ACTIVE CONSUMERS IN FLEXIBLE ENERGY SYSTEMS

User Motivations, Barriers, and Readiness for Participation

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CONTENT

- Background and core challenges
- Results presentation: INTELLIGENT (EU Horizon)
- Results presentation: Social License to Automate 2.0 (IEA UsersTCP)
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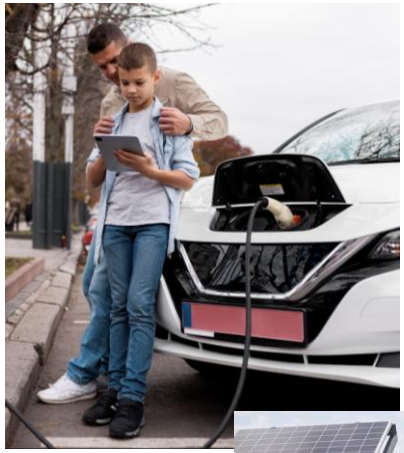

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THE CHANGING ROLE OF ENERGY USERS: FROM CONSUMERS TO SYSTEM ACTORS

- The energy transition increasingly relies on **active and flexible participation** from households, businesses, and communities.
- **Digitalization, automation, and new market mechanisms** create opportunities for participation and engagement
- Active consumer participation is hindered by challenges like **lack of information, lack of digital and energy literacy, topic complexity, lack of tangibility, trust issues, and unequal access**.
- Understanding **how and why people can and want to participate** is essential to the **development of accessible and inclusive solutions** that offer **tangible benefits**, achieving market integration and successfully further the energy transition.

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INTELLIGENT

INteroperable Tools for nEtwork-aware, Ledger-based Local energy sharIng and flexibility manaGEment leveraging user engagemeNT

The INTELLIGENT project is funded by the European Union under Horizon Europe, within the Climate, Energy and Mobility programme (ID 101160684).

Funded by the European Union

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PROJECT SUMMARY & ACTIVITIES

- **Project summary:** INTELLIGENT builds a cohesive infrastructure for P2P trading supporting multiple markets, diverse trading mechanisms and optimised community member trading and flexibility services.
- **Project goals**:
  - Creation of open-source P2P energy trading platform
  - User-centric approach to enhance user acceptance and engagement
  - Validation of trading eco-system within communities
- **Runtime**: Dec 2024 – Nov 2027
- **Presented results**: User requirements survey

