Strategies for Domestic Energy Conservation in Carinthia and Friuli-Venezia Giulia

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Introduction

The MONERGY project

- Designing a testbed comprising smart outlets, a data exchange network and a control software
  - Studying wireline and wireless network architectures to connect sensors
  - Researching software architectures to integrate heterogeneous devices
- Carrying out a monitoring campaign in real households
- Deriving energy usage models and developing tailored strategies for optimizing energy usage

Scenarios in the regions

- Identification of scenarios in the regions
  - Analysis of devices responsible for most of the consumption
  - Peculiarities affecting energy consumption
- Design of a monitoring system
  - communication network, data infrastructure, etc.
- Outline of conservation strategies for the regions
  - Combining existing strategies
  - Considering differences in the regions

Approach

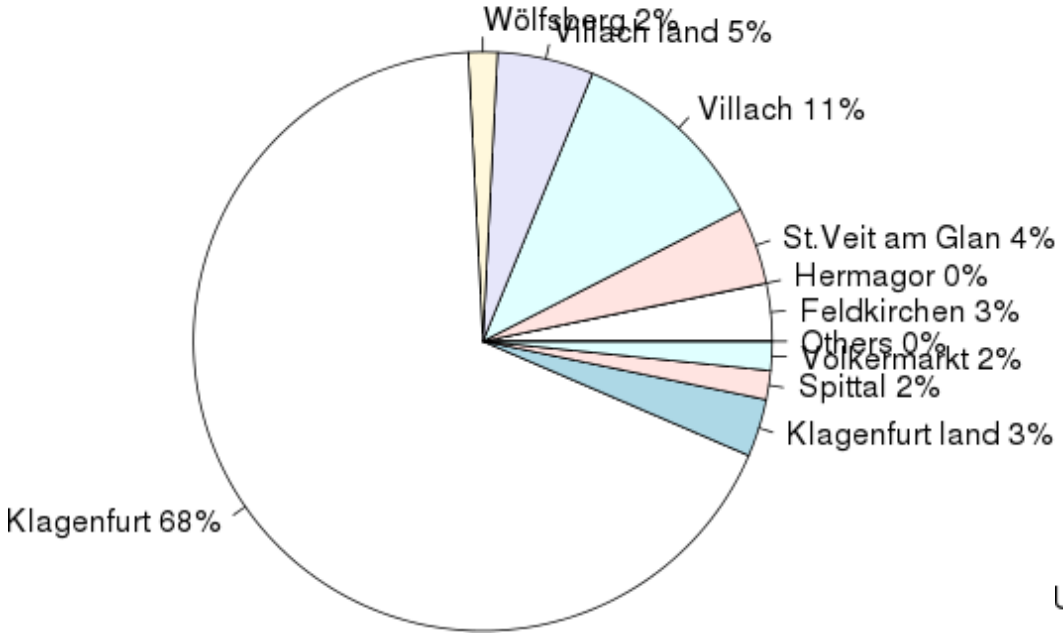
Survey study

- Web-based survey on our project website
- Mainly offered in Italian and German
- Targeted to residents in the regions older than 18
- Advertised using maling lists (companies and universities) and families
- Self-selected bias: results might not exactly describe the regions
- 43 questions grouped in 5 sections
  1. Household information
  2. Use of electric devices
  3. Sensitivity towards energy consumption and renewable energy generation
  4. Sensitivity and expectations towards technology
  5. Demographic information

