

# FROM POLICY TO PRACTICE: EXPLORING ENERGY EFFICIENCY POTENTIALS AND THE ROLE OF MUNICIPAL COUNSELING

## A SIMULATION STUDY FOR A SMALL SWEDISH MUNICIPALITY

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## Abstract

Municipalities play a vital role in the energy transition but often lack the resources to conduct detailed energy analyses and develop effective policy scenarios. The CommitClimate project addresses this challenge through the CommitClimate Simulator, a decision-support tool that enables municipalities to model future energy scenarios, assess renewable energy potential, and estimate emissions reductions. However, translating these projections into concrete implementation strategies requires additional expertise, particularly in addressing sector coupling and local barriers to adoption.

This study applies the Simulator to Jokkmokk, Sweden, to explore how free municipal energy counseling can accelerate the transition to renewable energy, enhance energy efficiency, and promote sustainable transport solutions. Three scenarios are analyzed: (1) Electrification, focusing on household PV adoption and electric vehicle uptake; (2) Resilience, emphasizing decentralized energy solutions, storage, and behavioral transport shifts; and (3) Commercial Efficiency, targeting energy savings and low-carbon transport in businesses.

Findings indicate that energy counseling can significantly increase renewable energy adoption, improve energy efficiency beyond baseline scenario, and accelerate the shift to sustainable transport, leading to major economic benefits. In the residential sector, additional PV installations could generate 10.8 GWh of renewable electricity and 28.2 million SEK in local economic benefits over 30 years. Behavior-based energy efficiency measures could save up to 7.5 million kWh annually, reducing household and business costs. In transport, accelerating the adoption of electric vehicles, cycling, and car-sharing by 10 years could yield 1.48 billion SEK in fuel cost savings.

These results demonstrate that free municipal energy counseling is a highly cost-effective measure for local governments to support the energy transition, providing economic, environmental, and social benefits. The study highlights the need for integrated planning tools that combine scenario modeling with real-world implementation strategies to optimize municipal energy planning.

Jokkmokk can position itself as a forerunner in energy resilience by actively promoting energy efficiency gains across households and businesses. The municipality can help reduce dependency on external energy sources and create a more self-sufficient local energy system. By prioritizing local energy production and efficiency, Jokkmokk can increase the availability of locally generated electricity, ensuring a more stable and secure energy supply. This proactive approach not only enhances the community's ability to withstand external disruptions—such as energy market volatility or supply chain crises—but also drives economic benefits by keeping energy investments and savings within the local economy. Through these efforts, Jokkmokk can set an example for other rural communities by demonstrating how municipal energy policies can foster both resilience and sustainability, making the transition to a low-carbon future more accessible and beneficial for all.

## CommitClimate Simulator: A Scenario-Based Approach

Municipalities play a crucial role in the energy transition but often lack the resources in staff and budget to do a full compilation of local energy use and more specifically to analyze data and create different policy scenarios to develop sound future energy strategies. The CommitClimate project offers a solution through the CommitClimate Simulator, a decision-support tool that helps municipalities explore different policy scenarios for reducing energy demand and expanding renewable energy across all sectors in the territory.

The CommitClimate Simulator allows users to input various data points to calculate current final energy use and CO<sub>2</sub> emissions and model future scenarios across major economic sectors. This includes:

- Model energy system changes over time based on different policy scenarios.
- Project future renewable energy generation (e.g., how much solar PV would be installed by 2050 under a given policy).
- Assess impacts on energy demand and greenhouse gas emissions.

However, turning these projections into actionable local strategies requires additional expertise. For example, if a scenario suggests installing 40 kW of solar PV per year, further analysis is needed to determine:

- How many households need to install PV to meet this goal;
- Economic impacts for both individuals (the total investment required and payback) as well as local economic benefits (job creation, energy independence, resilience);
- Barriers for implementation in the specific community and strategies to overcome them.

Another important limitation is the lack of sector coupling in the modeling. Energy systems are interconnected across sectors, and policy choices in one sector can create synergies or trade-offs in another. For example, electrification of transport - such as replacing conventional vehicles with electric cars- can enable better integration of local solar PV production, reducing fossil fuel dependence while increasing self-consumption of renewable electricity. Without considering these cross-sectoral dynamics, municipalities may miss opportunities to optimize their local energy transition. These aspects are beyond the scope of the Simulator and require additional municipal expertise to connect scenario results to real-world planning.

This feasibility study addresses these gaps by interpreting the Simulator's results and translating them into concrete implementation strategies. To demonstrate this approach, the study applies the Simulator to Jokkmokk, a small Swedish municipality located on the Arctic Circle in Norrbotten County and explores how free municipal energy advisory services can contribute to achieve policy goals.

## The Role of Municipal Energy Counseling

In Sweden, municipal energy and climate advisors have been providing free, commercially neutral guidance for decades. These advisors assist households, organizations, and small to medium-sized enterprises on various energy-related topics. Trained and financially supported by the Swedish Energy Agency, they are ensuring that advice is tailored to regional conditions.

Beyond offering individualized consultations, advisors engage in outreach activities, education, and collaborations with other stakeholders to enhance societal knowledge and awareness about energy issues. They serve as vital links between citizens and policymakers across municipal, regional, and national levels, facilitating the dissemination and implementation of current energy and climate policies.

This extensive network covers almost all of Sweden's 290 municipalities. Traditionally, municipal energy counselors were not permitted to work with municipal buildings or energy planning. Their primary focus was on:

- Reducing household energy use through improved insulation, heating efficiency, and behavioral changes.
- Providing guidance on renewable energy installations such as solar PV and heat pumps.

However, since 2025, municipal energy counselors are allowed to actively contribute to municipal energy strategies. This shift aligns with the increasing importance of electrification and sector coupling, which connects electricity production with other energy-consuming sectors like transport and heating. The enhanced role of energy counselors also facilitates the identification and mitigation of local barriers to energy transition. For instance, they can address challenges such as limited public awareness, regulatory hurdles, and financial constraints by providing targeted information and support. This proactive engagement not only empowers individuals and businesses to adopt sustainable practices but also fosters a more resilient and self-sufficient local energy system.

