

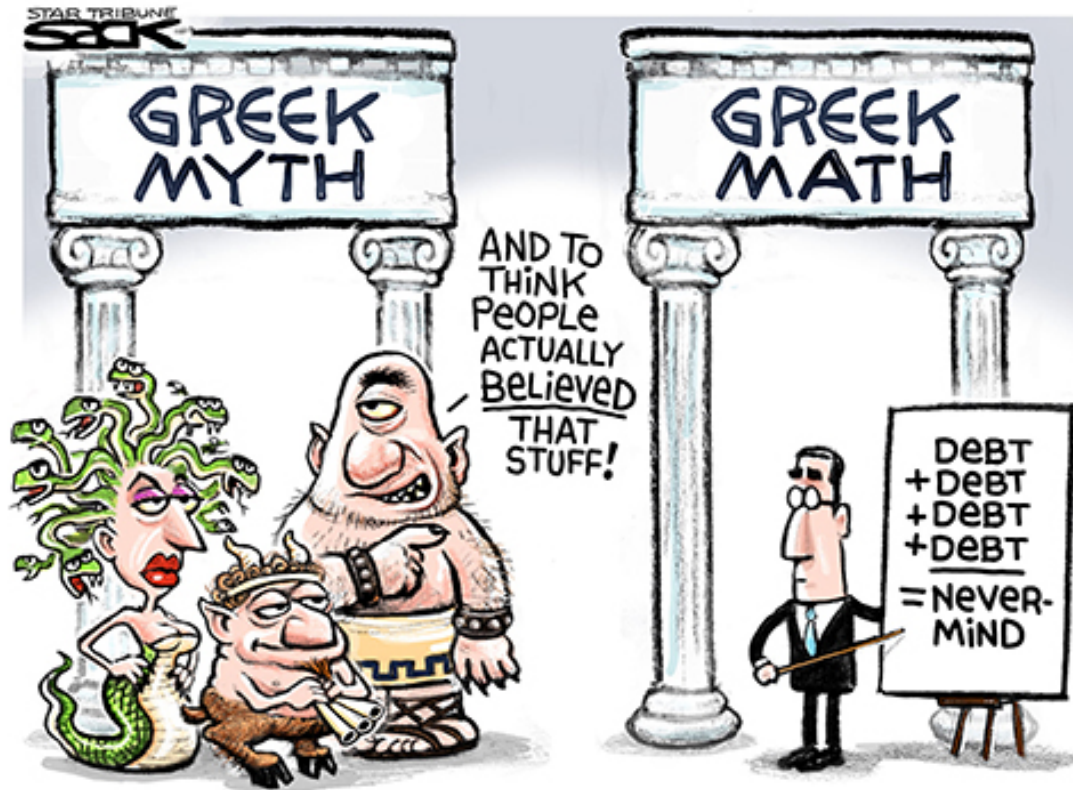


Smart Grids for a Smarter Greece

Energy self-management via decentralized Internet of Things systems

Dr. Evangelos Pournaras

The Greek Drama of Greek Recovery



Mythological “investment creatures” about the Greek development

Austerity accountants calculating the “sustainability” of Greek economy

Greek facts

In 2001, 3% of Greek land concentrates 35% of the population
In 1940, the same population was 16%!



Forcing an economy of scale at this stage can be costly & ineffective

Promising sectors: tourism, agriculture, education, **energy!**

Greek facts on Energy

Lignite: 50% of electrical generation

61% of energy resources are imported



Changing this situation requires complex reforms

What do we do in the meantime?

