# Power Struggles on the Blockchain
## – Energy Democracy at Last?

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Energy Economics & Regulation Seminar, November 17th, 2017

# Today

- Motivation
- Research design
- Theoretical foundations
- Hypothesis
- Findings
- Policy recommendations
- ACDC coin: A first simulation

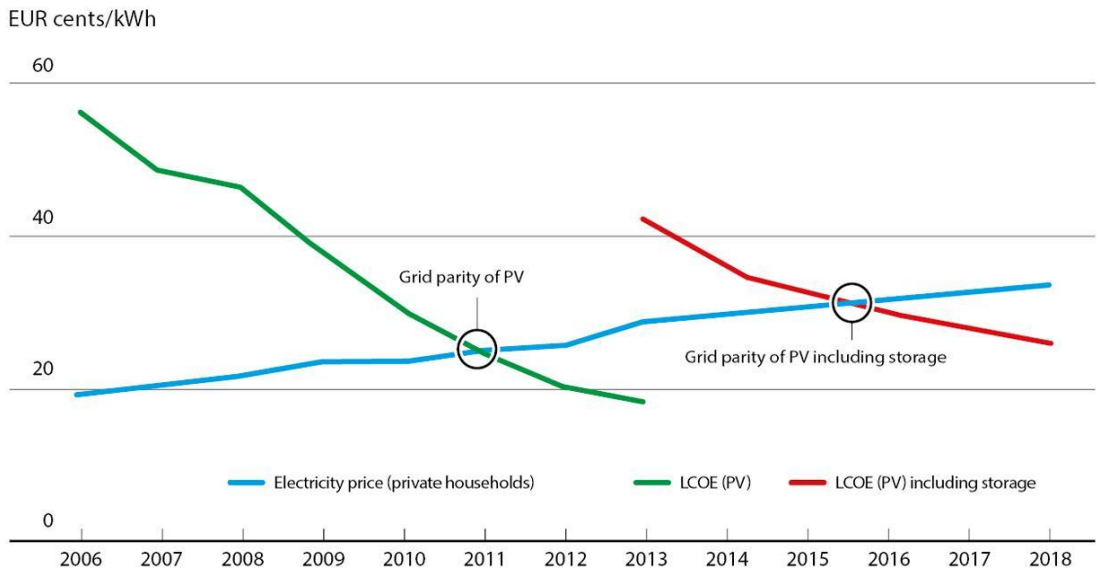

Energy production is increasingly decentralized and community based…


…but grid balancing, trading and billing is still centralised, …

RENEWABLE POWER GENERATION COSTS IN 2014

IRENA
International Renewable Energy Agency

FIGURE 5.17: GRID PARITY OF PV-STORAGE IN GERMANY



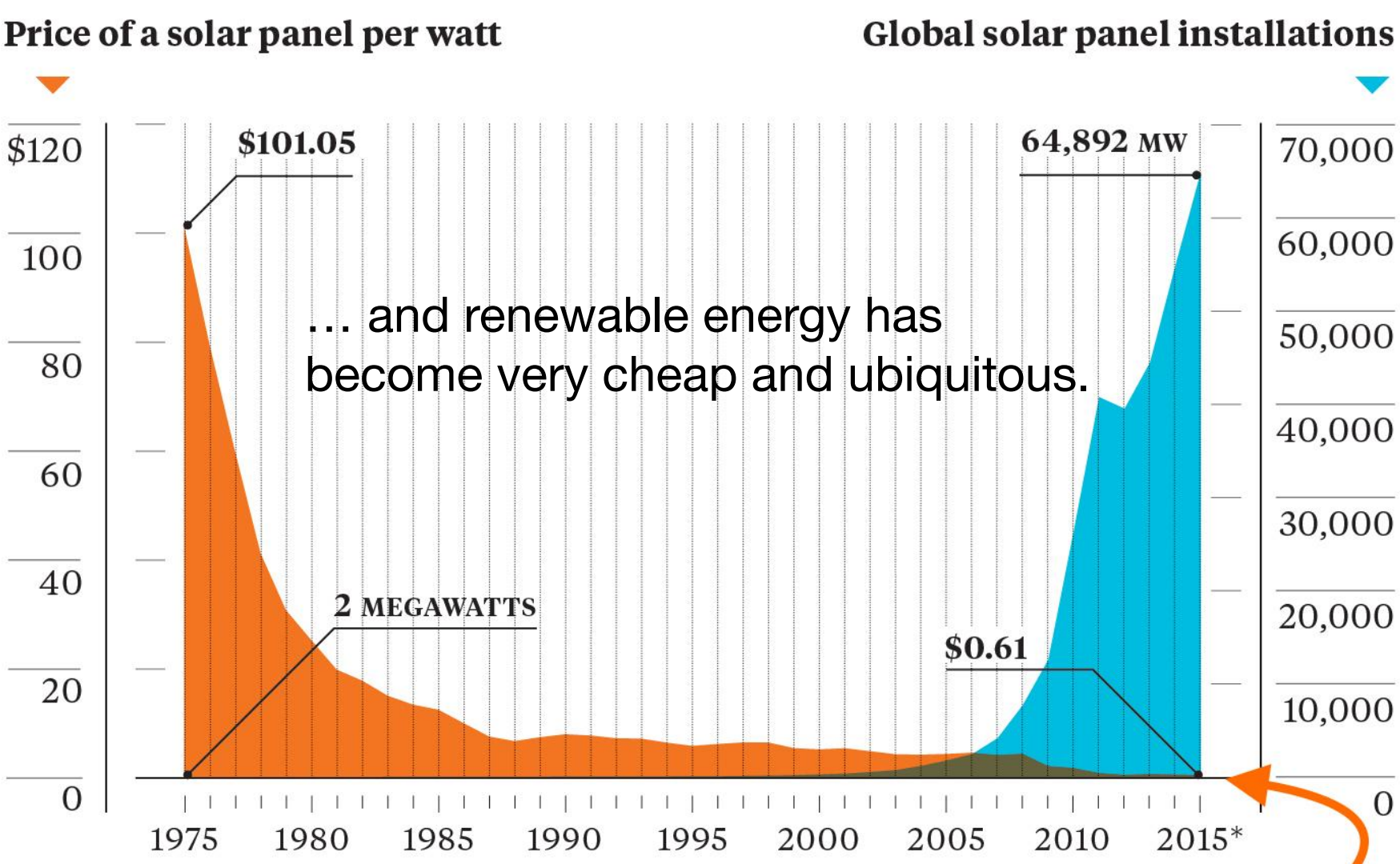

