Energy saving and sufficiency from the citizens’ perspective

beyond the obvious

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Executive summary

Concerns about the **energy security, demand growth and energy prices** have become a permanent part of public debate. In the ongoing **energy transition**, households play a pivotal role: they can reduce their energy consumption with new, more energy efficient technologies as well as changing **their consumption patterns toward reduced energy consumption**. Instead of focusing on energy efficiency or energy saving separately we should focus more on **energy sufficiency**, which takes into account all these aspects in sustainable energy consumption.

The clean energy transition currently underway is **driving a significant increase in electricity demand**, and as demand rises, production is also expected to grow. Ensuring **clean energy with decent price for everyone, everywhere, and under all circumstances** is challenging. Energy underpins all aspects of daily life and basic needs—either through direct consumption (e.g., heating, mobility, lighting, electrical appliances) or indirectly (e.g., food supply chains, manufacturing, services).

The increasing **complexity of modern energy systems** requires a multidisciplinary research approach. Energy consumption and production are closely linked to the structures of economy, technical systems, society, and everyday lifestyles. Consequently, **solutions developed from a single perspective are insufficient to influence the interconnected systems as a whole**.

This study examines **Finnish citizens as energy users**, focusing particularly on their opportunities to modify their energy lifestyles toward **more moderate, conscious, and sustainable patterns of energy** consumption.

- The energy crisis has triggered new household routines, but these will only become permanent if comfort and the smooth functioning of everyday life are not significantly compromised.
- Uncertainty around investments, fragmented information, and a lack of concrete guidance hinder more substantial changes on their own initiative, even when people are motivated to act.
- Change can be supported by providing clear and easy-to-use solutions, opportunities for peer learning, and assistance in adopting new technologies, also through community-based approaches.

This study was conducted as part of VTT's iBEX innovation programme. The iBEX projects focused on broad systemic challenges, one of which — "Save energy – make it a habit" — addressed the sufficiency and sustainability of energy use. The project was grounded in the understanding that reducing energy consumption is not merely a technical or economic issue; it is also shaped by behaviour, community dynamics, and the surrounding infrastructure. The work emphasized cross-disciplinary and cross-sectoral collaboration as essential for steering energy systems toward greater sustainability and justice.

The role of citizens in the changing energy landscape

Finland—along with numerous other countries—is shifting away from fossil fuels toward more electrified, efficient, and intelligent clean energy solutions. The direction and pace of this transition are shaped not only by political decisions but also by broader structural changes in society and by the agency of citizens. The energy transition is no longer merely a technological or economic issue. It is increasingly intertwined with everyday practices, lifestyles, and consumption patterns.

Global energy consumption and greenhouse gas emissions continue to rise due to economic and population growth, and the rapid expansion of renewable energy production and investments in energy efficiency have not yet been sufficient to counter this trend. At the same time, geopolitical crises—such as Russia's invasion of Ukraine—have introduced increasing concerns regarding energy prices and security of energy supply – both in the short and long term.

The Finnish government is committed to the European Union's climate targets and has set a national target of achieving carbon neutrality by 2035. According to Prime Minister Orpo's government programme, Finland aims to strengthen its competitiveness and attractiveness as an investment destination for renewable industry by doubling domestic production of clean electricity (Government of Finland, 2023). In addition, a wide range of EU-level and national regulations increasingly steer the built environment and consumer behavior toward more sustainable energy use.

A sustainable energy transition cannot be achieved through technological development or techno-economic policy instruments alone – it also requires changes in citizens' lifestyles and consumption habits. People are not merely targets of policy, but active agents who shape the trajectory of the transition. Their everyday choices—related to housing, mobility, and the ownership and use of electrical appliances—play a central role in determining both energy consumption and emissions.

Energy sufficiency must therefore be examined not only through the efficiency of individual devices or systems, but through the overall energy demand of everyday life. This includes **indirect consumption**—such as dietary choices, the use of services, and the purchase of goods—which also forms part of a person's energy footprint.

Building a sustainable energy society requires that the everyday practices shaping energy use are acknowledged and that citizens receive consistent support for these practices through energy policy. Energy is not merely a matter of individual choice; it also depends on societal structures that enable and encourage low-energy ways of living. This perspective challenges us to consider how our society can function with less energy—not by reducing quality of life, but by reducing overconsumption.

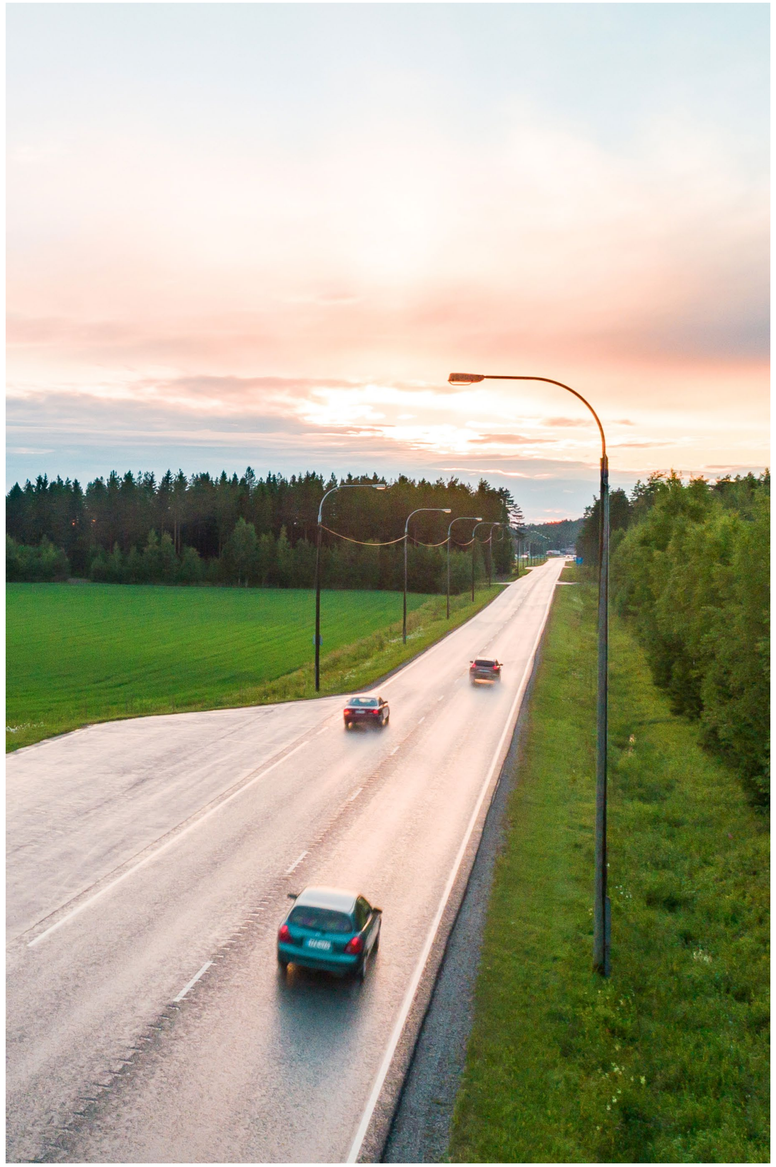
According to a recent citizen survey, two-thirds of Finns consider the goal of reducing greenhouse gas emissions to be important (Hyry 2025; Koljonen et al. 2025a). This is also reflected in the carbon footprint of household consumption, which decreased by **41% between 2000 and 2021**. Within the household carbon footprint, **housing and related energy use account for by far the largest share (33%)**, even though this share has steadily declined year by year. Private car use and food consumption also significantly increase household emissions (Ministry of the Environment 2025; Koljonen et al. 2025b). Sustainable energy use and citizens' agency therefore play a central role.

