Peer-to-Peer Energy Platforms: Incentives for Prosuming

Plateformes d'échanges d'energie pairs-à-pairs : incitations à devenir prosommateur

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Energy communities for collective self-consumption: frameworks, practices and tools
Session 4 – June 23, 2020
Opportunities and impacts of digital technologies for energy communities

Introduction

Globally

- Energy ; digital ; competitive transition
- Uberisation
- Energy internet *à la* Rifkin "*using Internet technology to transform the power grid of every continent into an energy internet that can help households sell surplus energy back to the grid and share it with neighbours*"

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P2P Energy exchanges

Experiments, Projects

"Transactive Energy" & microgrid: iconic Brooklyn Transactive Grid

BrooklynGrid project

TRANSACTIVEGRID

Microgrid

Electricity

Data

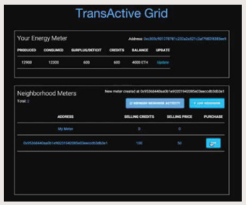
Token system
(Blockchain)

5 households produce energy surplus

Power productionis metered on a second-by-second basis, with information converted to blocks

Electricity surplus and demand is calculated using fictitious tokens

5 households buy energy surplus
(at present: manually)



Payment through energy tokens → no intermediary required

In future:

Buyers and sellers to use app allowing them to specify their preferences (e.g. donate 10% of electricity, sell more when prices go up, ...)

In future: microgrid to be expanded

Parties can decide individually with whom to enter into a contract and transactions are executed immediately

Table: From PwC Report 2016

Project name	Country/Region	Starting year	Focus level	Outcomes	Classification
P2P-SmartTest	Europe (Finland, United Kingdom, Spain, Belgium)	2015 (ongoing)	Distribution grid level	Advanced control and ICT for P2P energy market	Local control and ICT; Market design
EMPOWER	Europe (Norway; Switzerland, Spain, Malta, Germany)	2015 (ongoing)	Distribution grid level	Architecture and ICT solutions for provider in local market	Local control and ICT
NRGcoin	Europe (Belgium, Spain)	2013 (finish)	Consumer/ prosumer	P2P wholesale trading platform	Market design
Enerchain	Europe	2017 (ongoing)	Wholesale market	P2P wholesale trading platform	Market design
Community First! Village	USA	2015 (ongoing)	Consumer/ prosumer	Build self-sustained community for homeless	Local control and ICT
PeerEnergy Cloud	Germany	2012 (finish)	Consumer/ prosumer	Cloud-based energy trading for excessive production	Local control and ICT
Smart Watts	Germany	2011 (finish)	Consumer/ prosumer	ICT to control consumption in a secure manner	Local control and ICT
NOBEL	Europe (Germany, Spain, Greece, Sweden, Spain)	2012 (finish)	Consumer/ prosumer	ICT for energy brokerage system with consumers	Local control and ICT
Energy Collective	Denmark	2016 (ongoing)	Consumer/ prosumer	Deployment of local P2P markets in Denmark	Market design
P2P3M	Europe (United kingdom), Asia (South Korea)	2016 (ongoing)	Consumer/ prosumer	Prototype P2P energy trading/sharing platform	Market design

Table: Comparison of different R&D projects, from Sousa *et al.* *(2018)*

Economic analysis & Model

Research Questions

- Motivations of participants vs. economic efficiency in the emergence of P2P-E?
- Persistence of a legal entity or local network manager responsible for flexibility and ancillary services : a market dealer?.
- What kind of economic incentives these P2P exchanges create in contrast to centralized systems?

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Simple stylized model

- **Heterogeneous agents** from energy needs : ϕ
- **Intermittency** : $x \in [0, 1]$
  - if $x = 1$: Full availability of the DPU
  - if $x = 0$: DPU non available
- DPU $q > 0$: maximal production capacity in kWp
- Intrinsic preference to participate at the platform $\delta \geq 0$: (exogeneous) value of cooperation, localism, environmental value etc.

