intervention is measured. This method of testing allows for the most straightforward identification of causal effects and measuring effect sizes. Local gas providers[17] have demonstrated the support of rapid experimentation and knowledge acquisition through RCTs. In addition, previous work has

shown that such trials can be ultra-rapidly employed, and the most central results can be acted upon within weeks.

Conclusion and further recommendations

Gas demand in Europe and beyond must fall quickly for economic and political reasons and to limit profit flows for Russia. Economic incentives are important, but time, political will, legal solutions, and social mitigation measures are needed before forceful economic interventions can be made. Thus, the behavioral toolbox can relevantly complement the policy-response.

The selection of prospective interventions can be guided by feasibility frameworks that have originated from climate change mitigation research. These allow the ordering of prospective behavioral policies in terms of overall reduction potential. The demand-side potential through savings is strong, as recently argued. For example, the International Energy Agency suggests that simple actions (i.e., reducing thermostats by 1°C, working from home when possible, reducing cruising speed on motorways by 10 km/h) could save enough oil to fill 120 super tankers and enough natural gas to heat 20 million homes for a year.

Although much of the work will have to be done at the local level in collaboration with suppliers, we recommend that governments centrally aid this process, through the definition of a list of easily accessible tools (including incentives and choice architecture) under scientific best-practice. Governments could additionally provide local energy companies a budget for trials, proportionate to their household consumption. Promoting gas savings will mostly pay for itself, as any gas that is not consumed can be sold back into the gas market. Trialing should be directly accompanied by research institutes and behavioral research units. While we are aware of an emerging body of independent and uncoordinated trials, we believe that it is crucial that all efforts are registered in existing repositories to facilitate quick policy evaluation and comparison, and the continuous improvement of best practices. Simple reporting standards should be implemented, to facilitate participation in data documentation.

These measures combined will not only address the current gas crisis, but also allow ex-post evaluation. By combining systematic behavioral interventions with traditional economic incentives, we have short-term and long-term tools to substantially lower gas demand, which will – ultimately – also provide support for climate targets.

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FOOTNOTE:

17. Germany, for example, has almost 800 gas distribution system operators. The EU has almost 2,500, which are sufficiently heterogeneous in terms of consumer structure (rural/urban, rich/poor, etc.) and for which regulators already possess relatively detailed and consistent data from incentive-regulation exercises.

Author Contribution Statement

SB, AO, and GZ wrote and revised the initial draft.

Competing Interests Statement

SB, GZ, and AO declare no competing interests.