Survey data further show that citizens feel they are already making everyday choices that help reduce energy use. However, several bottlenecks limit further action — including the **cost of investments** and a generally **low willingness to make major lifestyle changes**, such as moving to a smaller home or adopting a vegan diet (Ministry of the Environment 2025; Koljonen et al. 2025b).

International experiments conducted in local communities and municipalities, such as low-carbon community initiatives, have demonstrated that participatory, grassroots-level action helps embed the energy transition into everyday practices (Gallagher et al., 2018; Hausknost et al., 2018; Heiskanen et al., 2015). In many European countries, community-driven solutions have already become part of everyday life. For example, in Germany and Denmark, citizen- and municipality-owned energy cooperatives and grassroots groups have been key drivers of the energy transition, strengthening regional self-sufficiency and deepening community engagement (Neij et al., 2025; Nikolic et al., 2025). At the same time, they have mobilised economic and institutional resources, making citizen-led renewable energy an integral part of formal energy policy (Jenkins et al., 2016).

Across these studies and real-world practices, the message is clear: a sustainable and just energy transition requires **grassroots agency** — policies that recognise citizens as part of the solution rather than merely targets of change.

Matchoss et al. (2025) have examined policy measures that promote moderate consumption and **energy sufficiency**, with the aim of halving consumption-based carbon footprints, particularly in the context of housing. They call for further research on how sufficiency-oriented practices can be incorporated into new construction, zoning, and urban planning to support residents' everyday actions. Achieving a sustainability transition therefore requires structural changes that enable and reinforce citizen agency.

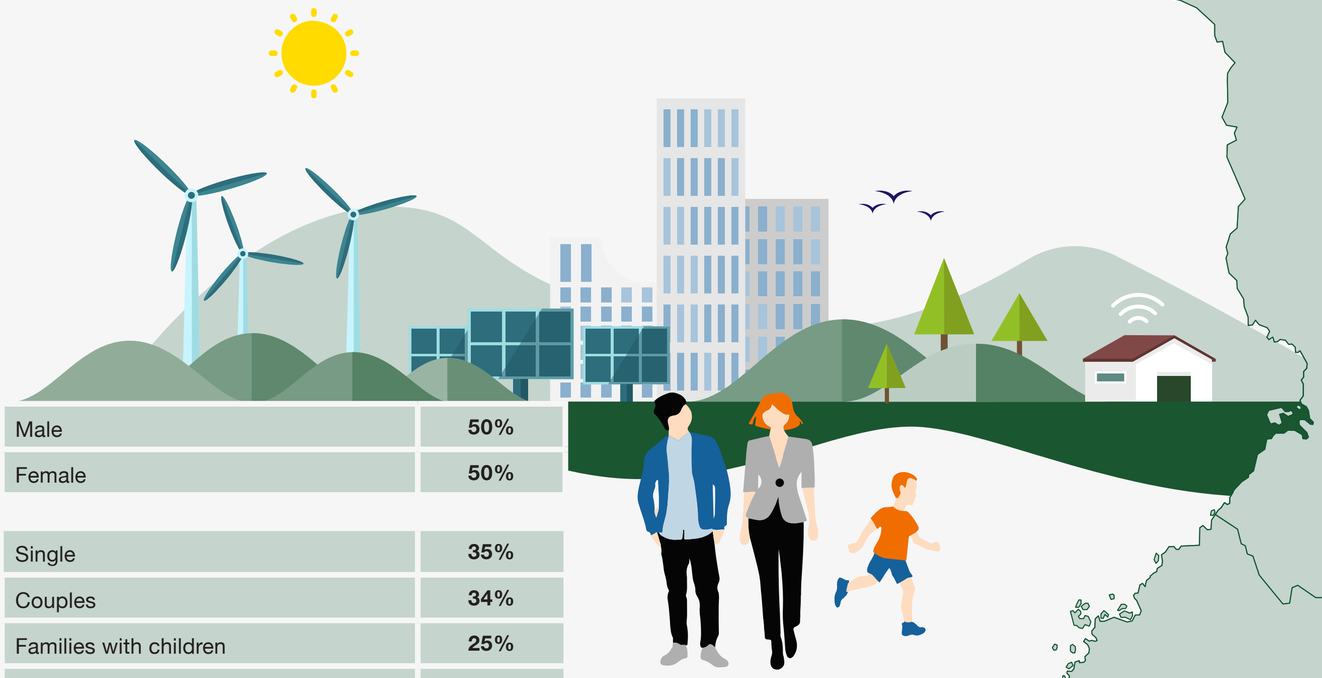


Research

The aim of this study was to identify Finnish citizens' attitudes and behaviors related to energy saving and to assess which incentives and support mechanisms could enhance their readiness to shift toward more sustainable and moderate energy consumption. The study combines quantitative and qualitative analysis to examine the challenges and enablers that citizens experience in their everyday efforts to save energy.

In the first phase, we explore how consumers perceive energy saving and the energy efficiency of major household appliances, and how they can be segmented based on their readiness to change their energy-use behavior toward more frugal and sustainable patterns. We then take a deeper look at the specific barriers and motivators faced by one of these segments.

The dataset consists of a nationwide survey (N = 1000) collected in 2023 complemented by a qualitative component (N = 41) collected in 2024, which provides an in-depth examination of the factors influencing everyday energy-saving practices in Finnish households.