Renewables: 13.8% of the gross final energy consumption

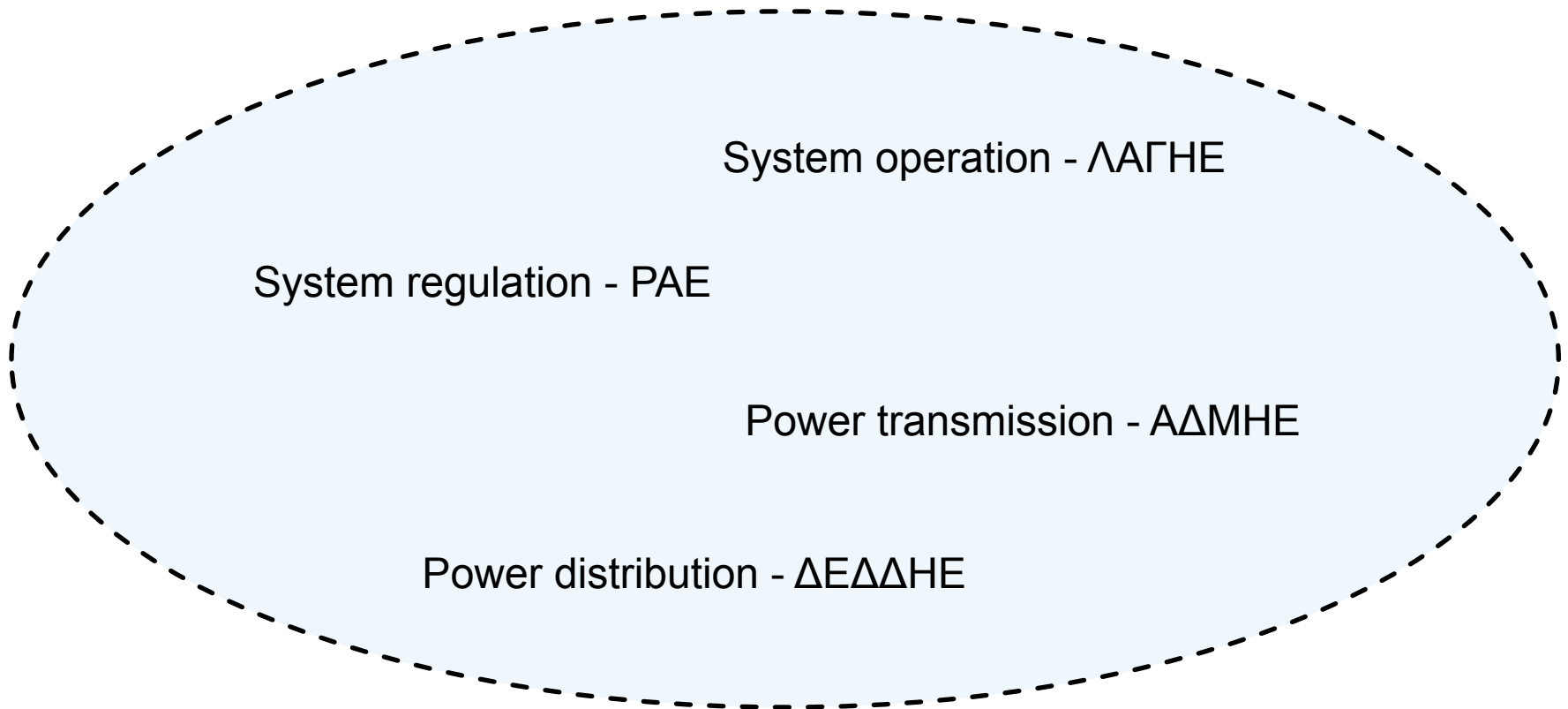


Sweden: 47.9%, Norway: 61.1%

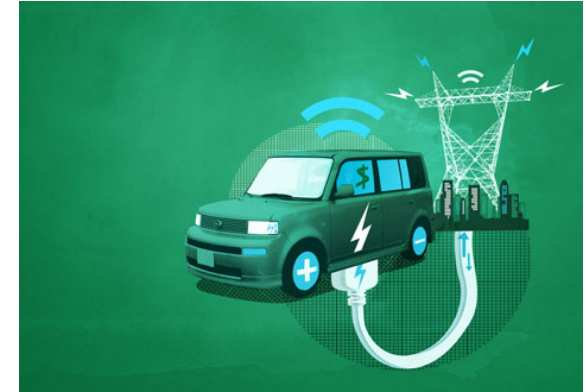
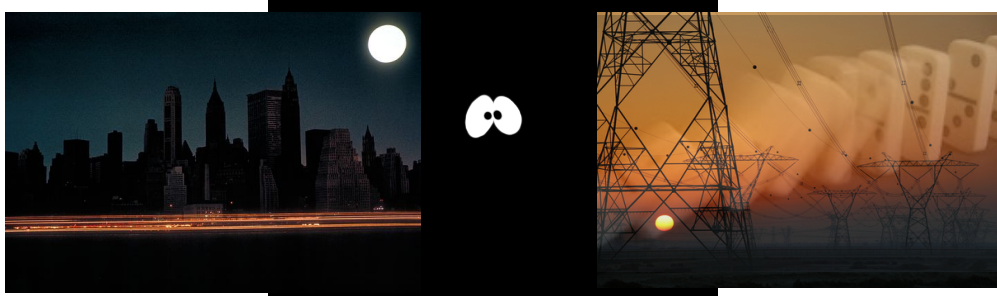


24% decrease in electricity consumption since economic crisis

Power Grid Authorities



Opportunities for Interventions



Which viable Smart Grid interventions can contribute to fire-up Greek recovery?