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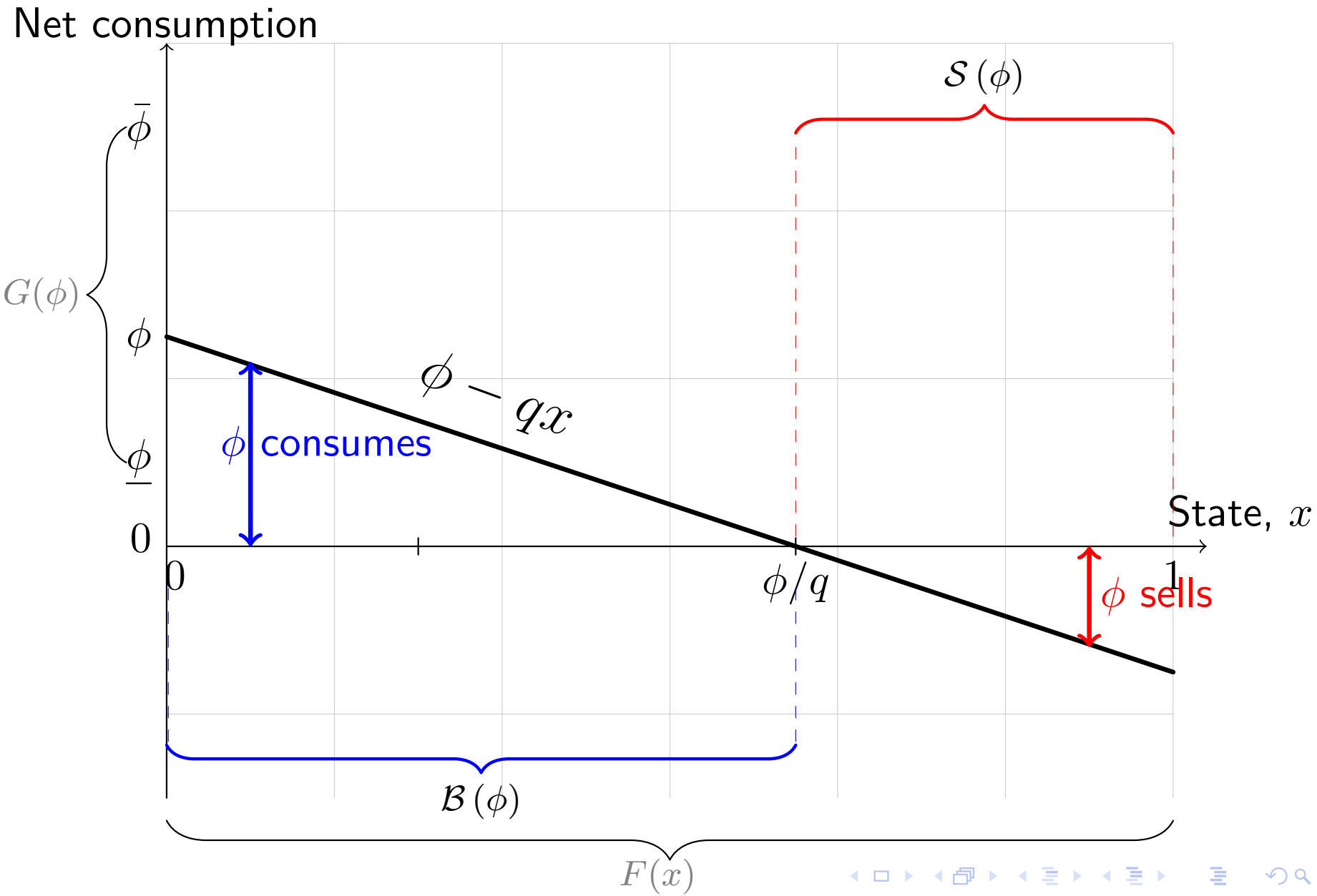
Our setup


Net consumption
$\mathcal{S}(\phi)$
$\bar{\phi}$
$G(\phi)$
ϕ
$\underline{\phi}$
ϕ consumes
$\phi - qx$
State, x
0
0
ϕ/q
1
ϕ sells
$\mathcal{B}(\phi)$
$F(x)$

Dealing platform

- Dealing technical and commercial platform able to identify prosumers supplies and demands
- $p(x)$ purchase price and $r(x)$ selling price
- In each state, demand and supply to the platform for each agent ϕ
- Platform max local welfare at each time $W(x)$ setting prices p, r