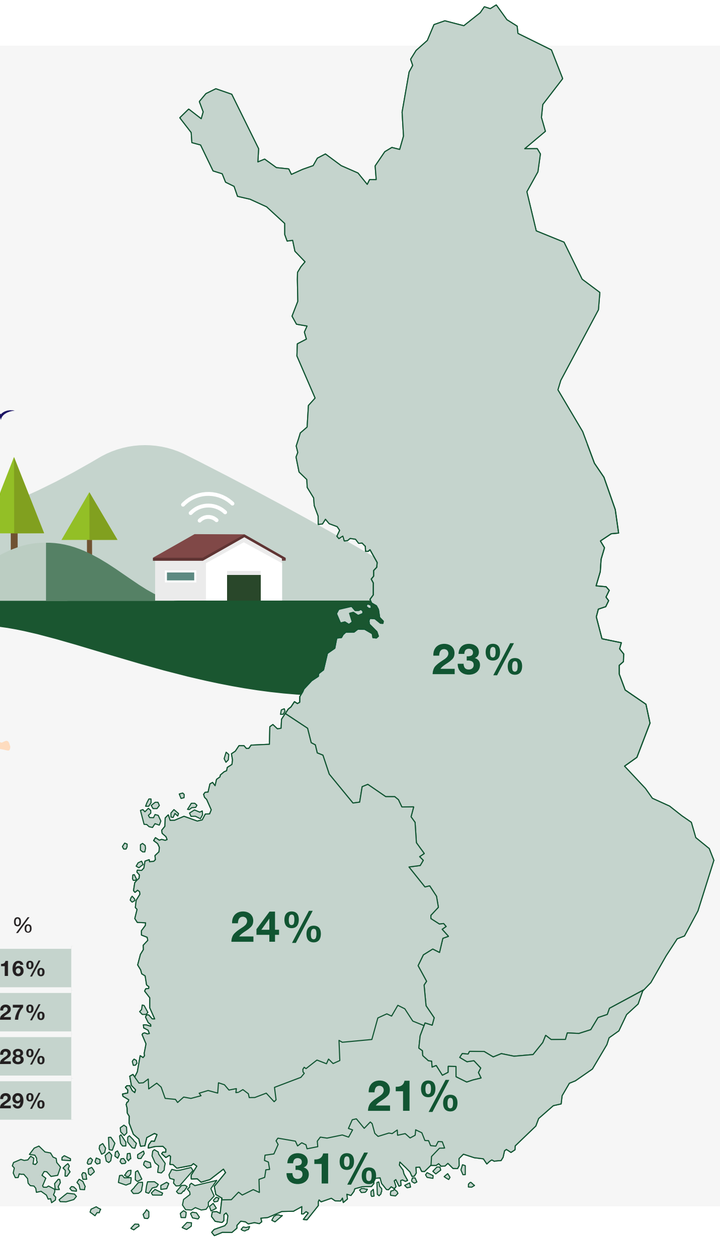


Male	50%
Female	50%

Single	35%
Couples	34%
Families with children	25%
Children or others at home	6%

Large city or suburb	35%
Small or medium-sized town or municipality	34%
Smaller locality, municipality or rural area	25%

Age Group	n	%
Gen Z (18-28)	160	16%
Gen Y (29-42)	268	27%
Gen X (43-58)	284	28%
Gen B (59-75)	288	29%



Four distinct groups of energy users
– Quantitative results

Based on the survey, respondents were divided into four distinct segments that showed clear differences in their energy use, attitudes toward energy saving, and readiness to shift toward more moderate energy consumption (Figure 1). In this study, energy saving is understood as the overall reduction of energy use through one's own behavior as well as through the choice of energy-efficient appliances.