Municipal energy counselors can take on new roles as they integrate into local energy planning as

- **Facilitating local energy communities and collective energy projects** – Supporting citizen-led energy cooperatives and shared renewable energy projects, such as community solar initiatives or local microgrids.
- **Advising on demand-side flexibility and smart grid integration** – Helping municipalities and businesses adopt smart energy solutions, including dynamic electricity pricing, demand-response programs, and battery storage to optimize energy use.
- **Strengthening local business engagement in the energy transition** – Supporting SMEs in adopting energy-efficient technologies, electrifying transport, and leveraging financial incentives for sustainable investments.
- **Developing local financing models for energy investments** – Assisting municipalities in accessing funding opportunities, designing local incentive programs, and connecting businesses and residents with green financing options.
- **Supporting municipalities in energy security planning** – Identifying strategies to enhance resilience against extreme weather, energy supply disruptions, and climate-related risks through diversified and decentralized energy systems.

## Jokkmokk: Facing Challenges and Opportunities in Energy Transition

Like many other small municipalities in Sweden's inland regions, Jokkmokk faces pressing demographic and economic challenges that threaten long-term development. A shrinking and aging population, a declining tax base, and labor shortages are common issues that hinder economic growth. Limited infrastructure investments, high construction costs, and a low supply of new housing further restrict Jokkmokk's ability to attract new residents and businesses. These challenges, combined with long distances, weak public transport, and dependency on fossil-fueled mobility, make it crucial for Jokkmokk to find new pathways for economic resilience.

However, the energy transition presents a major opportunity for Jokkmokk to turn these challenges into strengths. By leveraging its vast renewable energy resources, investing in new energy infrastructure, and embracing sector coupling, the municipality can boost local value creation, attract sustainable industries, and improve energy security. A well-planned energy transition can help retain local wealth, create jobs, and reduce dependence on external energy sources - a critical strategy for municipalities seeking long-term sustainability.

Hydropower stations in the municipality produce around 12.5 TWh of electricity annually. The power plants are owned by the state-controlled energy company Vattenfall, most tax revenues and economic benefits flow out of the municipality, leaving Jokkmokk with limited compensation for the environmental and social impacts of hydropower production. However, hydropower is a reason why Jokkmokk might become a strategic hub for Sweden's green industrial transformation. Several large-scale energy infrastructure projects are underway, including:

- A new 400 kV transmission line from Porjus to Gällivare, expanding the grid's capacity to support energy-intensive industries.
- Plans for hydrogen production near Porjus, to support the development of hydrogen-based technologies for fossil-free steel production.

These investments are crucial for Sweden's energy transition and will significantly increase electricity demand in the region. This reinforces the need for a well-planned local energy strategy that ensures Jokkmokk maximizes the benefits of these developments for its own community.

Jokkmokk's position as both a challenged rural municipality and a center for energy production makes it a crucial testbed for sustainable energy solutions. By using the CommitClimate Simulator for strategic planning and leveraging municipal energy counseling to engage local stakeholders, Jokkmokk can maximize the local benefits of the energy transition.

Rather than being a passive provider of electricity to industries elsewhere, Jokkmokk has the chance to become a leader in rural energy resilience, proving that even small municipalities can drive innovation, create economic value, and achieve long-term sustainability through smart energy planning.

## Jokkmokk municipality Baseline Energy Inventory 2021

The baseline energy inventory serves as a reference point for evaluating the impact of different policy scenarios on energy demand, renewable energy expansion, and municipal energy resilience.

The baseline year for this study is 2021 and a population of 4,728, with a **total energy consumption across the community amounting to ca 240 GWh**. Energy use is distributed across different sectors as follows: Transport: 38.3%; Buildings: 31.1%; Commercial and tertiary sector: 23.9%; Industry: 3.8%; Public infrastructure: 2.2%; Other: 0.8%.

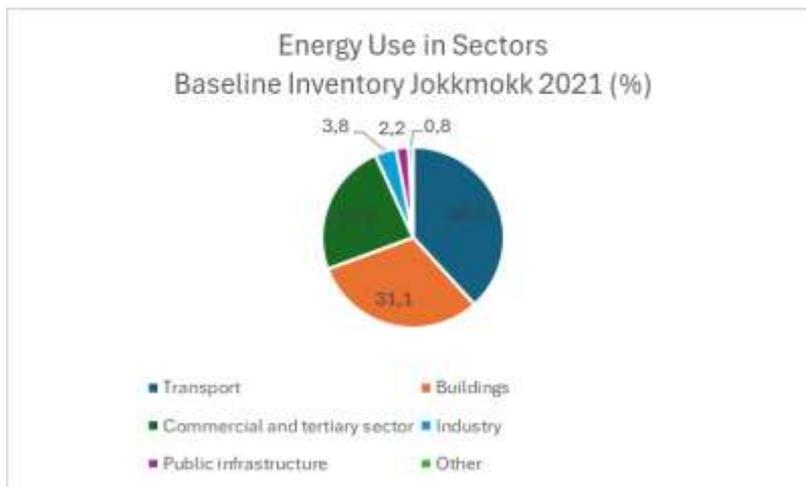


Figure 1 Graphic showing final energy use in 2021 in % for Jokkmokk baseline scenario: Buildings: 31.1%; Public infrastructure: 2.2%; Transport: 38.3%; Industry: 3.8%; Commercial and tertiary sector: 23.9%; Other: 0.8%

These figures indicate a strong dependence on personal vehicles for mobility, with limited use of public transport and active travel modes (walking and cycling). According to regional statistics and a local survey, the modal split in 2021 is assumed to be: Private car: 79%; Public transport: 5%; Walking: 12%; Cycling: 4%.

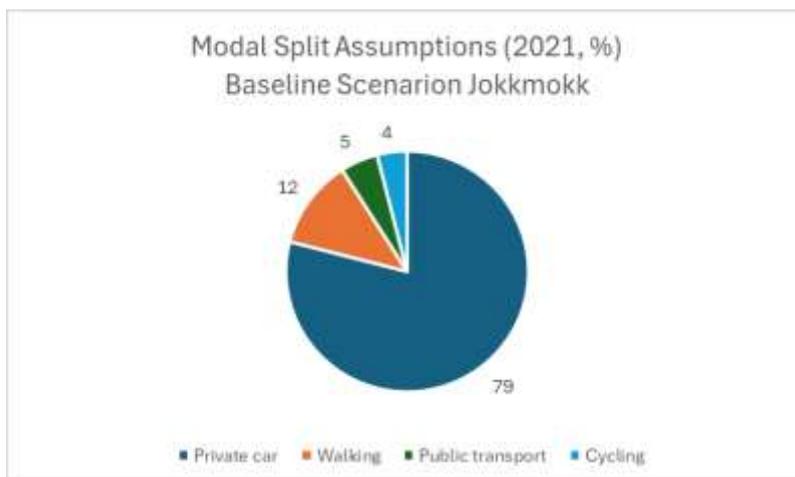


Figure 2: Graphic showing Modal Split Assumptions for Jokkmokk Baseline Scenario 202: Private car: 79%; Public transport: 5%; Walking: 12%; Cycling: 4%