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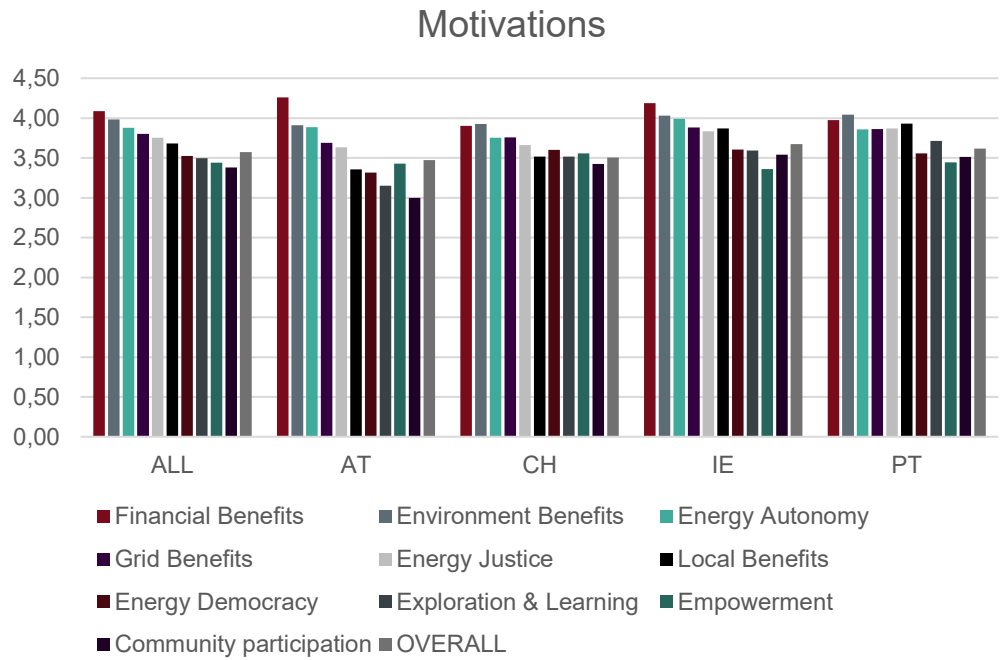
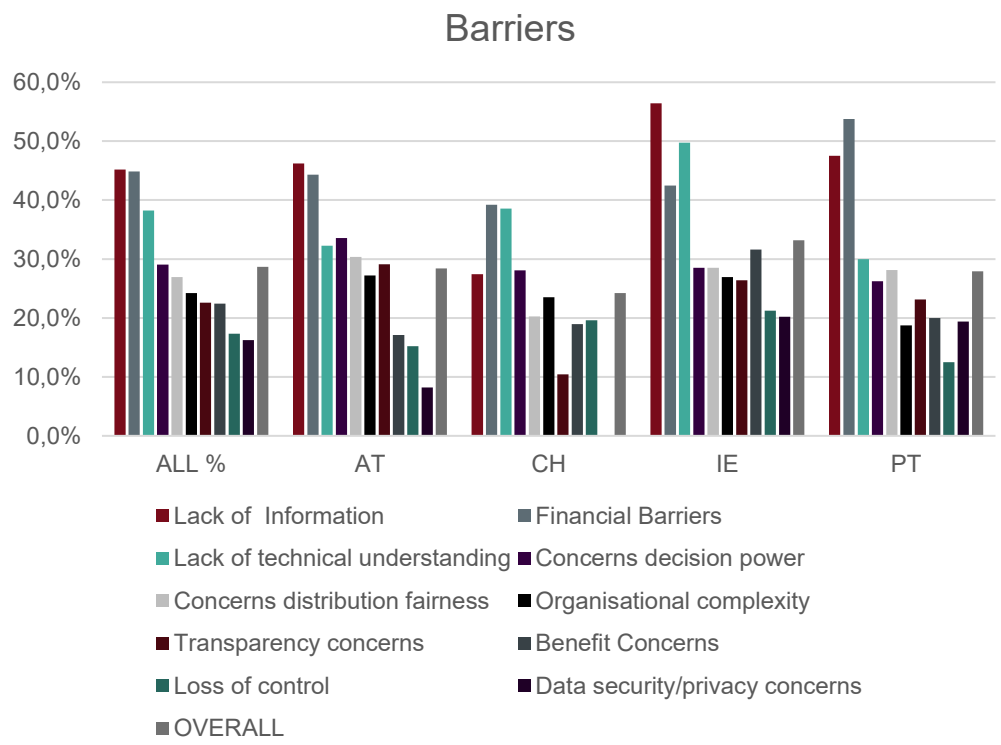
MOTIVATIONS