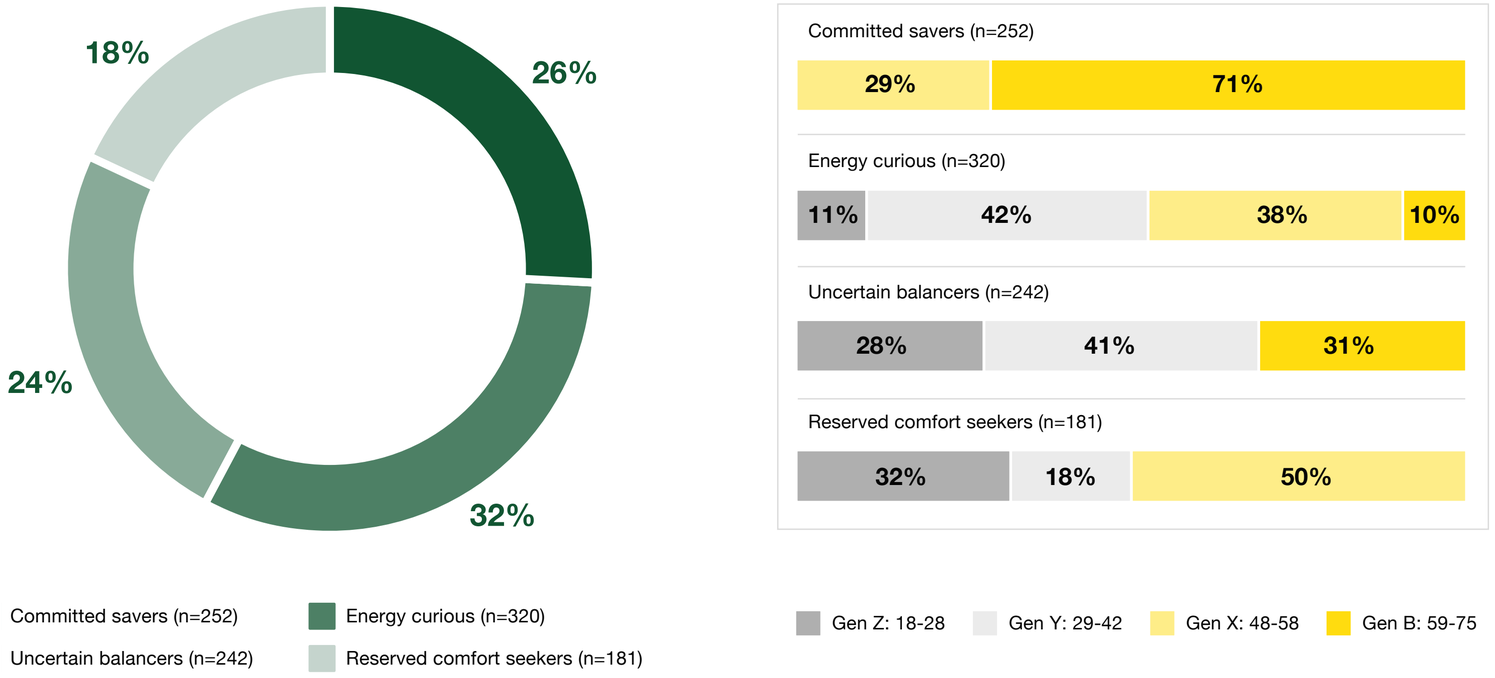
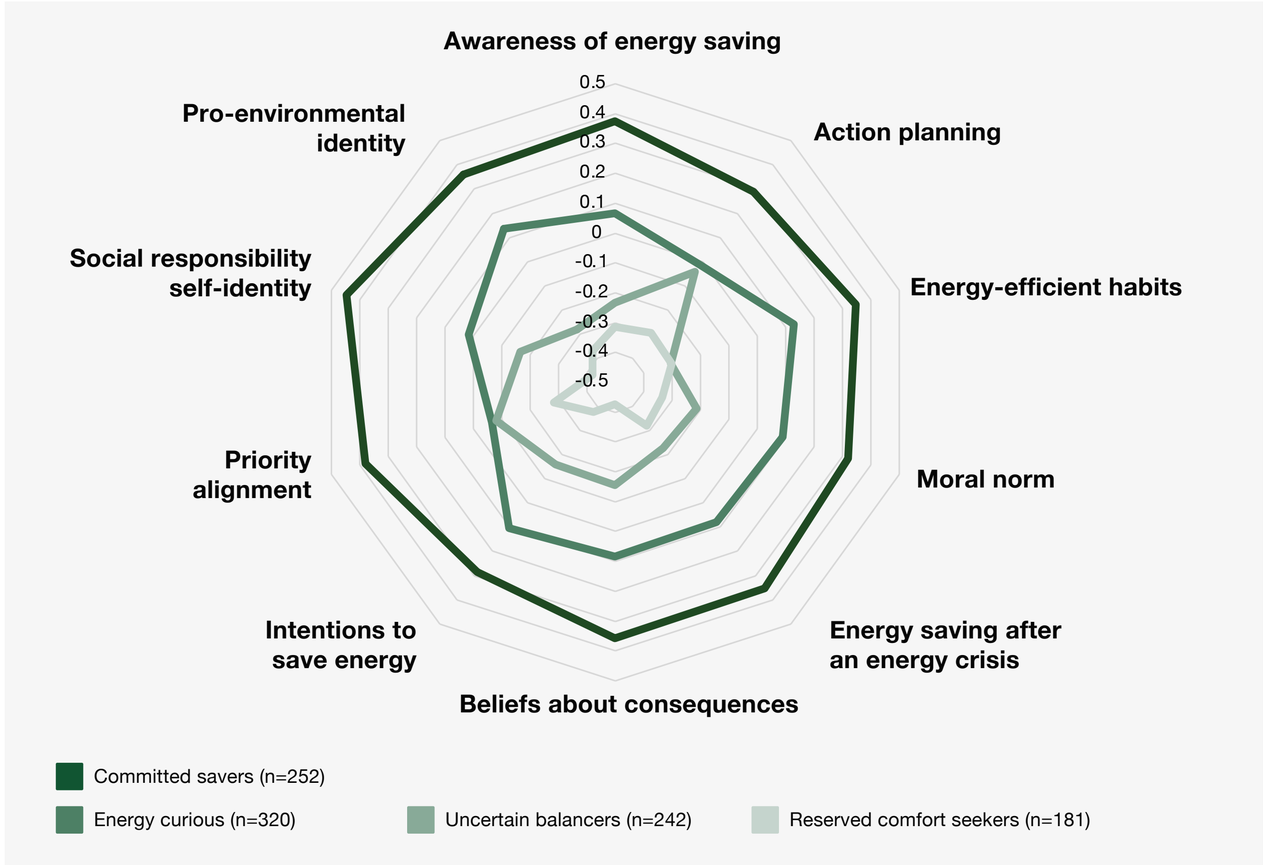


Figure 1. *Finnish consumer segments and their sizes, categorised according to readiness for change related to energy saving.*

- **Committed savers (n=252):** Predominantly older women with strong motivation and a high level of competence in energy saving. Energy-saving practices are deeply embedded in their routines, planning, and identity. Moderate energy use is seamlessly integrated into everyday life and is experienced as meaningful and rewarding.
- **Energy curious (n=320)**: Family-oriented individuals, typically aged 35–44, evenly split between women and men. They show a growing belief in the impact of energy saving and an increasing willingness to make changes. Their habits and plans are not yet well established, but their identity and intentions indicate a shift toward taking more active responsibility.
- **Uncertain balancers (n=242)**: Primarily young urban men aged 25–34, mostly from Southern Finland. They have value-based interest in energy saving and a desire to act responsibly, but lack planning, established habits, and strong commitment. Moderate energy use does not yet fit naturally into their daily routines or priorities.
- **Reserved comfort seekers (n=181):** Middle-aged individuals (with about 50% from Generation X) and younger men, especially from Western Finland. Energy saving is not a daily priority, and their knowledge, planning, and confidence in their own ability to influence energy use are low. Moderate energy use is perceived as difficult and hard to align with their current priorities.

Figure 2

Profiles of the four segments and their key psychological differences, based on each group's core motivational drivers and factors influencing behavior. At the two ends of the spectrum are the **Committed Savers**, who have the skills and routines needed to implement energy-saving practices in everyday life, and the **Reserved comfort seekers**, who show very little interest in saving energy. Between these extremes are two additional segments: **Energy curious**, who show a higher readiness for behavioral change, and **Uncertain Balancers**, whose readiness is lower.



Dimension	Explanation
Awareness of energy saving	Awareness of the causes of climate change and the basic principles of energy saving.
Action planning	Ability to plan concrete energy-saving and sustainability actions.
Energy-efficient habits	Routine-based and automatic energy-saving behaviors in everyday life.
Moral norm	A sense of moral responsibility and obligation to save energy.
Energy saving after the energy crisis	Motivation for energy saving that has strengthened as a result of the energy crisis.
Beliefs about consequences	The belief that one's own energy-saving actions have an impact on the climate and society.
Intentions for energy saving	Intention to engage in energy-saving actions in the near future.
Priority alignment	The extent to which energy saving aligns with one's everyday priorities.
Social responsibility identity	A sense of responsibility that promotes energy saving and influences others.
Pro-environmental identity	The degree to which environmental protection is part of one's personal identity.