## CommitClimate Scenario Design

The CommitClimate Simulator incorporates **underlying trends** that apply across all scenarios. These assumptions reflect broader societal and technological developments that influence energy demand and emissions, regardless of local policy choices. The key trends considered are:

- **Population Decline**  
The model assumes a gradual decrease in population over time, impacting overall energy demand, transportation needs, and waste generation. This reflects demographic projections for the region and aligns with long-term trends in rural areas.
- **Private Car Use and Efficiency Improvements**  
While the share of private car use remains high, the Simulator assumes that vehicles become more fuel-efficient over time as older models are replaced. This trend reflects advancements in vehicle technology, stricter emission regulations, and a general market shift toward low-emission and electric vehicles.
- **Declining Per Capita Waste Generation**  
The model assumes that the amount of waste generated per person will decrease over time. This reflects broader societal shifts towards waste reduction, increased recycling efforts, and improved resource efficiency.

These baseline assumptions provide a **common foundation** for all scenarios, ensuring that observed differences in energy consumption, emissions, and resilience are primarily driven by policy choices rather than external trends.

## Policy Scenarios Case Study Jokkmokk

To assess the feasibility of applying a Simulator for Local Energy Planning to a small community, three policy scenarios were selected that reflect different pathways for municipal energy counselling to contribute to:

- Energy demand reduction
- Expansion of renewable energy production
- Municipal energy resilience

Although the Simulator can model a wide range of scenarios, these three were chosen to capture key aspects of the private sector's role in the energy transition and to reflect the specific needs and characteristics of the community.

### 1. **Electrification Scenario**

This scenario focuses on accelerating electrification in family homes by promoting solar PV installations in the residential sector, electricity savings by 5%, and supporting a near-total shift to low-emission vehicles by 2050. Given the EU's phase-out of fossil-based engines, this scenario explores the synergies between solar PV and electric vehicles (sector coupling). Additionally, since municipal energy counselling is primarily used by family homeowners—who represent most residents - this scenario aligns well with local engagement patterns.

**2. Resilience Scenario**

This scenario takes a broader approach to enhancing local energy resilience. It includes solar PV, battery storage and solar heating for homes, alongside behavioral changes in transport, such as car sharing and modal shifts with a strong focus on increasing the share of e-bikes. By reducing reliance on centralized energy infrastructure, this scenario prepares the community for potential energy crises while promoting greater self-sufficiency.

**3. Commercial Sector Efficiency Scenario**

Unlike the first two scenarios, which focus on family homes, this scenario addresses energy efficiency in the commercial sector in Jokkmokk, which is after transport and buildings the third major sector of energy demand. It focusses on improved energy efficiency in buildings, PV installations and storage. This scenario is crucial for understanding how businesses can contribute to local energy goals and how municipal energy counselling can extend its impact beyond residential users.

Together, these scenarios provide a well-rounded exploration of how municipal energy counselling can support energy transitions in different sectors. They also highlight trade-offs and synergies between electrification, resilience, and efficiency, helping to inform policy decisions tailored to the community’s needs.

Scenario 1 Residential buildings	Scenario 1 Transport	Senario 2 Residential buildings	Senario 2 Transport	Scenario 3 Commercial Buildings
1. PV installation 40 kW/year 2. Electricity Saving 5%	Shift to low emission private cars Diesel 10% ; Electric: 90%	1. PV installation 40 kW/year 2. Solar heating: 10 kW/year 3. Electricity Saving 10% 4. Storage: 50kW/year	1. Car Sharing Speed 1 2. Modal shift 60% car, 12% walking, 7% public transport, 20% (e-)cycling	1. Energy efficiency; speed 1, start 2025 2. PV: 50kW/year

Table 1: Compilation of Scenario Design described in text

## CommitClimate Simulator Results

The simulation results provide insights into the potential energy and CO<sub>2</sub> savings in Jokkmokk Municipality under three distinct scenarios: **Electrification, Resilience, and Commercial Development in 2050**. Each scenario models different policy measures targeting the residential sector and transportation, highlighting the impact of energy efficiency improvements, renewable energy adoption, and transport sector transformation.

### Scenario 1: Electrification

This scenario focuses on accelerating electrification through solar PV installation, increased electricity savings, and a shift to low-emission vehicles. The results indicate:

- Residential sector: Energy savings of 7,241 MWh (11%), with a CO<sub>2</sub> reduction of 652 t/y.
- Transport sector: Energy savings of 24,969 MWh (32.3%), leading to a CO<sub>2</sub> reduction of 7,686 t/y.