664 participants; scale: 1 = not at all important … 5 = very important

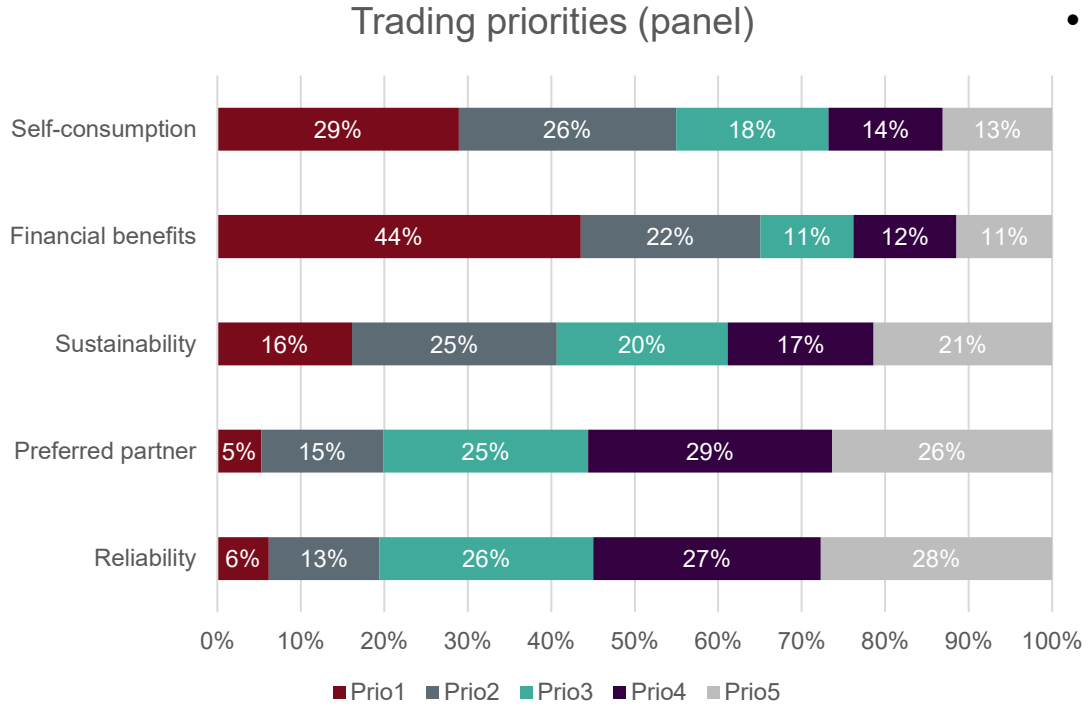
- Main motivations are
  - **financial benefits (mean 4.1 of 5)**
  - **environmental benefits (mean 4.0)** (1st place in Switzerland and Portugal) and
  - **increased energy autonomy (mean 3.9)**
  - followed by grid stability, energy justice and local benefits

BARRIERS



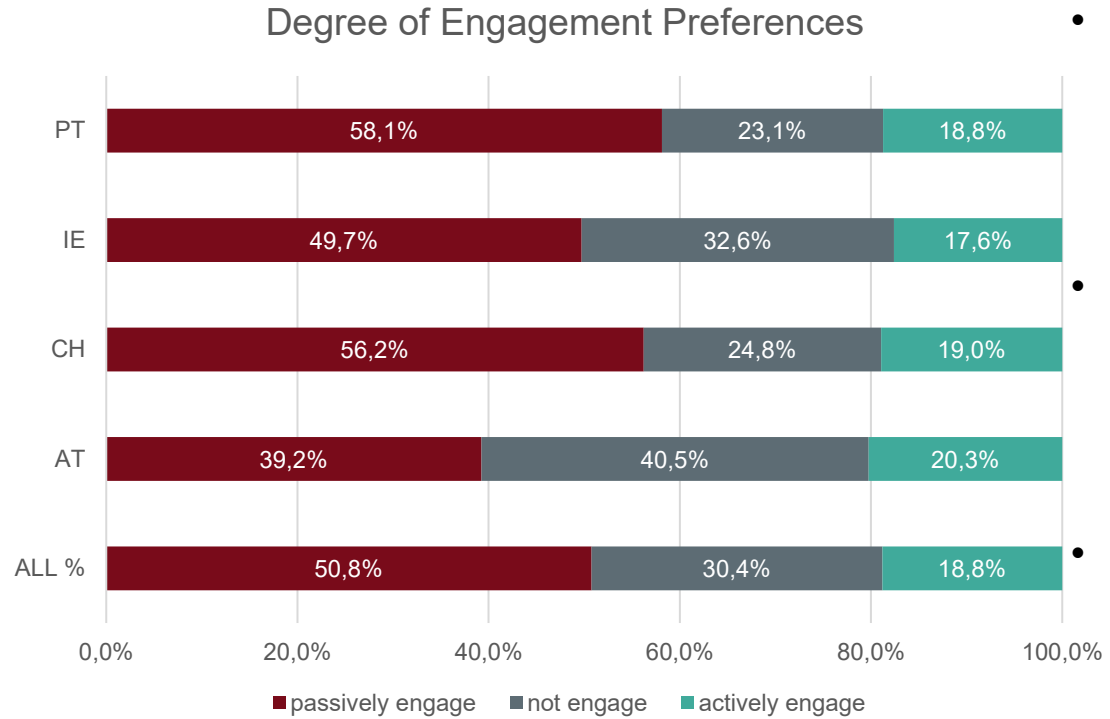
- Participants are most concerned
  - **about lack of information (45%)**,
  - **financial barriers (45%)** and
  - **lack of technical understanding (38%)**
  - followed by concerns about decision power, concerns about fairness, and organisational complexity