Decentralized energy self-management

Using bottom-up participatory Internet of Things technologies



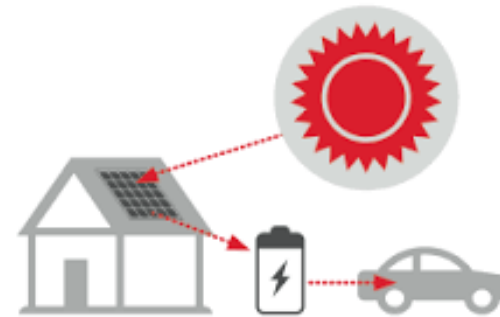
Energy Self-management Services

Cost reduction

Environmental-friendly usage

Local services

Prosumer



Protection mechanisms

Global services

Peak-shaving / energy reduction

Maximizing power injection from renewables



10 BREAKTHROUGH
TECHNOLOGIES

2011

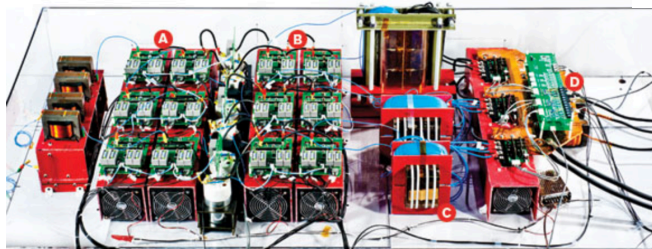
Smart Transformers

Controlling the flow of electricity to stabilize the grid

4 comments

DAVID H. FREEDMAN

May/June 2011



Two play fields: **main infrastructure & micro-grids**

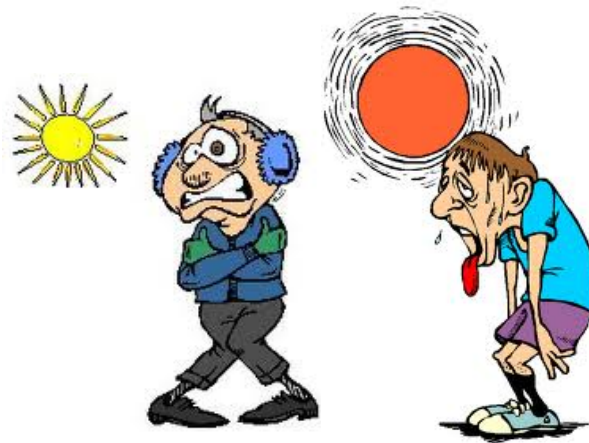
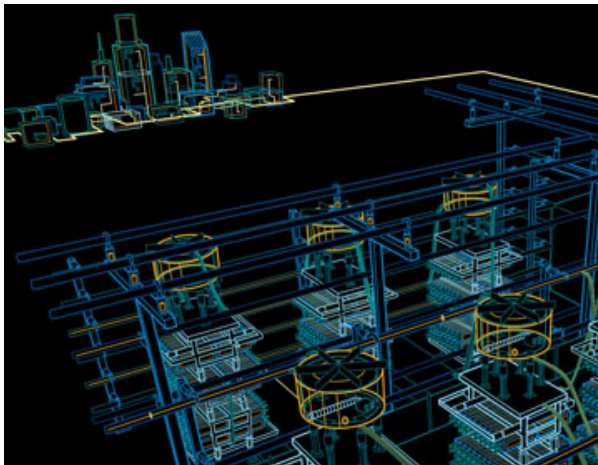
Case Study