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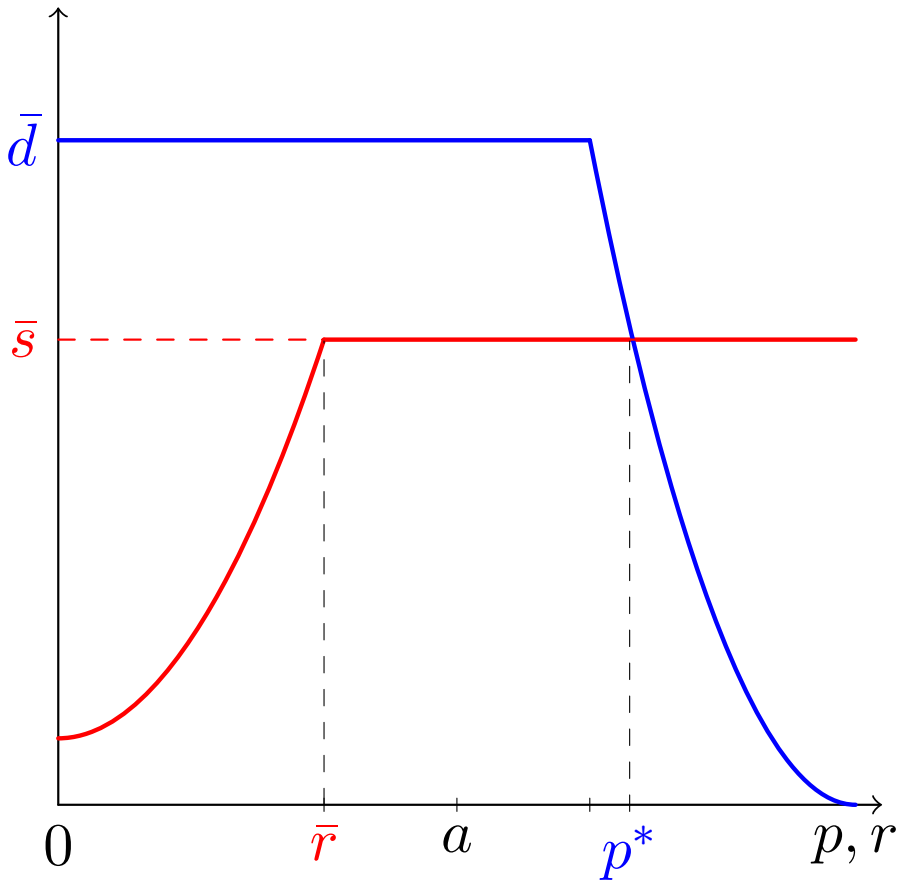
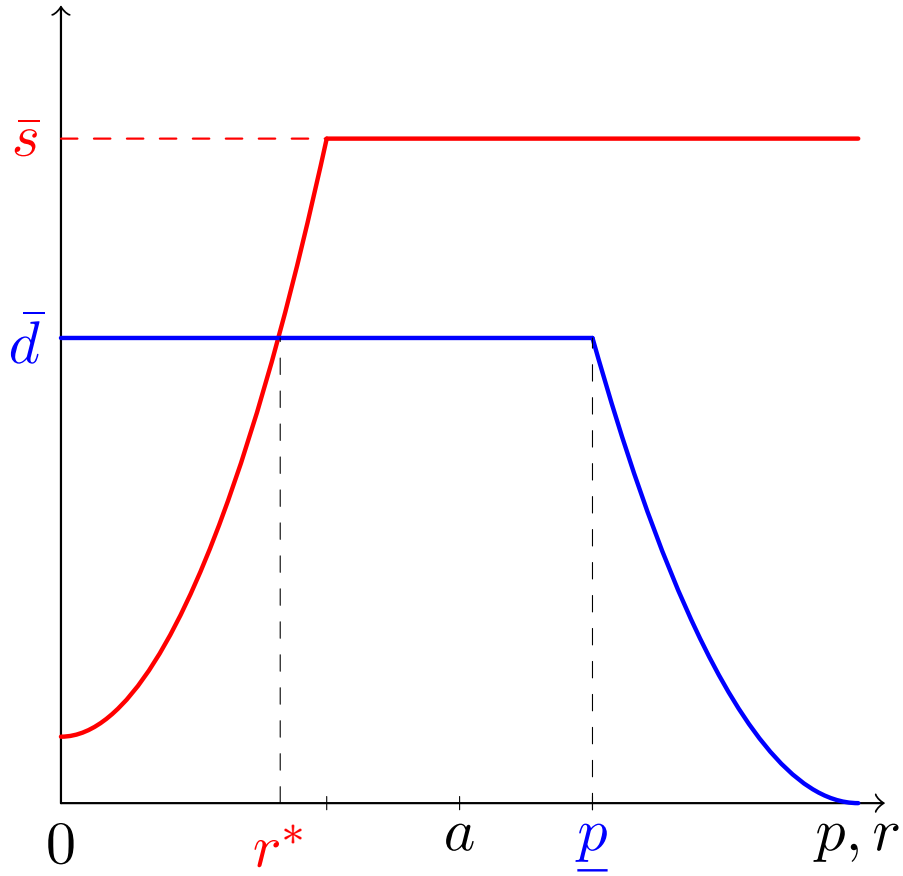
Optimal clearing prices in state x : two regimes

Selling prices $\leq$ price ceiling $<$ Grid price $<$ price floor $\leq$ Purchase prices



Low availability $x \leq \hat{x}$



High availability $x \geq \hat{x}$

Results: Incentives to install DPU

- **Fixed DPU size, q for all**
- With a pure dealing platform, prosumers are **not worse off** compared to the no platform configuration
- Extra-surpluses for prosumers = value of participate despite less favorable energy prices
- Extra-surpluses for prosumers = incentives to invest in DPU
- Investing in DPU increases self-consumption = reduces occurrence of purchase premia and sale shortfalls

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- **Variable DPU size, $q(\phi)$**
- Ambiguous as this create price effects (for profit platform):

$$\frac{\partial p^*}{\partial q(\phi)} \leq 0 \quad \text{and} \quad \frac{\partial r^*}{\partial q(\phi)} \leq 0$$

- Marginal incentives to install DPU are boosted by the positive marginal price effects they produce on the purchase price (to the platform)
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Discussion, extensions

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- Matching platform (dealer as a matchmaker) some incentives remain but an elastic matching technology is a factor that can enhance the prosumer's investments
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