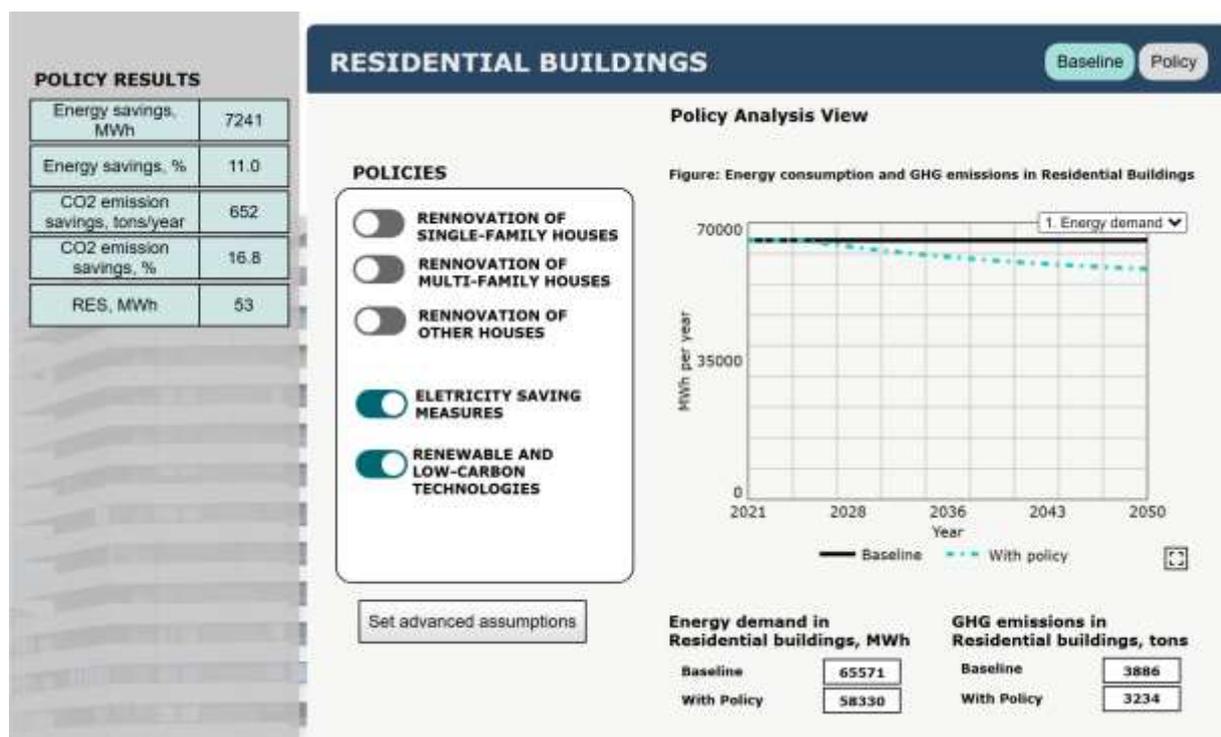


Figure 3: Screenshot of CommitClimate Simulator Results for Scenario 1 Residential Sector as described in text: Energy savings of 7,241 MWh (11%), with a CO<sub>2</sub> reduction of 652 t/y and installed PV Capacity of 53 MW.

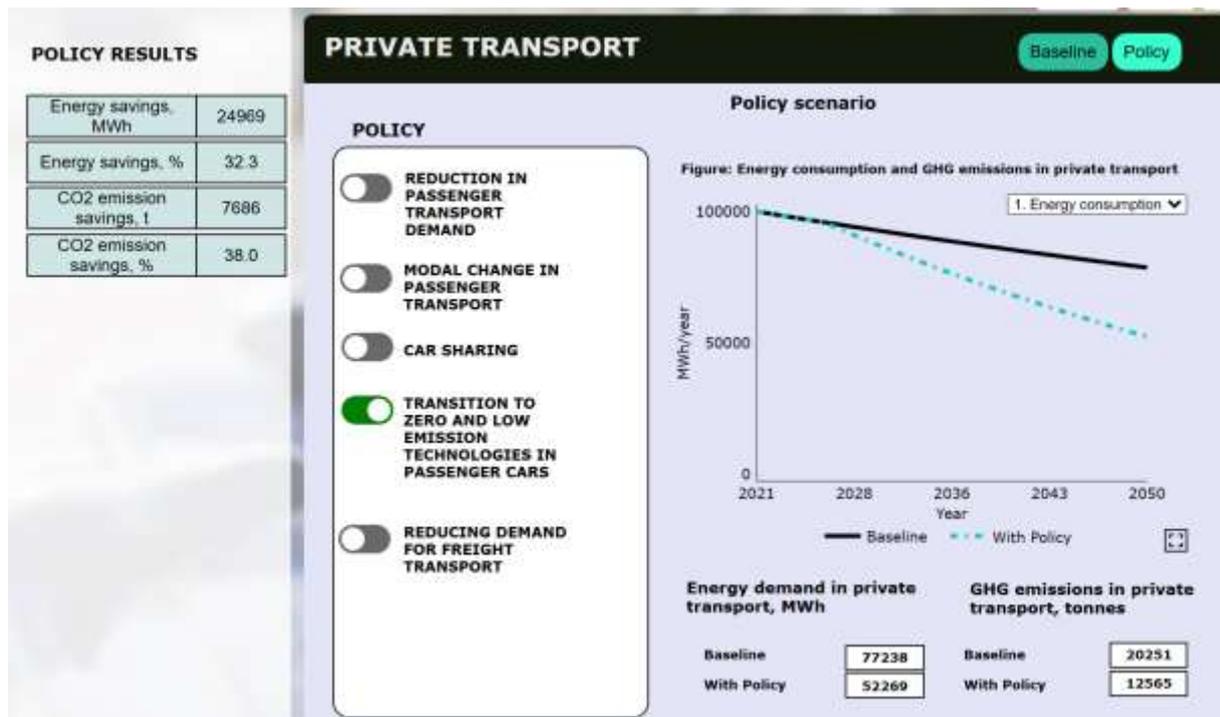


Figure 4: Screenshot of CommitClimate Simulator Results for Scenario 1 for Private Transport as described in text: Energy savings of 24,969 MWh (32.3%), leading to a CO<sub>2</sub> reduction of 7,686 t/y.

## Scenario 2: Resilience

The resilience scenario incorporates a **broader mix of measures**, including PV installations, solar heating, and behavioral changes in transport (e.g., car sharing and modal shifts). The results show:

- **Residential sector:** Energy savings of **9,305 MWh (14.2%)**, with a CO<sub>2</sub> reduction of **837 t/y**.
- **Transport sector:** Energy savings of **13,955 MWh (18.1%)**, leading to a CO<sub>2</sub> reduction of **3,621 t/y**.