Internet of Things Case Study

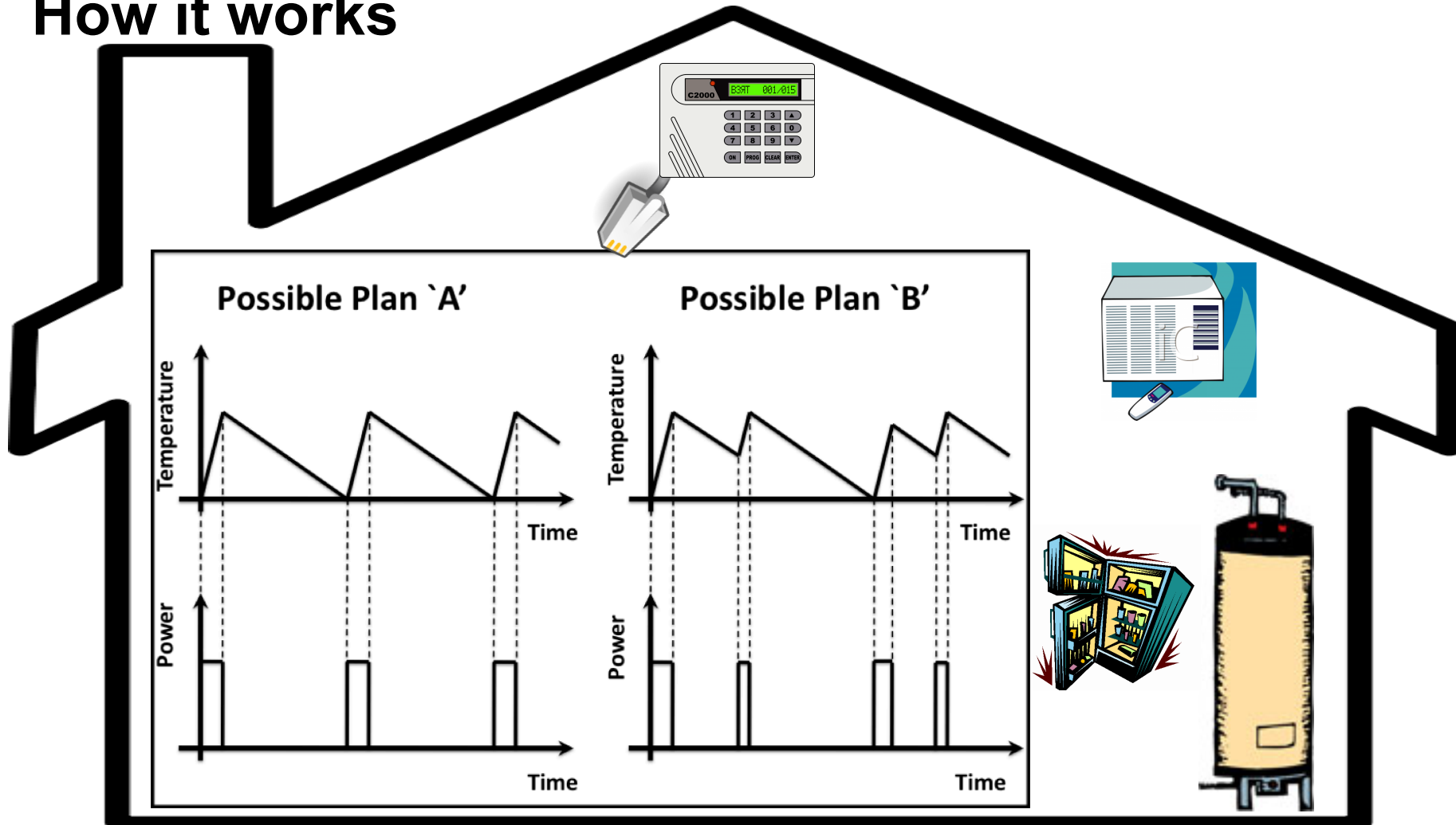
EPOS – Energy Plan Overlay Self-stabilization

Matching supply-demand via demand-side energy self-management

Decentralized regulation of socio-technical trade-offs
e.g. robustness, discomfort, fairness



How it works





Internet of Things

Smart software can control temperature setpoints of air-conditioners, refrigerators, etc.

LG introduces its first Smart Grid-Ready Refrigerator the DIOS

Category: Environment Household - Tags: Household, Lg, Smart Adapt, Smart Grid, Wi-fi, Wifi



Barely 24 hours Samsung's Smart Grid Ready fridge, LG is now announcing its very own connected Smart Grid-Ready DIOS Fridge in Korea. The new smart refrigerator offers updates and information that can be accessed via smartphones and tablets. It offers three powerful smart savings options: late night saving, preferable time saving and the Smart Grid-ready.

The smart fridge also comes with Smart Adapt, which allows owners to keep their refrigerator software up-to-date with the latest upgrades, features and options. The smart fridge is also a source of useful information as it keeps track of daily schedules and dispenses regular weather reports. And instead of having to jot notes on sticky memos, family members can turn the fridge's LCD screen into a note pad to leave messages for each another.

Via LGE

4 Comments

Category ENVIRONMENT HOUSEHOLD



Is this possible?

Smart software plans pre/post cooling or pre/post heating

Available Technologies

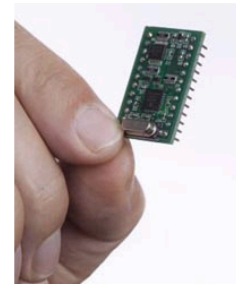
Grid Friendly Appliance™ Controller

Battelle Number(s): 12782-E, 13538-B
Patent(s) Issued
Available for licensing in all fields

Awards Won:
R&D 100 Award - 2008
FLC Award - 2007

Summary

The Grid Friendly Appliance controller developed at PNNL senses grid conditions by monitoring the frequency of the system and provides automatic demand response in times of disruption.



(click on image for full size)

Within the North American power grid a disturbance of 60-Hz frequency is an indicator of serious imbalance

between supply and demand that, if unarrested, leads to a blackout. This simple computer chip can be installed in household appliances and turn them off for a few minutes or even a few seconds to allow the grid to stabilize. The controllers can be programmed to autonomously react in fractions of a second when a disturbance is detected, whereas power plants take minutes to come up to speed. They can even be programmed to delay restart instead of all coming on at once after a power outage to ease power restoration.