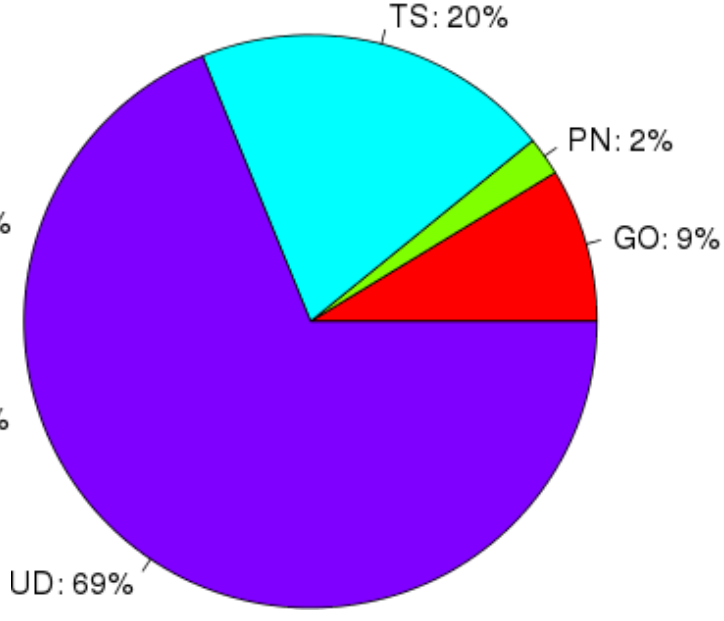
Results

- Collected 340 full responses out of 397 participants
  - 186 from Carinthia (96 F and 90 M)
  - 139 from Friuli-Venezia Giulia (63 F and 76 M)

Respondents from Carinthia



Respondents from Friuli



Scenarios

Energy-greedy devices

Devices	Carinthia	Friuli-V.G.
Space heating	District heating (30.65%) Oil (21.51%) Electric heaters (10.22%)	Gas (63.31%)
Space cooling	2.16%	Conditioners (45.19%)
Water heating	Electric boilers (41.4%)	Gas (82.01%)
Kitchen devices	Electric hob (98.37%) Electric oven (100%)	5.22% 87.97%
Laundry equipment Consumer electronics		

Exploitation of renewable energy sources

	Carinthia	**Friuli-V.G.**
Photovoltaics	2.69%	**7.91%**
Peak power (KW)	Mdn=3, IQR=2.75-3	Mdn=2, IQR=2-3
	"greater than 4KW"	"between 2.8 and 4 KW"
Thermal solar plant	**16.67%**	13.67%
Geothermal plant	0.54%	0.72%
Wind turbine	0.0%	0.0%

Sensitivity towards sustainable living and technology

	Carinthia	Friuli-V.G.
Has a time-dependent tariff	16.67% (night meter)	78.42% (smart meter)
Used in cheaper periods	Electric boiler (10.75%)	Washing machine (62.59%)
		lights, iron, conditioner, ...
Would use in cheaper periods	Washing machine (48%)	
	Boiler (23%), Drier (20%)	
Replaced in last 4 years	67.20%	41.73%
Devices replaced	Light bulbs (51%)	Light bulbs (38.85%)
	Washing machine (32%)	Washing machine (17.99%)
	TV (19.89%), Hob (15%)	TV (9.35%)
Knows HA systems	33.33%	37.41%
Has a HA system	3.23%	3.85%
Wishes energy awareness	73.12%	79.86%
In-home display	26.47%	46.85%
Web/mobile app	68.38%	52.25%
Other means	5.15%	0.9%

Energy conservation strategies

Existing strategies

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http://i.telegraph.co.uk/

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- **Solution:** increasing feedback resolution

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- **Persuasive interfaces:** supporting users in understanding energy usage

Existing strategies

Persuasive interfaces: supporting users in understanding energy usage

- Direct feedback: amount of energy in use, up to 15% of savings
- Indirect feedback: consumption information after event occurred
- Antecedent Vs consequent strategies: preventing instead of just reporting
- Most effective is appliance-level consumption information (NILM/Outlets)
- User modeling: appliance-level advices are estimated leading around 20%

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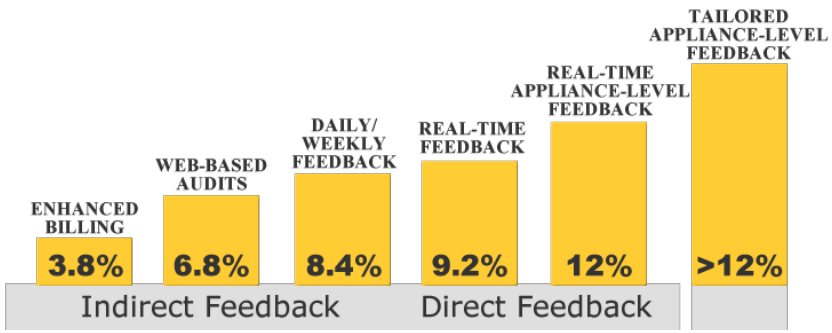