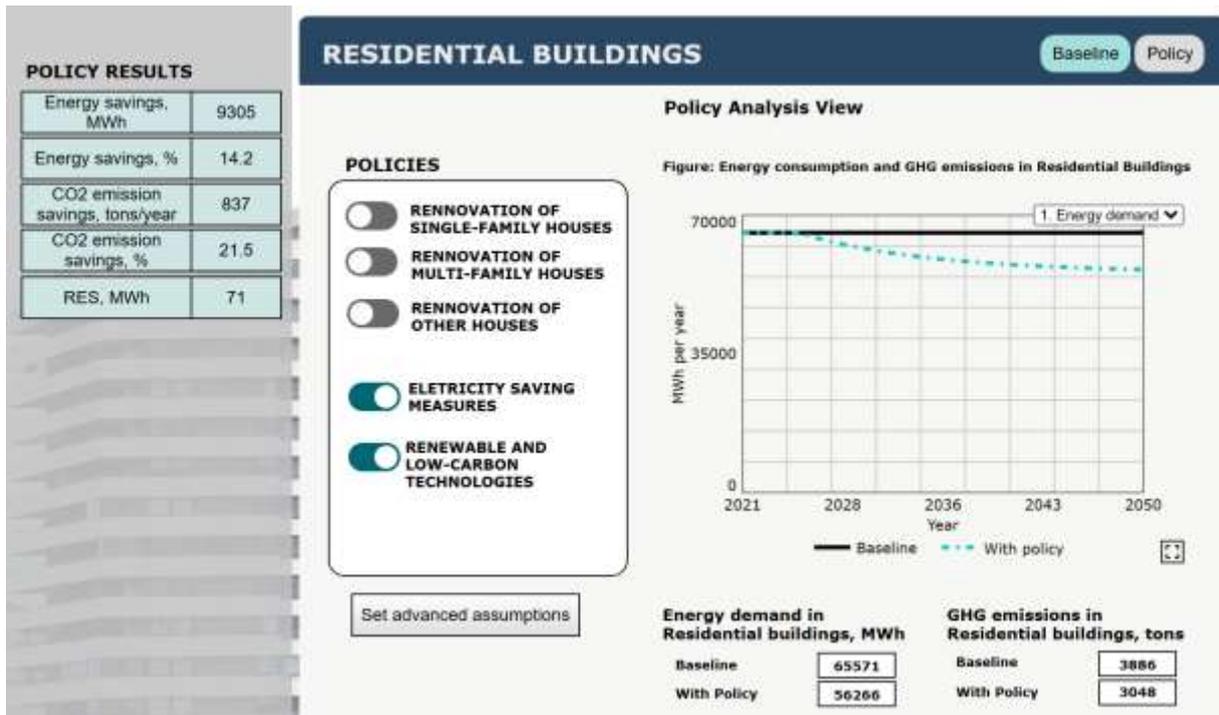


Figure 5: Screenshot CommitClimate Simulator Results for Scenario 2, Residential Sector, as described in text: Energy savings of 9,305 MWh (14.2%), with a CO<sub>2</sub> reduction of 837 t/y and renewable energy 71 MWh.

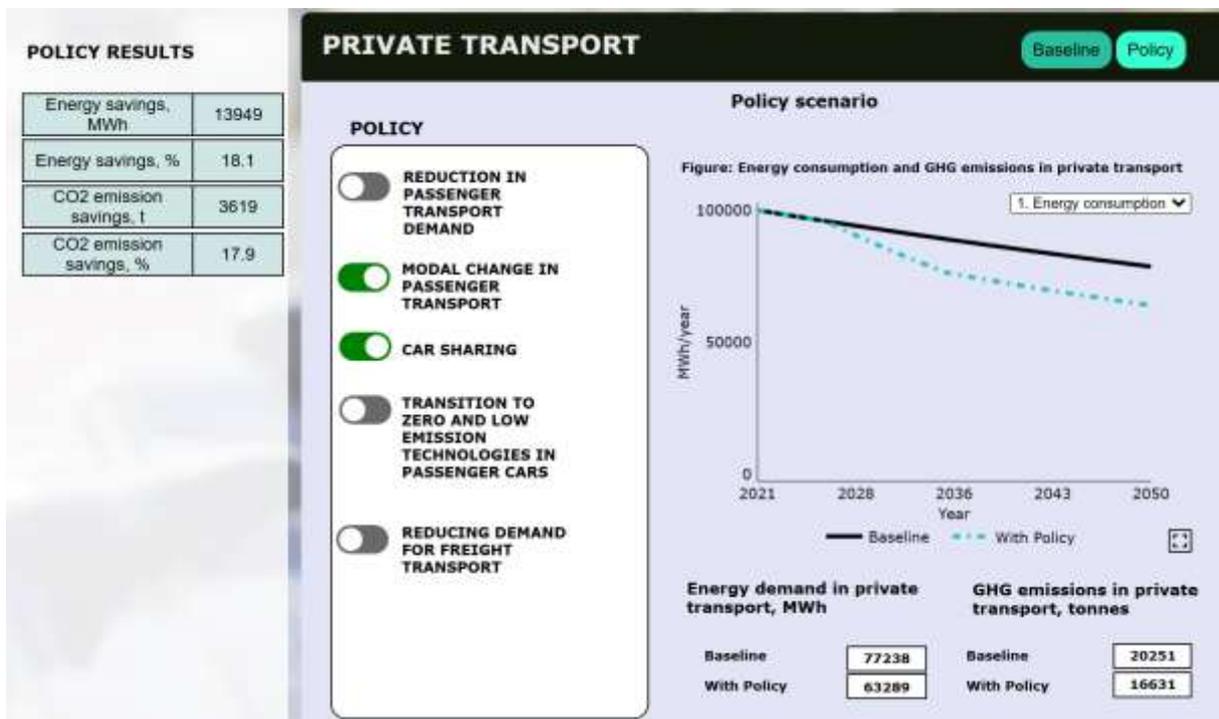


Figure 6: Screenshot CommitClimate Simulator Results for private transport as described in text: Energy savings of 13,955 MWh (18.1%), leading to a CO<sub>2</sub> reduction of 3,621 t/y.

## Scenario 3: Commercial Development

This scenario prioritizes **energy efficiency in commercial buildings** and results in:

**Commercial buildings:** Energy savings of **15,791 MWh (21.3%)**, with a CO<sub>2</sub> reduction of **1,325 t/y**.

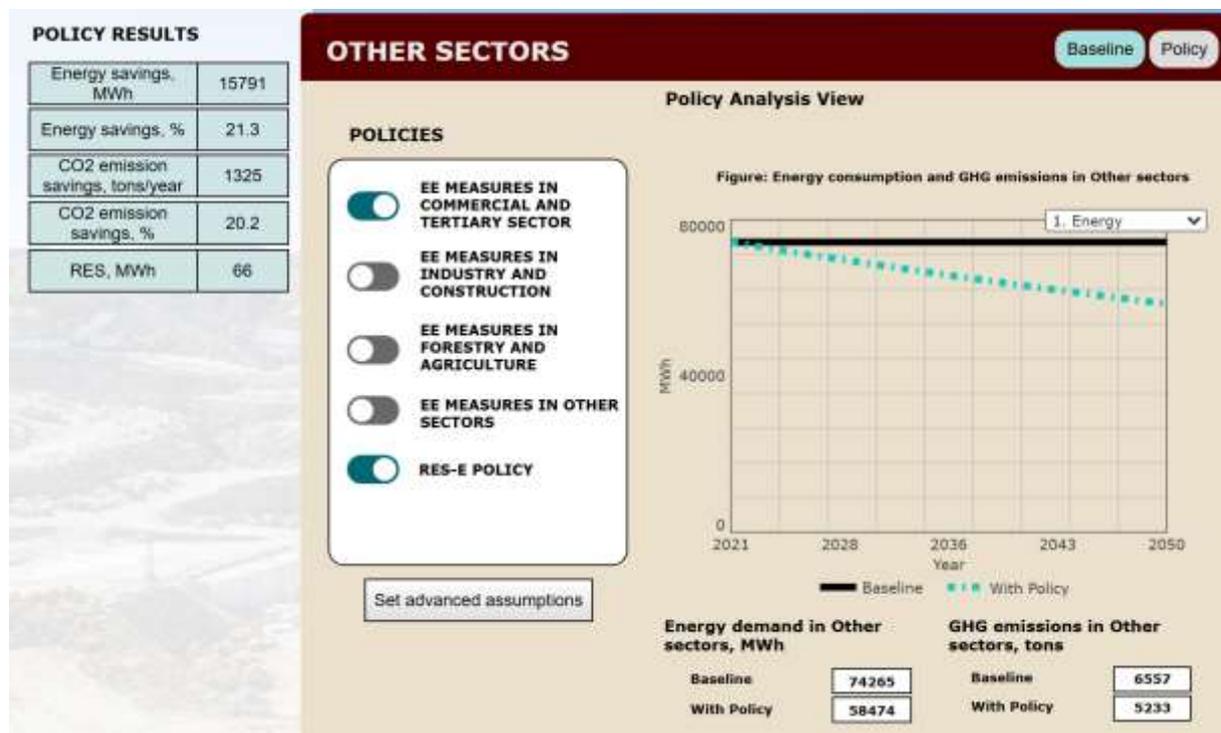


Figure 7: Screenshot CommitClimate Simulator Result Page for Scenario 3 Commercial Sector buildings as described in text: Energy savings of 15,791 MWh (21.3%), with a CO<sub>2</sub> reduction of 1,325 t/y.

## Overall results for Jokkmokk municipality

The overall results provide insights into how each scenario influences total energy use per capita and greenhouse gas (GHG) emissions per capita.

### Total Energy Use (MWh per capita)

- Scenario 1: Electrification (52.2 MWh/capita) results in the lowest energy use per capita, followed by Scenario 2: Resilience (54.5 MWh/capita) and Scenario 3: Commercial sector with the highest energy use per capita (56,4MWh/capita)

### Total Energy Savings (%)

- Scenario 1: Electrification (20.5%) has the highest total energy saving.
- Scenario 2: Resilience (17.1%) and Scenario 3: Commercial Sector (17,9%) achieve similar energy savings, suggesting that measures in the transport sector have a significant impact on the overall result.

### GHG Emissions Savings (%) and (tCO<sub>2</sub>/capita)

- Scenario 1: Electrification (35.6%) achieves the highest CO<sub>2</sub> savings, and the lowest per capita emissions (6.4 tCO<sub>2</sub>/capita).
- Scenario 2: Resilience follows with a 25.8% reduction and 7,4 tCO<sub>2</sub>/capita.
- Scenario 3: Commercial Sector achieve only a 17,9% reduction, leading to 8,2 tCO<sub>2</sub>/capita, confirming the importance of measures in the transport sector to meet climate neutrality targets.

### Key Takeaways

1. While all three scenarios lead to significant energy savings, most CO<sub>2</sub> savings are achieved in the transport sector. Electrification is the most effective strategy for reducing both total energy use and GHG emissions.
2. None of the scenarios come close to the sustainable CO<sub>2</sub> target of 1–2 tons per capita. Even in the best-case scenario, per capita emissions remain at 6.4 tCO<sub>2</sub>, far from the target needed for climate neutrality. This highlights the need for stronger, more integrated policy measures across all sectors, including industry, heating, and behavioral shifts in transport and energy use.
3. Resilience measures contribute to efficiency but need additional scaling. Scenario 2 (Resilience) and Scenario 3 (Commercial Sector) show that energy efficiency in buildings combined with solar power and behavioral changes are not enough to match the emission reductions achieved by direct electrification strategies.
4. These findings reinforce that no single sector or strategy alone can achieve the necessary reductions. A comprehensive, cross-sectoral approach combining electrification, efficiency improvements, behavioral change, and policy support is essential for Jokkmokk to meet its sustainability targets.

## General Local Benefits of Energy Transition Policy Implementation

The energy transition presents a major opportunity for Jokkmokk region, to overcome its demographic and economic challenges and create long-term, sustainable growth.:

### 1. Reduced Dependence on Fossil Fuels

- **Economic Retention:** Jokkmokk's current reliance on fossil fuels for transportation means that money flows out of the local economy to purchase oil and gas. By shifting to electric vehicles (EVs) and a modal shift change towards walking and cycling as well as car-sharing, the municipality can reduce its dependence on fossil fuel imports and instead rely more on locally sourced electricity. This change will keep more money within the community, boosting local businesses and economic activity.
- **Local Energy Resources:** By investing in local renewable energy projects, such as photovoltaic (PV) systems, Jokkmokk can ensure that more of the economic benefits of energy generation are retained within the community.

## 2. Harnessing Local Energy Generation through PV Systems

- **Empowering Local Communities:** By installing photovoltaic (PV) systems, local businesses and households can produce their own clean electricity. This not only reduces energy costs but also keeps the money spent on energy within the local economy. The installation of PV systems can create new opportunities for local contractors, technicians, and other service providers, fostering job growth.
- **Local Energy Autonomy:** In a remote region like Jokkmokk, where distances are long and public transport is limited, increasing energy self-sufficiency through solar power helps reduce reliance on external sources, making the community more resilient to energy price fluctuations and disruptions.

## 3. Energy Security and Economic Stability

Diversifying the energy mix is a powerful way to build a resilient community. By not relying on any single energy source, communities can better cope with supply disruptions. Energy efficiency—our "first fuel" - reduces overall consumption, laying the groundwork for a more adaptable and secure system. Alongside this, embracing resilient transportation methods such as car-sharing, cycling, and walking helps decrease our dependency on personal cars and fossil fuels. Together, these strategies foster a robust and sustainable environment, ensuring that even during challenging times, communities remain strong and less vulnerable to external shocks.

## 4. Health Benefits

- **Increasing the share of people who cycle and walk instead of driving has a host of health benefits.** Regular physical activity through cycling and walking improves cardiovascular fitness, strengthens muscles, and helps control weight, thereby reducing the risk of chronic conditions like heart disease, diabetes, and hypertension. This shift toward active transportation also contributes to better mental health by lowering stress levels and fostering a greater sense of community through more direct human interactions.
- **Fewer cars on the road mean reduced air pollution,** which benefits respiratory health and overall well-being. Together, these changes lead to a healthier population and a more vibrant, resilient community.

## 5. Local Economic Growth

- **Saving energy translates directly into saving money,** creating a positive ripple effect throughout the community. When households and companies spend less on energy, those savings remain local, enabling reinvestment in other essential goods and services.
- For companies, the benefits are particularly significant. **Reducing energy costs boosts profit** immediately, without the need to drive additional sales to achieve the same gain. This direct increase in profitability means businesses can innovate, expand, and contribute even more robustly to the local economy. Ultimately, energy efficiency not only supports environmental sustainability but also lays the financial groundwork for enduring local prosperity.