P2P TRADING PRIORITIES



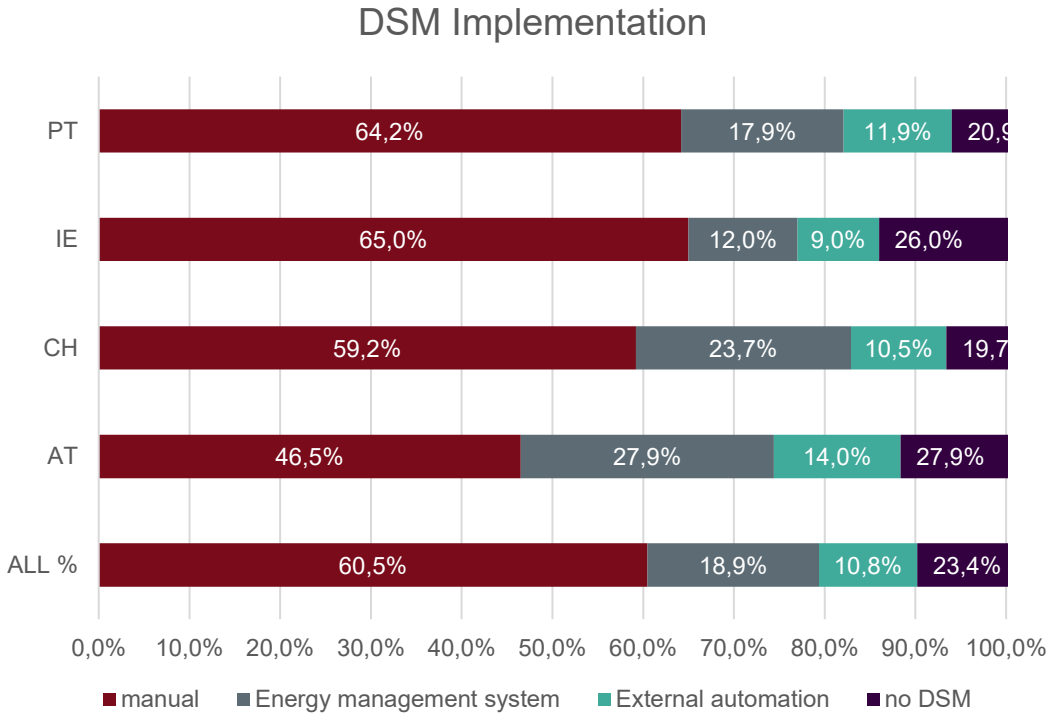
- Most important trading priorities
  - **financial benefits (82% & 66%) and**
  - **self-consumption** (**74% & 55%**) followed by
  - **sustainability** (prio 3)