Advantages

- More reliable power grids are less costly to run
- Smaller electricity bills for consumers
- More efficient power plant use

for future grid management

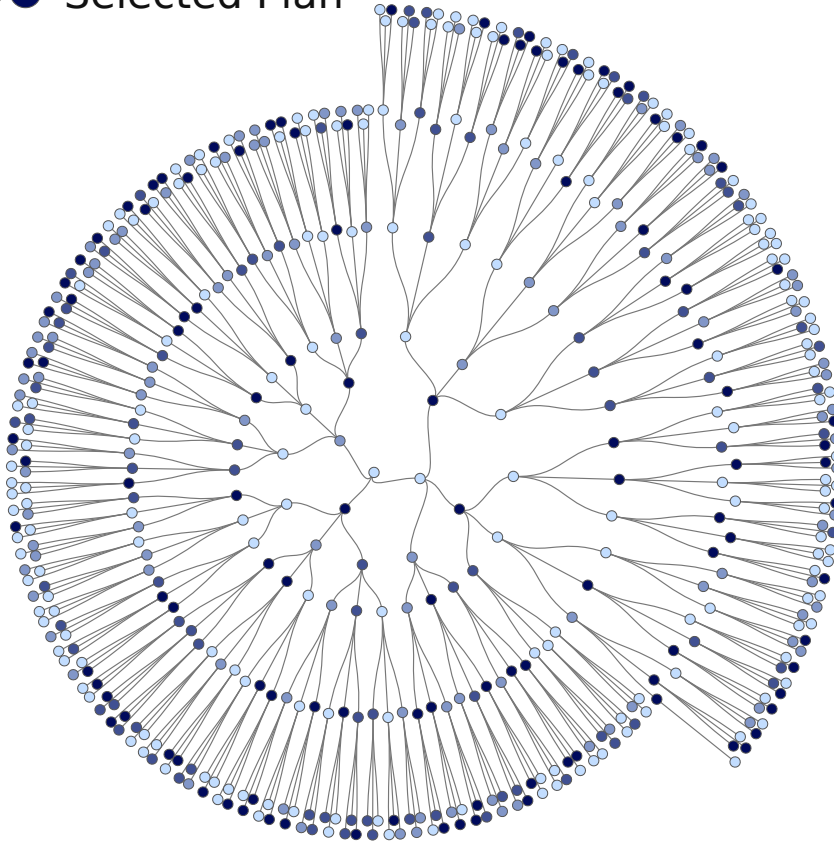


Pacific Northwest