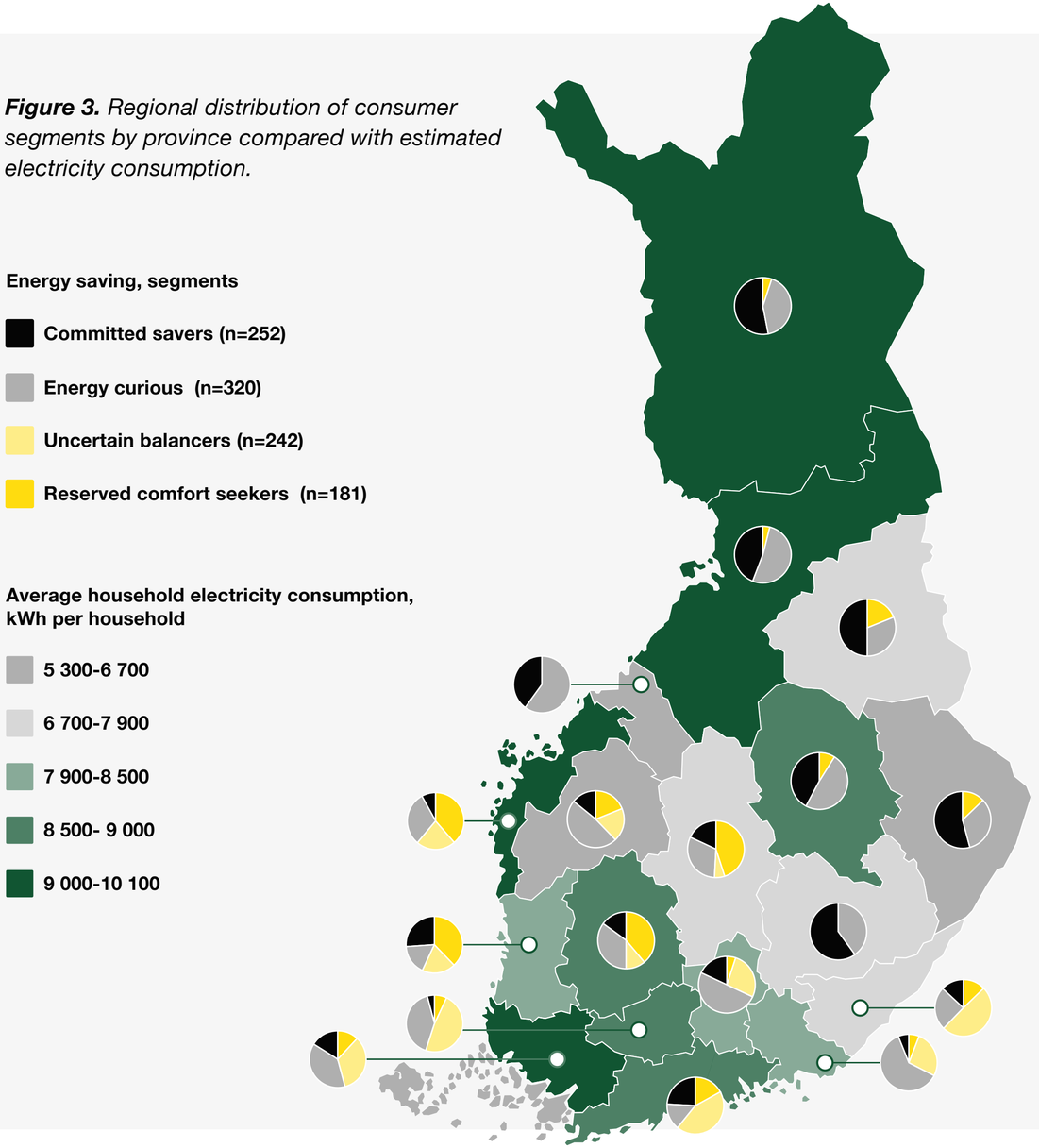
Table 2. *Description of dimensions*

Figure 3 illustrates the regional distribution of consumer segments in Finland as well as differences between regions in estimated household electricity consumption. Household electricity use by region was estimated by subtracting agricultural electricity consumption (LUKE 2023) from the combined residential and agricultural consumption reported by Energiateollisuus ry (Energy Industry Finland, 2022). The estimate was further refined based on the predominant heating method in each region: regional district-heating shares were incorporated by assuming that households using district heating consume approximately **70% less electricity** than electrically heated homes (Suomen ympäristökeskus, 2022). In addition, consumption estimates were weighted by the estimated number of electrically heated and district-heated households in each region, ensuring that regional differences are realistically reflected in household-level direct electricity use. These estimates should be regarded as approximate and indicative due to the assumptions required in the calculation.

In Eastern and Central Finland, electricity consumption is below the national average, and attitudes toward energy saving are more positive than in other regions. Conversely, in Western and Southern Finland, household electricity consumption is somewhat higher, and the proportion of **Uncertain balancers** is above average.

Notably, the share of **Energy curious** is significant across many regions throughout Finland. Their wide geographical distribution and high readiness for change make them a particularly valuable target group for promoting more moderate and sustainable household energy use.

Figure 3. *Regional distribution of consumer segments by province compared with estimated electricity consumption.*



Focus on Energy curious

– Qualitative results

The **Energy curious** account for roughly one third (32%) of Finnish consumers and represent a segment with substantial potential for change. They view energy saving positively, recognise its importance, and actively seek to improve their everyday practices, even though their routines are not yet fully systematised. The group is characterised by a strong sense of moral responsibility and a belief that saving energy is a duty toward both the climate and society. Compared to other segments, they have a stronger conviction in the effectiveness of their own actions, which reinforces their sense of agency and readiness to take concrete steps.

Growing interest in energy efficiency—particularly in appliance choices and technological solutions such as smart meters—supports their transition toward more active engagement. Their pro-environmental identity is also well established.

The significance of this segment is further heightened by its demographic and regional diversity. The group consists mainly of family-oriented households with adults typically aged 35–44. They live in both suburban areas and smaller towns across different parts of Finland, which makes them a key target group for national and regional interventions. It is possible that support measures aimed at this group could also benefit others, although this would require further research.

The qualitative research focused on households in suburban areas, where public transport is accessible and everyday conditions more easily support energy-saving activities and sustainable mobility compared to rural regions. These families also demonstrated interest in technological solutions and services that enhance energy efficiency.

The qualitative research was carried out in two complementary phases. The first phase consisted of a two-week diary study (n = 27 households), which explored everyday energy-saving practices, barriers, and motivational factors. This was followed by a separate group discussion (n = 14) with different participants than in the diary phase. The purpose of the discussion was to deepen the insights, surface shared experiences, and better understand emotions and peer dynamics. By combining the findings from both phases, a comprehensive view of the segment's current situation, readiness for change, and concrete opportunities and barriers was formed.

The in-depth analysis revealed several insights that complement the quantitative findings. The motivation of the Energy curious is driven in particular by **financial pressure**, which has intensified as electricity prices have risen. Moral responsibility and a pro-environmental identity also play an important role. However, practical actions in daily life often remain fragmented and impulsive because systematic routines are still missing. Establishing new habits requires that comfort is not compromised; even small changes can feel burdensome without clear guidance.