DEGREE OF ENGAGEMENT DEGREE

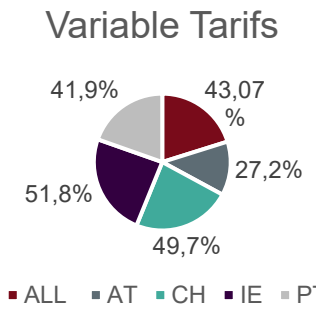


- Overall, there is a **clear preference for passive involvement (51%)** – being informed but not needing to participate
- Interest in **active involvement** within is relatively consistent, lying between 17.6% and 20.3%) while
- 23%-40.5% **wish not engage** at all

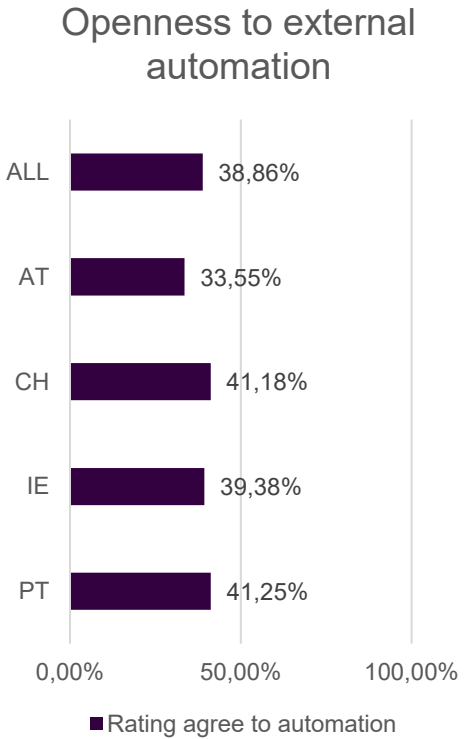
CURRENT DSM IMPLEMENTATION

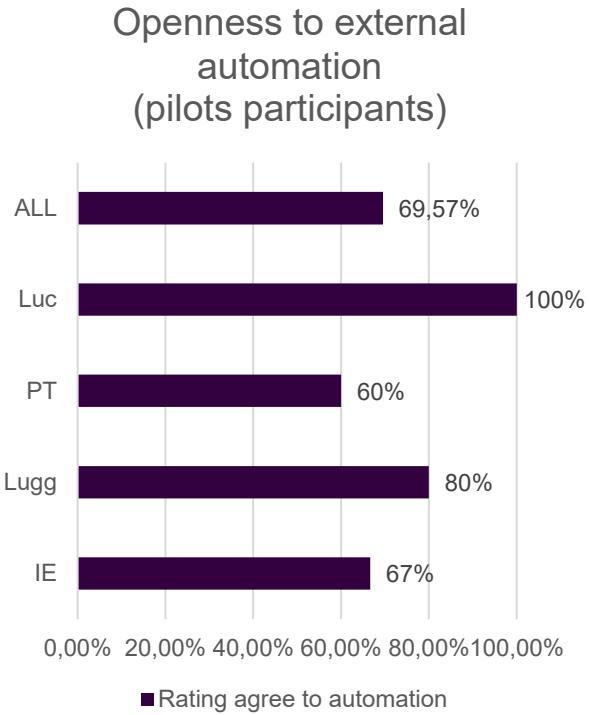


- The majority with variable tariffs **practice manual DSM.**
- **The Swiss and Austrian participants use automation to a higher degree**



EXTERNAL AUTOMATION





- **Openness to external automation** is **limited** (39%)
- Significantly more openness (70%) among pilot participants