SMART GRID
DEMONSTRATION PROJECT

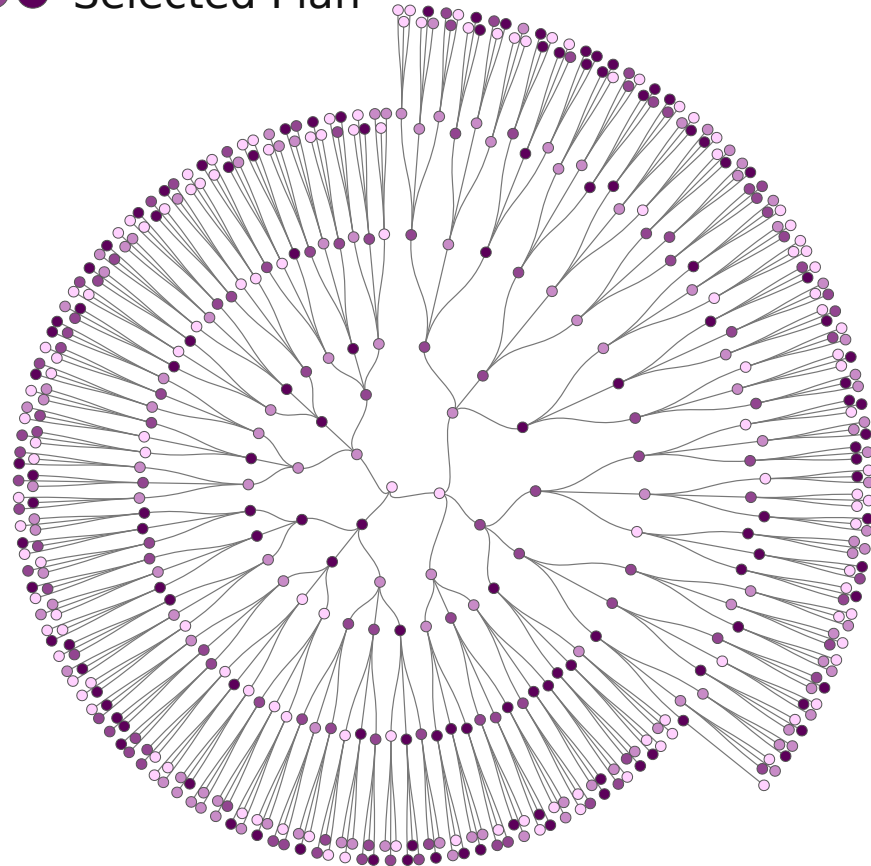


Let Things “Talk” to Each Other

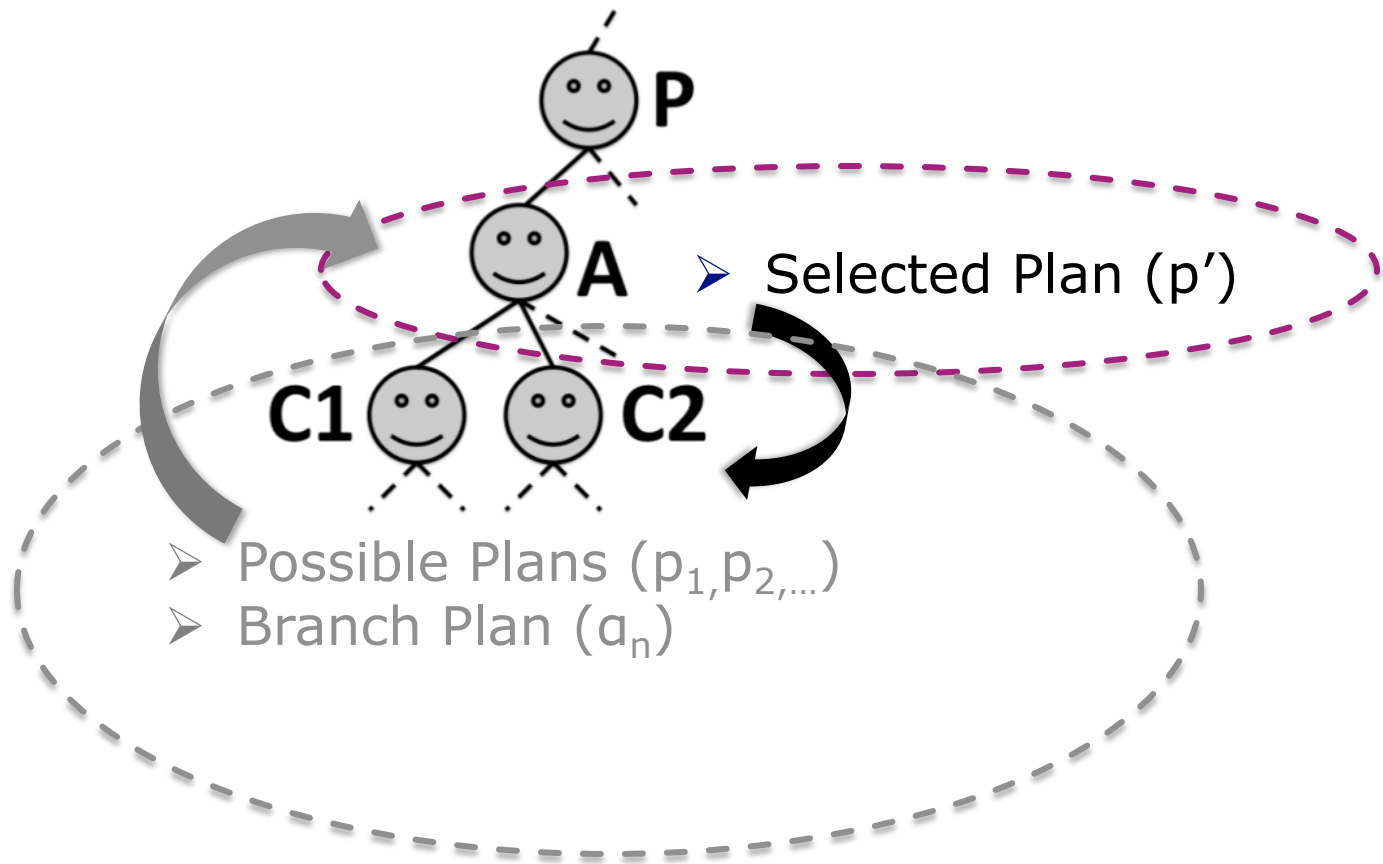
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Selected Plan