Current development

Insert-coin: pay-as-you-go appliances

- Combines appliance-level information to prepaid billing
- Money as unit for energy and activities
- Classification of appliances (e.g., importance)
- Classification of users (e.g., different awareness $\rightarrow$ different credit)

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- Identifying users (appliance login)
- Preventing users from operating without credit (relays)
- Preventing specific users from adding credit (privileges)
- Detecting loads connected to each outlet (NILM)

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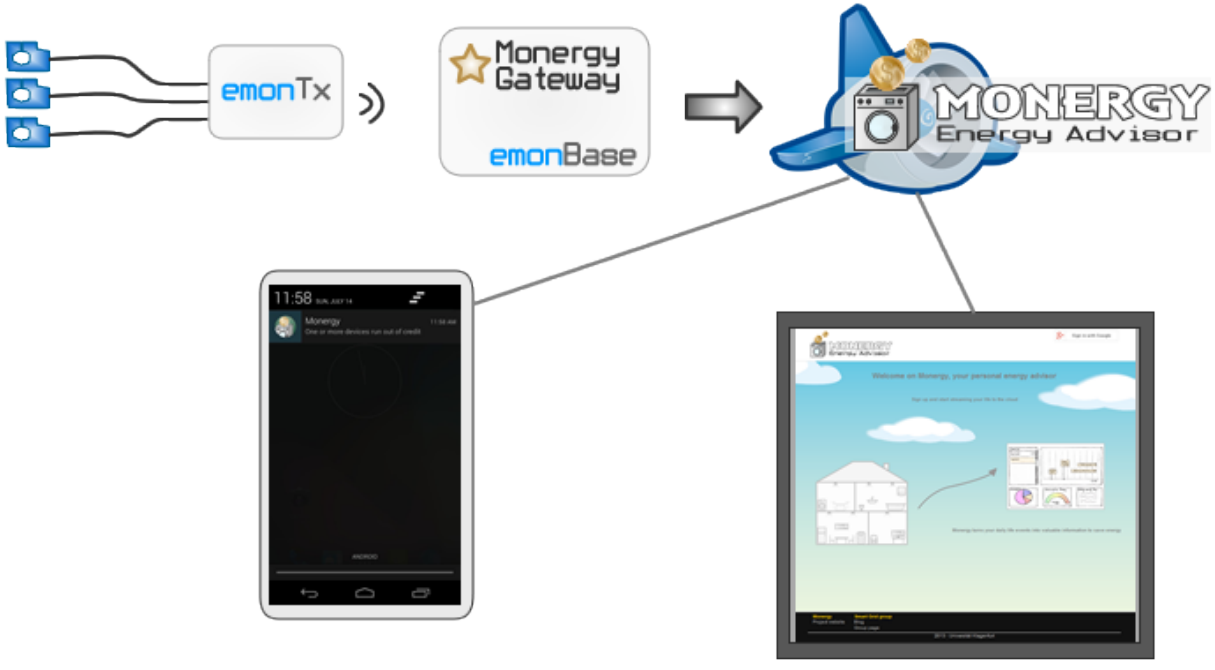
What could be expected in future and assumed (for an experiment)?

- Could be directly implemented in smart appliances
- We know the position of devices (config. file)
- There is only a resident

Insert-coin: the system



- The OpenEnergyMonitor open monitoring platform + MonergyDæmon
- The Google AppEngine webapp (*http://intelligentenergyadvisor.appspot.com/*)
- The Android-based smart notification system

Conclusions

- Planning conservation strategies should consider regional differences
- We spotted some differences with the survey study
- We analyzed existing solutions in two separate papers
  - Hardware communication aspects for the sensor network
  - Software architecture tacklying interoperabily issues
- We proposed and implemented a strategy that **fits for both regions**

Future work

- Carrying out the measurement campaign
- Testing effectiveness of pay-as-you-go devices in promoting conservation
- Extracting models of appliance usage

Questions

Thanks for your attention.

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http://www.monergy-project.eu/
http://smartmicrogrid.blogspot.co.at/