AUTOMATED DSM CONDITIONS - PANEL

- **Financial aspects (47x)**: financial benefits and low investment costs
  - “Clear and proven financial benefits”
- **Transparency and understanding (44x):** Full insight into what is happening, why, by whom. They need explanations, traceability, and accessible information.
  - “Complete transparency regarding the impact of this automation on my tech, from revenues generated to amount of wear on my hardware”
  - “Transparency on any actions taken (logbook etc)”
- **System Reliability, Security and Privacy (30x):** Reliable system, supply and billing, data protection, cyber security, and legal safeguards are repeatedly emphasized.
  - “Data security and privacy: The protection of sensitive operational and customer data must be guaranteed at all times”
- **Control & personalisation (23x):** Ability to opt in/out, set priorities, and keep personal decision-making power.
  - “Keeping the power of decision over matters that concern me”
  - “Ability to regain control easy and quickly”
- **Knowledge, Information & Support (23x active; 73x passive)**: Strong need for education, training, and advice (many said “I don’t know”)
  - “Information and training on the advantages and disadvantages, as well as the possibility of having prior contact with the technology”
  - “I would have to deal with this topic much more intensively beforehand”
- **Trust and Fairness (18x)**: Fairness of distribution, trust in other members and third parties, fair (democratic) governance
  - “You’d have to have guarantees that everything would be fair, the distribution of energy and spending”
- **Comfort, convenience and usability (10x):** Automation must not reduce comfort, routines, or convenience.
  - “To have at least the same comfort and security as before with better financial benefits”
- **Regulation & governance** (**7x**): Legal framing and mechanisms for ensuring legal compliance
  - "It's important to me that automation considers not only technical but also organizational and legal requirements comprehensively"

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Social License to Automate 2.0

UsersTCP

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SOCIAL LICENSE TO AUTOMATE 2.0

SLA2.0 – An Inclusive and Community-oriented Social License to Automate

The Social License to Automate 2.0 project was carried out under the UsersTCP, under the auspices of the IEA. The Austrian contribution was funded by the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology.

The “Social License to Automate 2.0” team would like to thank the Swiss Federal Office of Energy (SFOE) for their support.

PROJECT SUMMARY & ACTIVITIES

- **Project summary:** The *Social License to Automate Tasks* explore factors impacting **acceptance** of (automated) demand side management and **flexibility readiness** and develop stakeholder-oriented recommendations
- **Project goals**:
  - Understand the role of gender and diversity factors in flexibility
  - Identify flexibility consumption profile markers via load profiles
  - Identify the contribution potential of energy communities towards a social license to automate
- **Participating counties:** AT (Lead), CH, SE, NO, NL
- **Runtime**: Nov 2022 – Oct 2024
- **Presented results**: Literature research, flexibility framework, load profile diversity, flexibility profiles, inclusivity recommendations

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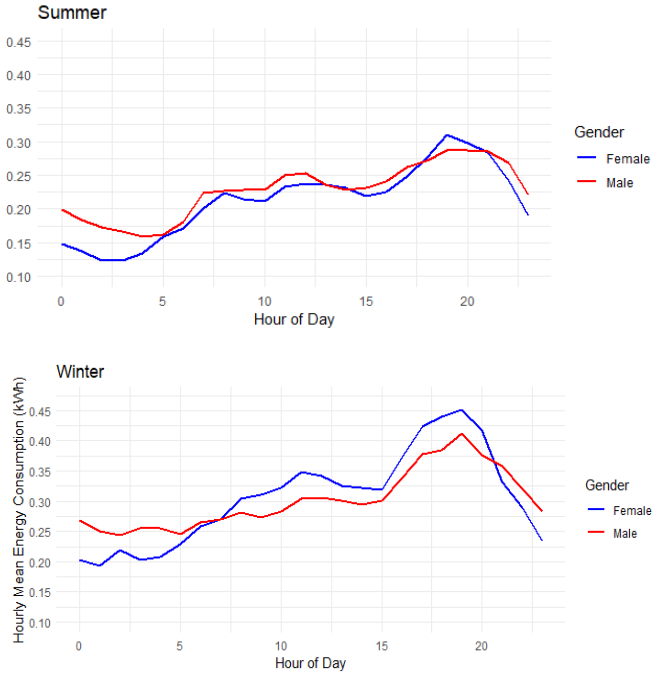
DIVERSITY & FLEXIBILITY: *LITERATURE RESEARCH*