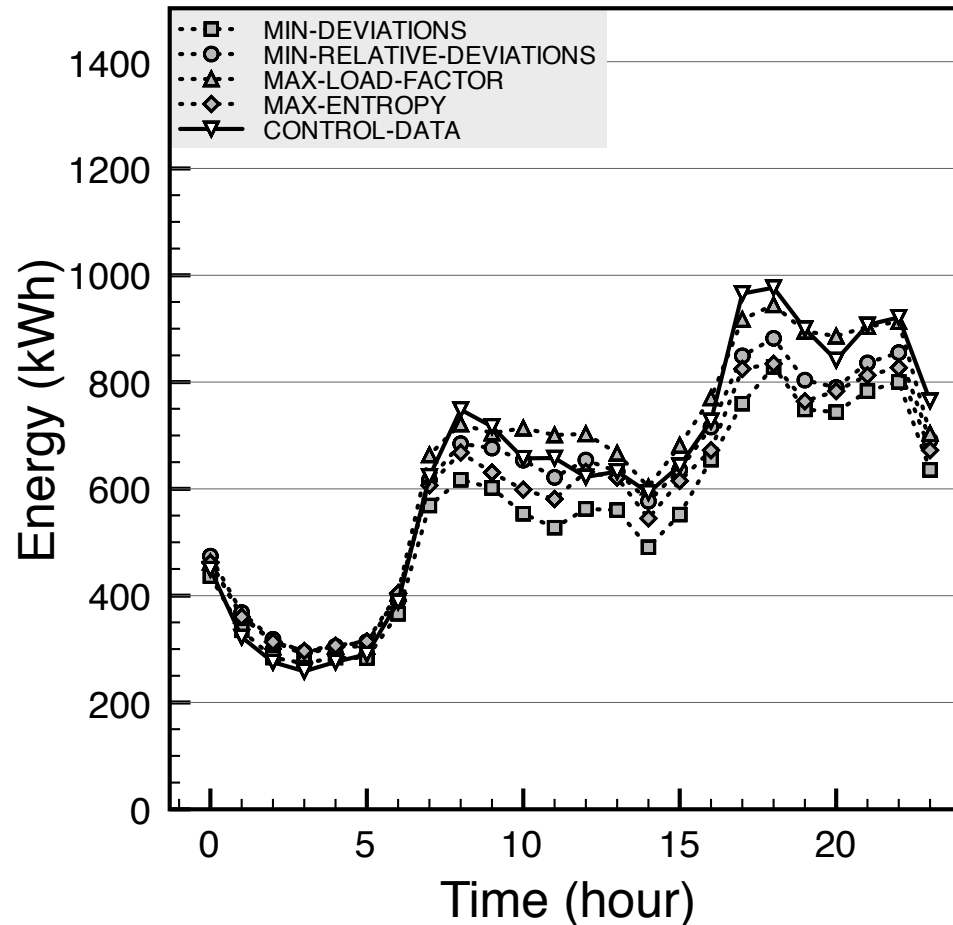
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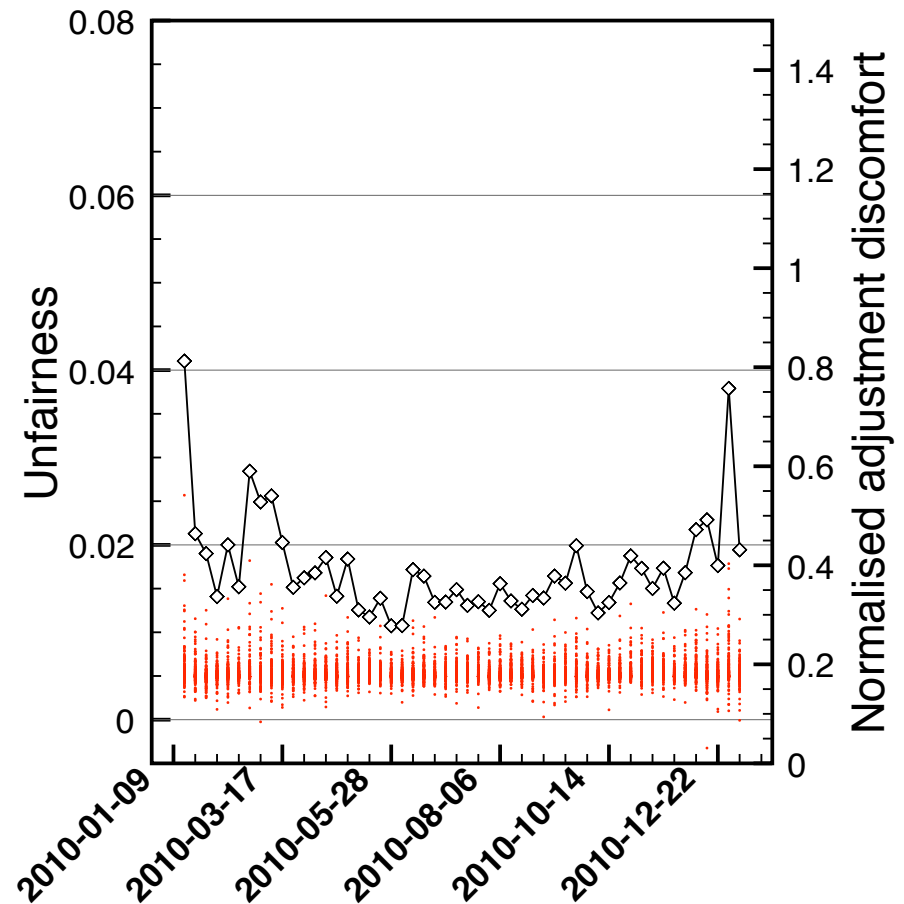
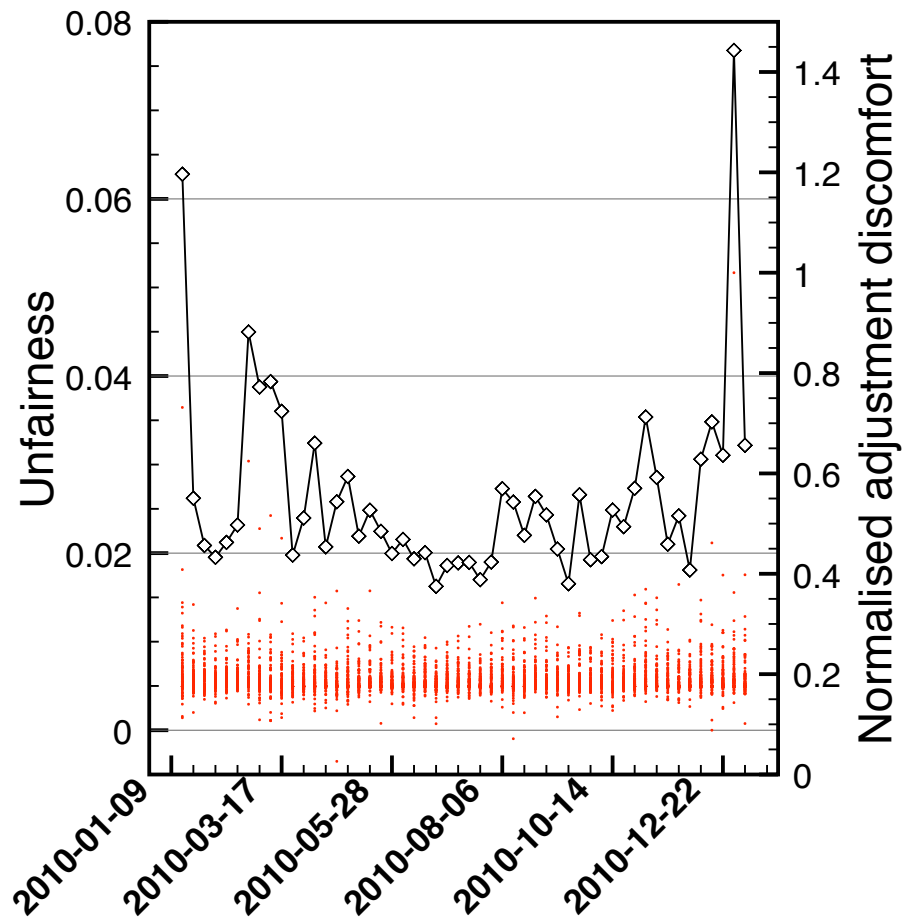
Decentralized Cooperative Energy Management