> **"There is a clear willingness to change, but moving toward more impactful actions requires practical support, clear information, and solutions that are easy to adopt."**
>
> **Anu Seisto, Research Team Leader, VTT**

Technological solutions are of interest, but their adoption is hindered by perceived lack of skills and insufficient support. Energy use related to mobility is not recognised as an area for potential savings, as driving is considered essential for families. Own energy production, such as rooftop solar panels, is seen as a strong form of commitment, but high costs and unclear support mechanisms limit adoption. Community engagement and peer learning also remain underutilised resources, despite existing interest.

In summary, there is a clear willingness to change, but transitioning toward more impactful actions requires **practical support, reliable information, and easy-to-adopt solutions**. Table 3 summarises the key themes from the analysis along with the related enablers and barriers.

Theme	Enablers	Barriers
Behaviour and routines	Existing small saving routines; Willingness to develop new habits; Belief that saving does not require major loss of comfort	Lack of time and planning; Irregular routines; Uncertainty about effective saving methods
Awareness and attitudes	Basic understanding of energy saving; Moral motivation; Willingness to learn	Uncertainty about effectiveness; Superficial climate thinking; Fragmented information
Financial motives	Savings driven by rising energy prices; Strong financial incentives; Willingness to reduce energy costs	High investment costs; Lack of knowledge about solutions; Insufficient advice and peer support
Mobility and energy saving	Financial motivation; Availability of alternatives (e.g., cycling, public transport); Interest in electric vehicles	Car use seen as unavoidable; Public transport perceived as inconvenient; Low awareness of energy-efficient mobility options
Energy ownership and production	Interest in self-sufficiency; Feeling of control through own production; Positive attitudes toward renewable energy	High investment threshold; Uncertainty about available support; Lack of technical skills and financing options
Comfort vs. energy efficiency	Willingness to make light compromises; Routines that do not reduce comfort; Establishment of routines	Comfort and wellbeing prioritised; Uncertainty about impact on quality of life; Optimization perceived as difficult
Technological solutions	Interest in smart devices and consumption monitoring; Potential for transparency and control; Good experiences with user-friendly technologies	Lack of knowledge; Perceived difficulty of use; Doubts about cost-effectiveness of devices
Community and social environment	Influence of role models and examples; Interest in community-based solutions; Energy crisis sparks discussion	Busy family life limits engagement; Lack of models and examples; Absence of community structures

***Table 3**. Enablers and Barriers to Behavioral Change.*

Diary study

Financial pressure is the primary trigger for change

For the Energy curious, several themes intersect in ways that shape how energy-saving behaviors emerge in everyday life. Awareness of climate change and the importance of saving energy exists, but it is often surface-level and tied to the realities of daily life. Attitudes toward climate issues are generally positive, and people believe their actions matter — yet in practice, the strongest motivating factor is financial. Rising electricity prices and transmission fees have been a concrete catalyst for behavioral change. Behind this lie a sense of moral responsibility and a pro-environmental identity.

"The price of electricity and transmission fees has multiplied — we have no choice but to save."

Lack of information and support limits action

Many respondents reported difficulty finding clear, practical information about the benefits of investments, available technologies, or which actions genuinely make a difference. This barrier is particularly evident for larger investments — even when the desire to save energy is strong, uncertainty prevents concrete decisions.

"It's been difficult to find clear information on where to get affordable and effective solutions."

Energy-saving actions are often fragmented — not yet habitual

In most households, energy saving is not a systematic process; instead, it consists of individual actions such as switching off lights, adjusting indoor temperatures, or optimizing the use of household appliances. In some families, these practices have already become part of daily routines without compromising comfort, but in many others they remain irregular and not fully established.

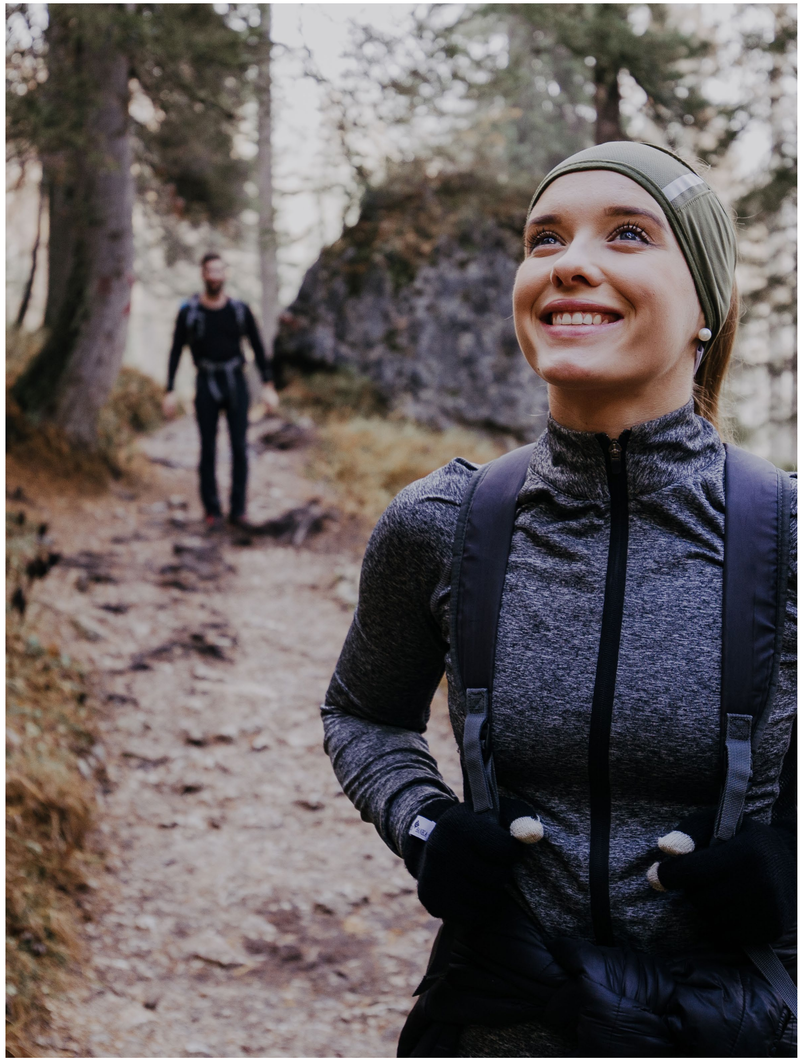
Technology is appealing but perceived as difficult to approach

Smart meters and consumption-monitoring tools are of interest, but without sufficient support and explanations, they are seen as complicated to use. Families recognise the potential of technology, provided that it is easy to understand, and the benefits are clearly demonstrated.