- **Gender**
  - DSM technology and communication is typically **designed with male, technology-affine users in mind**, not reaching women sufficiently
  - **Gender roles** challenge DSM implementation with the home as a feminine domain, technology as masculine domain
- **Age**
  - Participation of the **elderly** is challenged by **lacking digital literacy and apprehension** towards new technology
  - Flexibility of **younger consumers** is limited by social constraints (lack of choices)
- **Income**
  - **Energy saving practices are already part** of the everyday life of the energy-poor but homes they live in are often **energy-inefficient**
  - **Risk of excluding low-income households** from the cheapest available energy when it is made dependent on being able to afford the necessary technology

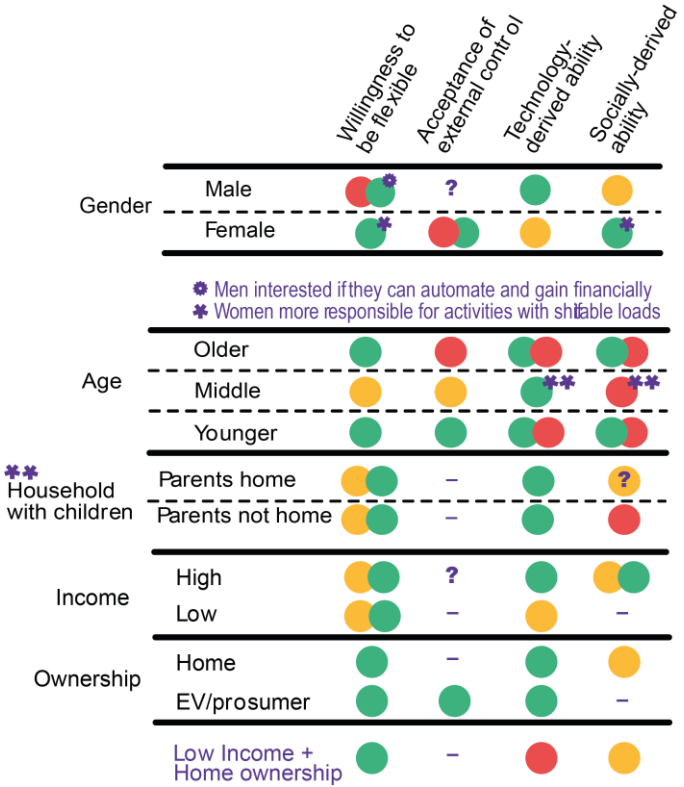
DIVERSITY & FLEXIBILITY:
FLEXIBILITY MARKERS IN LOAD PROFILES

- **Gender**
  - **Men** have **higher baseline consumption** and respond more to financial incentives
  - **Women** have **higher consumption peaks**, especially in winter
- **Income**
  - Households with **higher income** show **higher consumption**
  - Variations with household composition (**higher peaks with kids**)
- Age
  - **Young and old** have **lower consumptions** and **different patterns**
  - **Highest consumption** and peaks with **middle age**.



DIVERSITY & FLEXIBILITY: *FLEXIBILITY FRAMEWORK*

- **Gender**
  - **Women** are more willing to **manually** shift and have more **socially derived** ability
  - **Men** are more **willing if they can automate** shifting with more **technology-derived** ability
- **Age**
  - **Willingness** to shift is a **U-curve**, while willingness to accept **external control decreases** with increased **age**
  - **Ability to be flexible** does not seem to be affected by age in and of itself, but by circumstances often connected **life stages** (e.g. parenthood)
- **Income**
  - **Mixed findings** regarding willingness (link to benefits)
  - Intersection between **income and ownership**, links to **technologically-derived ability**