System Robustness vs. Human Discomfort



Fairness with more Social Options



Conclusions

Greek recovery cannot exclusively wait for generous investments on development

Energy sector is highly under-exploited, yet strategic for Greece

Energy self-management mechanisms using minimal interventions are promising here

We do not need to reinvent the wheel – adapt successful practices to our needs

Questions?

“Make the best use of what is in your power and take the rest as it happens” - Epictetus

[1] Evangelos Pournaras, Matteo Vasirani, Robert E. Kooij and Karl Aberer, Decentralized Planning of Energy Demand for the Management of Robustness and Discomfort, IEEE Transactions on Industrial Informatics, Vol. 10, Nr. 4, pp. 2280-2289, 2014 © IEEE

[2] Evangelos Pournaras, Matteo Vasirani, Robert E. Kooij and Karl Aberer, Measuring and Controlling Unfairness in Decentralized Planning of Energy Demand, in the proceedings of the IEEE International Energy Conference-EnergyCon 2014, Dubrovnik, Croatia, May 2014. © IEEE

[3] Evangelos Pournaras, Martijn Warnier and Frances M.T. Brazier, Local Agent-based Self-stabilisation in Global Resource Utilisation, International Journal of Autonomic Computing, Vol. 1, Nr. 4, pp. 350-373, 2010 © Interscience Publishers

[4] Συνέντευξη: Χρειαζόμαστε μια πραγματική ψηφιακή δημοκρατία, ΑΠΕ-ΜΠΕ, Δεκ. 2015
<http://www.amna.gr/article/97775/Eu.-Pournaras-sto-APE-MPE:-Chreiazomaste-mia-pragmatiki-psifiaki-dimokratia>