Comfort is non-negotiable — there are limits to how far savings can go

Although there is a desire to act in a climate-friendly way, everyday choices are built around finances and comfort. Lowering the room temperature at home is considered difficult, especially in families with children – cold is not an option, even if consumption is to be reduced.

"I don't like feeling cold, so that's why I haven't lowered the temperature."



Opportunities for major actions are limited — many feel that all the "easy wins" have already been taken

Many families feel that the most accessible energy-saving measures have already been implemented. The remaining options require larger investments or compromises that are perceived as difficult. Solar panels and other forms of household-level energy production are appealing, but high costs and unclear support schemes limit adoption.

"There's really nothing left to cut — we've already considered everything."

Mobility is rarely seen as part of energy saving

Reducing car use is not viewed as realistic for many families due to long distances and the logistics of children's hobbies and daily routines. As a result, mobility-related energy consumption is not perceived as a tangible area for savings in the same way that household electricity use is.

Community-based solutions are a key but underused resource

Many families recognise that implementing broader energy-saving actions would require peer learning, shared experiences, and collective solutions. There is interest, for example, in neighborhood-level solar projects or exchanging practical insights about everyday saving practices.
However, the potential of community-based approaches remains largely untapped. Lack of coordination, practical skills, and time — combined with the fact that energy-saving discussions tend to remain within the family — reduce peer influence and slow down collective learning at the community level.

Group discussions

The group discussions highlighted the emotional dimensions of energy saving and the importance of a sense of ownership. Participants did not perceive energy merely as a cost factor, but as an everyday "companion" that evokes emotions and shapes daily routines. The rapid demand-side measures introduced during the energy crisis, such as shifting electricity consumption to lower-price hours, had, for many in this group, become established long-term practices.

Self-generated energy, such as solar power or wood heating, strengthened participants' sense of control and commitment. The discussions also emphasized themes of parenthood, responsibility toward future generations, and the moral obligations within the family, where economic and environmental motives intertwine with everyday practicalities.

Community-based solutions were viewed with interest, yet a lack of information and support hindered the transition from ideas to action. Still, a willingness to experiment was visible in many small-scale daily saving practices, for example, reducing the use of electric saunas, adjusting consumption patterns, or developing DIY solutions such as traffic-light–style applications for monitoring electricity prices. At the same time, respondents described the lack of feedback data on their consumption and its impacts, which undermines motivation to adopt new routines.

The group discussions clearly showed how practical guidance, peer learning, and a sense of ownership significantly enhance the likelihood of achieving lasting behavioral change. They also revealed that while sustainability is valued as an important principle, decisions in everyday life are most often driven by cost-efficiency and household comfort.

> **"Sustainability is regarded as an important value, but in practice, cost-efficiency and household comfort still tend to be the decisive factors."**
>
> **Tom Tamlander, Researcher, VTT**

Supporting the Energy curious

Energy curious were selected as the primary target group in this study, as their readiness to adopt more moderate energy use was exceptionally high and their attitudes toward energy-saving measures clearly positive. The segment was also sizeable, as 32% of respondents across Finland fell into this segment.

Understanding the support needs of this segment enables the development of new services that could also prove valuable for other consumer segments.

Based on the results, there is a need for measures that:

1. Facilitate and motivate everyday energy management,
2. Provide concrete information and practical examples,
3. Strengthen peer learning as well as neighborhood- or resident-driven ownership of energy use.

1 Ease in everyday life and motivating practices

What are the barriers?

- Perceived effort, lack of guidance or difficulty finding instructions, and the sense that changes are cumbersome
- Limited understanding of mobility-related energy consumption as part of the overall energy footprint
- The perceived necessity of car use in families

What enables change?

- Small, easy-to-adopt behavioral adjustments
- Development and support for alternative mobility options
- Gamification and reward mechanisms as tools for motivation

Concrete opportunities:

- Smart applications and consumption-focused games
- Development of shared-mobility solutions (e.g., car-sharing)

2 Capabilities, information, and decision support

What are the barriers?

- Fragmented and hard-to-interpret information, along with uncertainty about the profitability of investments
- Subsidies and financing options perceived as complex and unclear

What enables change?

- Clear, practical information supported by concrete examples and services
- Integrated solutions for energy-related investments (financing + technology + maintenance)

Concrete opportunities:

- Investment subsidies for various joint initiatives; cooperative or group-purchase models
- Peer support and narrative case examples from families in similar situations

3 Community and peer influence

What are the barriers?

- A sense of being left alone, limited discussion, and the absence of established engagement models
- Peer support and joint initiatives are not yet part of everyday practice

What enables change?

- Community-driven projects and neighborhood initiatives
- Joint energy projects within families

Concrete opportunities:

- Energy-saving campaigns, challenges, and community projects that generate comparative data
- Positive examples from different life situations and sharing of concrete benefits
- School and association-based projects that bring families together and involve children as active participants

Conclusions

More sustainable household energy consumption requires a holistic approach—one that goes beyond technical solutions to also address behavior, community practices, and prevailing social norms to reduce energy consumption. From the household perspective, daily routines, financial pressures, comfort, and limited access to clear information are intertwined in ways that call for multifaceted support and clear guidance. Thus, instead of focusing on solely energy efficiency or energy saving, we should move towards increasing energy sufficiency combining the above aspects.

The study highlights that the challenges and opportunities experienced by consumers reflect a broader need for new operational models that combine energy sufficiency with economically viable solutions.

Four consumer segments were identified in the study, of which the Energy curious were selected as the primary target group. This segment demonstrated the strongest potential for behavioral change. Their key challenge centers on how everyday practices, such as home heating, consumption habits, and mobility choices, can be reshaped toward more sustainable energy use, without excessive compromises to quality of life.

The qualitative research showed that everyday emotions and the need for a sense of control are closely tied to energy use. Many of the energy saving practices adopted during recent energy crises have become permanent routines, and on-site generation of energy was experienced as empowering. Yet opportunities for investment often remain untapped when concrete guidance and practical examples are lacking. There is clear willingness to experiment and to explore new ways to save energy, but uncertainty about the cost-effectiveness of investments combined with concerns about reduced comfort limits the feasibility of taking action.

However, a shift toward more sustainable energy use does not happen on its own. Changes in everyday practices may be slowed by the lack of instructions and the perception that change is burdensome. For example, the perceived necessity of car use in families can make it difficult to recognise the role of mobility in total energy consumption. Small, easily adopted solutions, services, and the use of gamification can all play a role in establishing new routines.