DIVERSITY & FLEXIBILITY: FLEXIBILITY PROFILES

High Flexibility Readiness (high on capacity, willingness and ability factors):	• High-income • Home-ownership • Tech-savvy (male)
Medium Flexibility Readiness (enabling factors but also barriers):	• Younger consumers • Households with childen • Tenancy
Low Flexibility Readiness (more barriers than supporting factors)	• Low-income • Elderly consumers

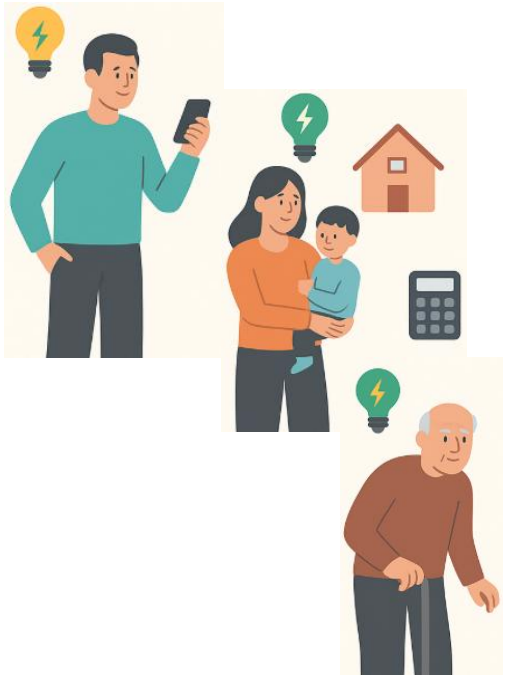


Image source: AI generated (ChatGPT)

INCLUSIVITY RECOMMENDATIONS FOR DSM PROGRAMS

- **No Financial or Technology Barriers to Participation:** Ensure that there are ways of participation that don't require financial investments or new technology purchases (e.g. participation via apps)
- **Low-tech Solutions for Limited Digital Skills:** Ensuring that technological advancements do not exclude users who may not be comfortable with or able to use advanced technology
- **Accessible Solutions Integrated with Everyday Activities:** Make solutions more intuitive and accessible, also in terms of language
- **Support for Digital and Energy Literacy:** Provide accessible information materials, workshops, and community engagement efforts
- **Tailored Support for Low-income Households:** Implement subsidizing programs and financial incentives to help low-income groups
- **Understand routines, flexibility habit building, and household negotiations:** Collect diversity-specific data to understand household dynamics and improve tailoring of participation chances
- **Understand the impact of measures taken:** Collect diversity-specific data on who makes use of funding and the impact incentives and support schemes have

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CONCLUSIONS

Key Takeaways

KEY TAKEAWAYS FOR POLICY AND MARKET DESIGN

- **Information and transparency** are preconditions for flexibility provision: Users must see *what happens, why, and with what effect*.
- **Trust and fairness** determine willingness to engage: Automation and external control are accepted only if they are *understandable, reversible, and beneficial*.
- **Diversity matters:** Socio-economic, age, and digital-skill differences affect *willingness ability and capacity* to contribute flexibility.
- **Inclusive design for a socially just transition:** Multiple entry points, low-tech options, clear communication can ensure that flexibility-based opportunities do not exclude vulnerable users.

TOWARDS A SOCIALLY ROBUST ENERGY TRANSITION

- Achieving flexibility at scale requires not only technical readiness but also **social acceptance** and **institutional support**.
- **Policy frameworks** should recognise that engagement is conditional: people participate when they **trust the system**, **see value**, and **retain autonomy**.
- **Energy communities and collective schemes** can bridge individual limitations and create fairness and visibility in benefit distribution, but they cannot take over the responsibility of a welfare state and need policy support to fulfil this potential.
- The next step: **translate user-centred evidence into regulatory and market mechanisms** that empower all consumers to become active system participants.

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THANK YOU!

Lisa Diamond, 06.11.2025