## Maximizing Free Energy Advice Through Better Policy Integration

Municipalities have a unique opportunity to tap into the power of free energy advice services, turning what is often an overlooked resource into a cornerstone of local sustainable development and economic growth. In today's climate of rising operational costs, integrating tailored energy guidance into municipal strategies can yield significant benefits. By using free energy advice, local governments can streamline compliance with legal and environmental standards, support business competitiveness, and even provide crucial assistance to vulnerable households and community associations. The following sections describe several approaches that demonstrate how municipalities can seamlessly integrate free energy advice into their existing policy instruments, driving both cost savings and enhanced community well-being.

### **Municipal energy advice as a tool:**

#### **1. Supervision and legal requirements for businesses**

- Collaborating with the environmental office for supervision according to the Environmental Code, where energy efficiency is part of the requirements.
- Offering advice on how businesses can reduce energy consumption to meet legal requirements while saving money and informing about opportunities for energy-efficient technology during energy audits for businesses.

#### **2. Land use planning and municipal energy plan**

- Free energy counseling helps identify opportunities for energy efficiency and local renewable energy across residential commercial and transport sectors.
- Counseling provides insights to optimize energy use in buildings and infrastructure, promoting low-energy urban design.

#### **3. Building permits and energy requirements for new construction and renovations**

- Collaborating with the building committee to provide advice on how energy-efficient technology can be implemented in new or renovated buildings during building permit applications.
- Informing property owners about existing requirements and which energy efficiency measures are most cost-effective.

#### **4. Business development companies and business support**

- Supporting businesses in identifying and applying for financial support for energy efficiency from national and EU programs.
- Helping businesses develop energy efficiency projects that strengthen their competitiveness.

#### **5. Supervision of individual measurement and billing (IMD) in multi-family houses**

- Providing advice to property owners on how to implement energy efficiency measures to avoid individual measurement requirements.
- Offering support to optimize heating and water usage in multi-family houses.

#### **6. Collaboration with the municipal district heating company**

- Offering advice to district heating customers on how to reduce energy use and lower costs.
- Working with property owners to ensure that district heating substations are in optimal condition.

### **7. Promotion of energy communities and solar shares**

- Helping households and businesses organize energy communities for joint production and use of renewable energy.
- Identifying roof spaces that the municipality can lease for solar shares for those who lack their own roofs.

### **9. Municipal projects and innovation support**

- Participating in development projects where the municipality seeks EU and government grants for innovative energy solutions.
- Initiating test beds for new energy technology where businesses and households can participate.
- Participating in the design of innovative local policies to promote walking, cycling, and electric transport and support citizen engagement.

## Quantified Economic Impact of Free Energy Counselling in Scenarios

Public energy counseling can play a key role in accelerating the transition to renewable energy and increasing energy efficiency in Jokkmokk. By providing tailored advice on photovoltaic (PV) systems, electric vehicles (EVs), and energy storage, energy counseling can help overcome financial and technical barriers, leading to increased adoption of sustainable energy solutions. This analysis quantifies the impact of energy counseling by assessing its influence on PV uptake, electricity savings, and economic benefits for households, businesses, and the transport sector.

### Step 1: Estimating the Impact of Counseling on PV Uptake

Energy counseling helps households and businesses understand the benefits of solar energy, financial incentives, and best practices for installation. This leads to increased confidence and adoption of PV systems.

#### **Basic technical assumptions:**

- Without energy counseling, 3 households per year will adopt PV over the next 30 years. With energy counseling, 5 households per year will adopt PV over the same period.
- Total additional PV systems due to counseling over 30 years: 60 additional PV systems.
- Each household PV system generates 6,000 kWh per year. Over 30 years, each system produces 180,000 kWh in total.
- Total additional electricity produced due to counseling: 10.8 GWh over 30 years

### Investment in PV Systems Due to Counseling:

- Each PV system costs 153,000 SEK per household, including installation. Total investment for 60 additional PV systems: 9.18 million SEK; 10% of investment costs are assumed to stay local.
- Over 30 years, each PV system generates approximately 470.000 SEK in income. Total long-term financial benefit from additional PV adoption: 28.2 million SEK

This means that **energy counseling can lead to an additional 10.8 GWh of locally generated renewable energy** and **28.2 million SEK local economic benefits** reducing dependency on external electricity sources and lowering energy costs for households.

## Step 2: Electricity Savings from Energy Counseling and Economic Impact

Energy counseling not only increases PV adoption but also promotes more energy-efficient behavior, leading to significant electricity savings.

### Basic Electricity Savings Assumptions:

Without energy counseling, households save 1% of their electricity use through general improvements. With energy counseling, households save 5% due to targeted efficiency measures in scenario 1 and 10% in Scenario 2. The Commercial Sector improves energy efficiency with 3% without and 10% with counselling This leads to the following electricity savings in each scenario:

Scenario	Electricity Savings Without Counseling	Electricity Savings With Counseling
Scenario 1 (households)	1.448.200 kWh	7.241.000 kWh
Scenario 2 (households)	1.861.000 kWh	9.305.000 kWh
Scenario 3 (commercial sector)	3,158,200kWh	15.791.000 kWh

### Total Additional Electricity Savings Due to Counseling and Economic Benefits

It is assumed that electricity savings can be achieved without investments but by behavior change, maintenance and controlling.

Scenario 1 (Residential Sector): 5,792,800 kWh = 8,689,200 SEK savings (1.5 SEK/kWh)

Scenario 2 (Residential Sector): 8,374,500 kWh = 12,561,750 SEK savings (1.5 SEK/kWh)

Scenario 3 (Commercial Sector): 12,632,800 kWh = 12,632,800 SEK savings (1 SEK/kWh)

**Thus, energy counseling can lead to additional electricity savings between 5.7 and 8.3 Million kWh in the household and about 12 Million kWh in the commercial sector**, reducing costs and increasing local energy resilience. If businesses typically operate at an 8% profit margin, meaning they need to generate 12.5 SEK in sales to make 1 SEK in profit, a cost saving of 12,632,800 SEK is equivalent to 157,910,000 SEK in increased sales to generate the same profit.