To support decision-making, households need clear and practical information. Fragmented guidance and uncertainty around the cost-effectiveness of investments can slow progress, but concrete examples, integrated solutions, and peer support can lower the threshold for action. Stories from similar families and joint initiatives help build trust and encourage participation.

Community engagement is a powerful driver of change. Many people feel they are navigating energy decisions alone, and peer support is not yet part of everyday life. Energy saving campaigns, challenges, and school- or association-based projects can bring families together and involve children as active participants. Positive examples and the sharing of tangible benefits reinforce the sense that change is both possible and worthwhile, and that it is something worth joining.

What everyone should know about energy consumption

Energy sufficiency refers to using only the amount of energy that is genuinely necessary. It means utilising energy efficiently and responsibly, without unnecessary consumption or harmful environmental impacts. Energy sufficiency is not only about saving energy—it is about using energy intelligently so that essential functions can be performed with minimum amount of energy. Key principles of sufficiency within the clean-energy transition include:

- **Using energy according to actual needs:** Avoiding unnecessary consumption, for example by switching off lights that are not in use and optimising heating (or cooling) of homes.
- **Energy efficiency:** Choosing appliances and systems that consume less energy. Efficiency can also be increased through **consumption management and demand response**, optimising energy use with smart home technologies.
- **Sustainable production:** Increasing the use of renewable energy sources and reducing the use of fossil fuels.

Demand response means adjusting electricity consumption in response to supply and demand conditions. In practice, this may involve shifting appliance use to different times, reducing consumption during peak hours, or enabling automatic adjustments through smart-grid solutions. Demand response helps decrease grid load and can lower costs for consumers.

Despite technological advancements that have significantly improved energy efficiency, global total energy consumption has continued to rise due to economic and population growth, as well as changing consumption patterns. One contributing factor is the **rebound effect**, which refers to situations where the savings achieved through improved energy efficiency are partly—or even entirely—offset. This happens when the reduced energy cost encourages people (or companies) to use more resources than originally intended.

For example, when cars become more energy-efficient and use less fuel, people may end up driving more, reducing the overall savings. Also, energy-efficient household appliances can lower electricity bills, but if people use these appliances more carelessly or redirect the saved money toward new electronics, the net savings in energy may be smaller.

"Although the adoption of new technologies has significantly improved energy efficiency, global total energy consumption has continued to rise due to economic and population growth as well as changing consumption patterns."

Tiina Koljonen, Principal Research Scientist, VTT

References

Gallagher, J., Coughlan, P., Williams, A., & McNabola, A. (2018). Innovating for low-carbon energy through hydropower: Enabling a conservation charity's transition to a low-carbon community. Creativity and Innovation Management, 27(4), 375–386. https://doi.org/10.1111/caim.12291

Hausknost, D., Haas, W., Hielscher, S., Schäfer, M., Leitner, M., Kunze, I., Mandl, S. (2018). Investigating patterns of local climate governance: How low-carbon municipalities and intentional communities intervene in social practices. Environmental Policy and Governance, 28(6), 371–382. https://doi.org/10.1002/eet.1804

Heiskanen, E., Jalas, M., Rinkinen, J., & Tainio, P. (2015). The local community as a "low-carbon lab": Promises and perils. Environmental Innovation and Societal Transitions, 14, 149–164. https://doi.org/10.1016/j.eist.2014.08.001

Hyry, J. (2025). Ilmastobarometri 2025. Valtionhallinnon ilmastoviestinnän ohjausryhmä. Saatavilla: https://kaustisenseutu.fi/site/assets/files/13489/ilmastobarometri_2025_1.pdf

Jenkins, K., McCauley, D., Heffron, R., Stephan, H., & Rehner, R. (2016). Energy justice: A conceptual review. Energy Research & Social Science, 11, 174–182. https://doi.org/10.1016/j.erss.2015.10.004

Koljonen, T. ym. (2025a). Kansallisen energia- ja ilmastopolitiikan uudet toimet ja skenaariot (KEITO) - pitkän aikavälin ilmastosuunnitelman taustaselvitys. VTT Technology. https://publications.vtt.fi/pdf/technology/2025/T443.pdf

Koljonen, T. ym. (2025b). Kansallisen energia- ja ilmastopolitiikan uudet toimet ja skenaariot (KEITO) - keskipitkän aikavälin vaikutusarviot. VTT Technology. https://publications.vtt.fi/pdf/technology/2025/T442.pdf

Matschoss, K., Salmivaara, L., Heiskanen, E., Kanerva, M., Laakso, S., Nyforse, T. & Pekkanen, T. (2025). Kohtuus esiin tehokkuuden varjosta –kuinka kohtuus sisältyy suomalaistenasiantuntijoiden näkemyksiin kestävän asumisen ohjauskeinoista? Alue ja Ympäristö 54(1), ss. 76-101 Kohtuus esiin tehokkuuden varjosta - pdf

L Neij, J Palm, H Busch, T Bauwens, S Becker, A Bergek, A Buzogány, C Candelise, F Coenen, P Devine-Wright, T Hoppe, A Kortetmäki, K Pantazis, F Palaiogiannis, M Margosi, D Petrovics, J Plöchl, G Ruggieri, S Ruggiero, K Standal, P Scherhaufer, I Soutar, Energy communities—lessons learnt, challenges, and policy recommendations, Oxford Open Energy, Volume 4, 2025, oiaf002, https://doi.org/10.1093/ooenergy/oiaf002

Nikolic, J., & Sorknæs, P. (2025). Energy communities in Denmark: Potential and opportunities. https://vbn.aau.dk/en/publications/energy-communities-in-denmark-potential-and-opportunities/

Seyfang, G., & Haxeltine, A. (2012). Growing grassroots innovations: Exploring the role of community-based initiatives in governing sustainable energy transitions. Environment and Planning C: Government and Policy, 30(3), 381–400. https://doi.org/10.1068/c10222

Suomen ympäristökeskus. (2022, October 7). Rakennusten lämmitys kuluttaa runsaasti energiaa. Ilmasto-opas. https://www.ilmasto-opas.fi/artikkelit/rakennusten-lammitys-kuluttaa-runsaasti-energiaa

Valtioneuvosto (2023). Vahva ja välittävä Suomi. Pääministeri Orpon hallituksen ohjelma 20.6.2023. Valtioneuvoston julkaisuja 2023:58. https://valtioneuvosto.fi/hallitukset/hallitusohjelma

Ympäristöministeriö (2025). Keskipitkän aikavälin ilmastosuunnitelma (Luonnos). Saatavilla: https://ym.fi/keskipitkan-aikavalin-ilmastopolitiikan-suunnitelma

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