





# LLM's for the Swiss Energy Transition

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#### **Overview**

1. Social Aspects of the Energy Transition

2. Bridging the socio-technical gap with LLMs

3. Try It yourself: Use-Cases at PSL & NCCR







# Human Centric Energy Transition: Bridging Society & Technology



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### **CARMA: Resistance in the Real World**



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Fast Lanes: How ETH engineers want to solve the traffic jam problem

Engineers from EPFL and ETH Zurich propose dividing roads into fast and slow lanes. The use of credits is intended to minimize congestion during rush hour.



"And the desk perpetrators strike again - yay. It may work in theory on the computer, but the human factor cannot be calculated. It's a shame, **money thrown out the window** again without doing anything really useful. "

"A typical idea from educated people. The problem is that some drivers won't drive faster in the express lanes, so, like with the Autobahn vignette, you're paying for something you don't get. **It'll never work.** "

**<u>Needed:</u>** Platform to break down the wall of miscommunication on both sides.

# Why Surveys are not good enough

|                     | Traditional Survey →□→ | LLM – Chat <b>→</b> □→             |
|---------------------|------------------------|------------------------------------|
| Feedback            | One - Shot             | Continuous                         |
| Depth of Insights   | Limited                | Context – Aware, Interactive       |
| Bias Mitigation [2] | Survey Bias            | Adaptive, Real-Time Clarifications |

#### **Our Goals:**

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- Reduce Misinformation
- Capture Dynamic Nature of Opinions
- Follow Up Opportunity

#### ARTIFICIAL INTELLIGENCE

Durably reducing conspiracy beliefs through dialogues with Al

Thomas H. Costello\*, Gordon Pennycook, David G. Rand



[2] "Durably reducing conspiracy beliefs through dialogues with AI" - https://doi.org/10.1126/science.adq1814

[3] In Context Impersonation Reveals Large langue Models' Strengths and Biases – Neurips - Akata et al.

[4] Simulating Opinion Dynamics with Networks of LLM-based Agents, T. Rogers et. al.

# LLMs as an "Intermediary Dynamic Translator"



#### $\rightarrow$ <u>Promotes</u> direct exchange and immediate critique



[3] In Context Impersonation Reveals Large langue Models' Strengths and Biases – Neurips - Akata et al. [5] Using LLM's for Market Research (Harvard Business School – Brand, Israeli, Ngwe)

# **Applications of this technology**

- 1. Research:
  - Phase I: Data Collection
  - Phase II ("Synthetic Citizen Model"):
    - Policy simulations & Acceptance Tests
- 2. Commercialization:
  - Communes / Cantons
  - Product & Market Research
- 3. NCCR Website + Research Collection



# **System Requirements**

| Requirement            | Key Points   | Implementation / Tools                              |   |
|------------------------|--|---|---|
| 1. Usability           | <ul><li>Public Web Access</li><li>User Interface</li></ul> | Google Cloud,<br>React.js                           | 2 |
| 2. Expert Information  | <ul><li>System role</li><li>PDFs</li></ul>                 | <ul> <li>Configuration file</li> <li>RAG</li> </ul> |   |
| 3. Information Storage | - Database   | - SQL   |   |
| 4. Reproducibility     | - Customizable   | - Docker  |   |



#### **Minimum Viable Product: Chat Platform**





### Integrating Expert Knowledge: Retrieval Augmented Generation (RAG)



#### **Example Expert Knowledge:**

- Solar Energy Regulations in the City of Zurich
- Official Roadmap Energy Transition 2050
- Previous Conversations

# **Citizens Science Project: Solar Energy Stories**

- We asked people about their concerns and experiences with solar energy
- Rule Based LLM Tuning:



#### Solar Energy Stories

| # Conversations (14.03.25) | 52           |
|----------------------------|--------------|
| Exchanges per Conv.        | ø 5.36 exch. |
| User Response              | ø 131 chars. |
| Assistant Response         | ø 700 chars. |
| Time Spent                 | ø 16.42 min  |



# **Reducing Biases with LLMs**

| USER<br>"Our property is only sunny from 10:00 to 16:00 .<br>We believe investing in solar isn't worthwhile | ASSISTANT<br>" It's a common misconception that solar only works<br>with constant, direct sunlight. Modern solar panels<br>produce even with diffuse light and shorter exposure " |  |  |
|---|---|--|--|
|   |   |  |  |
| USER<br>"What about feed-in tariffs? I've heard that there<br>won't be any and negative pricing might occu  | ASSISTANT<br>" situation is more nuanced e.g.: intelligent<br>storage systems and self-consumption optimization<br>new mechanisms are being developed "                           |  |  |
|   |   |  |  |
| Environmental Sustainability Concerns - (1  |   |  |  |
| Knowledge Gap - (1  | 1245, 1946)   |  |  |
| Technical Constraints - (1  | 1605, 1698)   |  |  |
| Multi-unit Property Decision Making -   | (1048, 1588, 1605, 1855)  |  |  |
| Financial Barriers -  | (1076, 1229, 1266, 1288, 1935, 1945)  |  |  |
| Renter Limitations -  | (1049, 1076, 1232, 1494, 1597, 1680, 1689)  |  |  |
| ETH zürich  | 1 2 3 4 5 6 7<br>Number of Conversations 12   |  |  |

#### Real-world insights that scientists can learn from

| ASSISTANT "Any advice for other homeowner associations?"                         | USER<br>" Focus on system monitoring and integrated<br>solutions for cost sharing and billing, we handled it<br>ourselves the lack of available products. |  |
|--|---|--|
|  |   |  |
| ASSISTANT  | USER  |  |
| "What's the single most important lesson you learned from your PV installation?" | "Discuss a <b>joint self-consumption (ZEV) model</b> with your neighbors early."  |  |
| Main Concorns for Solar Owners   |   |  |
| Municipal Restrictions   | -1 (1246)   |  |
| Long Wait Times for Installation   | -1 (1279)   |  |
| System Monitoring Challenges   | - 2 (1217, 1252)  |  |
| Shared Property Approval   | 2 (1897, 1263)  |  |
| Coordination Challenges with Multiple Contractors                                | 2 (1670, 1279)  |  |
| Winter Production Shortfall  | 3 (1254, 1951, 1684)  |  |
|  | Number of Conversations   |  |

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#### How can we scale this up?



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# How can you use this?

1. Draft the Chatbot Role

You are an AI – Chatbot specialized in ....

2. Provide Relevant Data (PDF's etc.)



3. Setup (easy & we can assist)

#### Cost Breakdown:

Data + Role: at your own cost ☺

Hosting + Domain: 10 – 20 CHF / Month

LLM – Cost: 10 - 20 (CHF / 1000 conversations)

~ 20-40 CHF / month



### **Conclusion and Outlook**



#### 2. Commercialization:

- Communes/Cantons
- Product & Market Research

#### 3. NCCR – Website + Research Collection







# Thanks, feel free to try it out!



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chatbot.solarpionier.ch

#### References

[1] <u>https://www.20min.ch/story/zuerich-fast-lanes-so-wollen-eth-ingenieure-das-stau-problem-loesen-103198662</u>

[2] "Durably reducing conspiracy beliefs through dialogues with AI" - <u>https://doi.org/10.1126/science.adq1814</u>

- [3] In Context Impersonation Reveals Large langue Models' Strengths and Biases Neurips Akata et al.
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- [5] Using LLM's for Market Research (Harvard Business School Brand, Israeli, Ngwe)
- [6] A self-contained karma economy for the dynamic allocation of common resources, Elokda et al.