### Step 3: Local economic benefits Transport

Final energy use for transport has a significant share in Jokkmokk, of which passenger cars have a significant share. In 2024, about 5% of the registered 2.871 cars were electric. At the current pace with about 11 new electric passenger cars per year it would take more than 200 years to reach a fully electric car park. However, the EU has mandated that all new cars sold by 2035 must be zero-emission vehicles, setting the stage for widespread electrification. Consequently, Eurelectric's RePowerEU scenario<sup>1</sup> estimates that 80% of passenger cars could be electrified by 2050. However, achieving full electrification depends on several factors, including policy enforcement, market trends, infrastructure development, and consumer behavior. Energy counseling can play an important role to encourage alternative transport solutions, leading to significant reductions in fossil fuel consumption.

#### Scenario 1 (Electrification for residential sector)

Baseline scenario for the shift to electrification: If fossil fuel cars are phased out in 2035, meaning no new ones can be purchased but existing ones can continue to be used, the transition to an electric vehicle fleet in Jokkmokk will accelerate significantly.

Today, only 4.77% of newly registered cars in Jokkmokk are electric, meaning that each year around 11 new electric cars are added to the total fleet. At this pace, by 2035, Jokkmokk would have around 258 electric cars, making up about 9% of all registered vehicles. However, after 2035, with no new fossil fuel cars entering the market, all newly registered cars will be electric.

Since fossil fuel cars typically remain in use for around 12 years, they will start disappearing naturally as they age out. Given the current rate of 228 new cars registered per year, the transition will be quite rapid. By 2047, the last fossil cars purchased in 2035 will reach the end of their lifespan, meaning that by 2050, nearly all of Jokkmokk's car fleet will be electric. Only a few remaining fossil cars—those that last longer than average—might still be in use, but their numbers will be negligible.

Reaching a 90% share of electric passenger vehicles in 2050 results in the following local economic benefits:

- Energy savings from transport (90% electric cars in 2050): 24,969,000 kWh per year
- Equivalent fuel savings (assuming 50% gasoline, 50% diesel, at 9 kWh/liter for gasoline and 10 kWh/liter for diesel, price 20 SEK/liter):
  - Gasoline saved:  $(24,969,000 \div 9) = 2,774,333$  liters = 55.49 million SEK
  - Diesel saved:  $(24,969,000 \div 10) = 2,496,900$  liters = 49.94 million SEK
- Total Transport Cost Savings: 105.43 million SEK per year

#### Estimating the Impact of a 20% Faster Transition

If energy counseling accelerates the transition to electric cars by 20%, this means that Jokkmokk would reach 90% electric car adoption earlier than 2050. The earlier this shift happens, the sooner the community benefits from energy and cost savings. A 20% acceleration means that every milestone in the transition to electric vehicles happens earlier. Instead of reaching 90% electric cars in

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<sup>1</sup> <https://www.eurelectric.org/in-detail/transport-electrification/>

2050, this could happen around 2045 or slightly earlier. By achieving this milestone five years earlier, the town would accumulate additional energy and cost savings from 2045 to 2050 compared to the slower transition.

### **Additional Local Benefits (2045–2050)**

If the full 90% electric transition happens in 2045 instead of 2050, then for these five extra years, Jokkmokk would already be saving the full 24,969,000 kWh of energy annually = 124,845,000 kWh.

Fuel Savings Over 5 Extra Years:

- Gasoline saved: 13,871,665 liters = 277.43 million SEK
- Diesel saved: 12,484,500 liters = 249.69 million SEK
- Total additional savings: 527.12 million SEK

### **Summary of Local Benefits from Faster EV Adoption**

If energy counseling helps speed up the transition by 20%, reaching 90% electric cars by 2045 instead of 2050, Jokkmokk could benefit from:

- An extra 124.8 GWh of energy savings over 5 years
- An additional 26.35 million liters of fuel saved
- An extra 527 million SEK in fuel cost savings

### **Scenario 2 (Resilience, residential sector):**

Scenario 2 focus on car-sharing and changing the modal split. Car-sharing is assumed to happen in a 1% pace each year with no investments. The modal shift is assumed to happen mainly from cars to cycling and e-bike. To estimate how many people in Jokkmokk need to get an e-bike to increase the cycling modal split from 4% to 20%, the following assumptions are made.

Currently, in Jokkmokk, only 4% of all trips are made by bicycle, meaning that out of the town's 4,728 residents, approximately 189 people regularly cycle. To achieve a more sustainable and active transport system, the goal is to increase this share to 20%, which would mean around 946 people choosing cycling as their primary mode of transport. This shift would require an additional 757 residents to take up cycling.

Given Jokkmokk's rural setting, longer travel distances, and colder climate, e-bikes are likely to play a crucial role in making cycling a viable alternative to car travel. While some of the new cyclists will use regular bicycles, a significant portion will likely require e-bikes for practical and comfort reasons. If around 70% of these new cyclists will need an e-bike, this would mean approximately **530 e-bikes** would be necessary to facilitate the transition.

Reaching the assumed modal shift and car-sharing in 2050 would result in the following local benefits:

- 13,955,000 kWh saved per year due to increased cycling and car-sharing.
- **Equivalent fuel savings** (assuming 50% diesel, 50% gasoline, at 9 kWh/liter and 20 SEK/liter):
  - Gasoline saved: 775,278 liters = 15.51 million SEK

- Diesel saved: 697,750 liters = 13.96 million SEK
- **Total Transport Cost Savings: 29.47 million SEK per year**

### **Estimating the Impact of a Faster Transition until 2040**

If the target modal shift (20% cycling share) is reached by 2040 instead of 2050, the economic benefits will be realized 10 years earlier. If free energy counseling accelerates the transition to a 20% cycling modal share, reaching the goal by **2040 instead of 2050**, the total additional economic benefit would amount to **294.7 million SEK** in fuel cost savings over the 10-year period.

### **Conclusion**

Free energy counseling in Jokkmokk has the potential to significantly accelerate the transition to renewable energy, energy efficiency, and sustainable transport, resulting in substantial economic and environmental benefits. By increasing the adoption of PV systems, counseling could lead to an additional **10.8 GWh of renewable energy production** and **28.2 million SEK in local economic benefits** over 30 years. Enhanced energy efficiency measures could further save **up to 7.5 million kWh annually in households** and **6 million kWh in the commercial sector**, reducing costs and strengthening local energy resilience.

In the transport sector, energy counseling could expedite the transition to **electric vehicles, cycling, and car-sharing**, leading to earlier realization of fuel cost savings. If these shifts happen **10 years earlier**, the additional benefits amount to **527 million SEK in the residential EV sector and in scenario 2 to up to 294.7 million SEK through increased cycling and car-sharing**. These results highlight the significant role of energy counseling in driving economic savings, energy independence, and emissions reductions, making it a highly cost-effective strategy for sustainable development in Jokkmokk.