*Source*: EuPD Research/ BDEW 2013.

… although grid parity is here, …

June 2017, Germany:

1 kWh solar PV (on field) costs 5,66 EUR cent

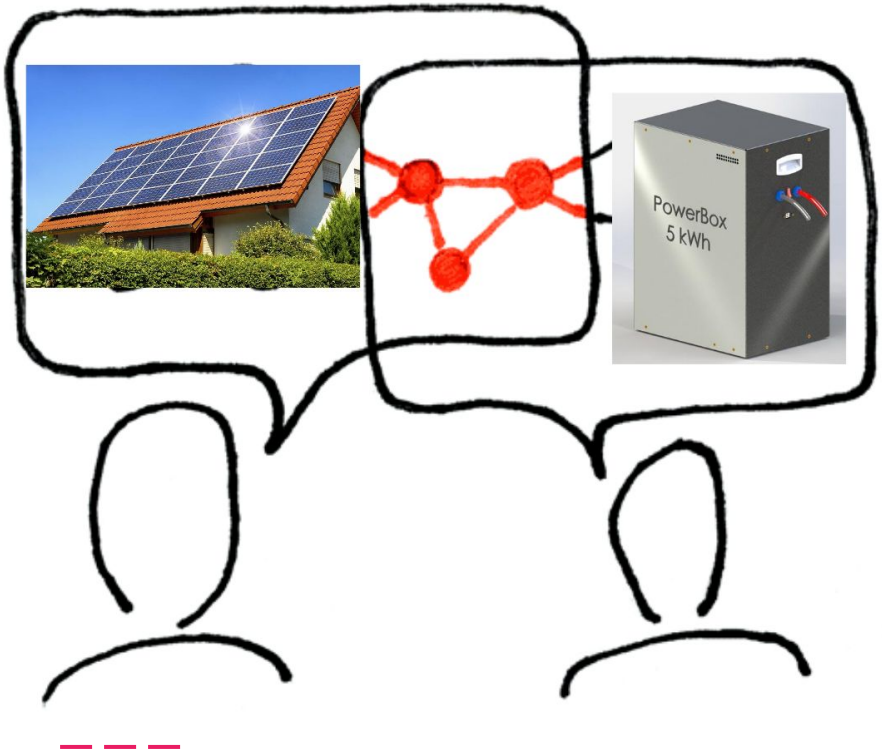
1 kWh mixed electricity from household retailer costs 29 EUR cent


Price of a solar panel per watt
Global solar panel installations
$120
100
80
60
40
20
0
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
$101.05
64,892 MW
2 MEGAWATTS
$0.61
… and renewable energy has become very cheap and ubiquitous.
1975
1980
1985
1990
1995
2000
2005
2010
2015*

# Blockchain

… could allow prosumers to trade electricity locally, without a central intermediary.

But how?



# What is a blockchain?

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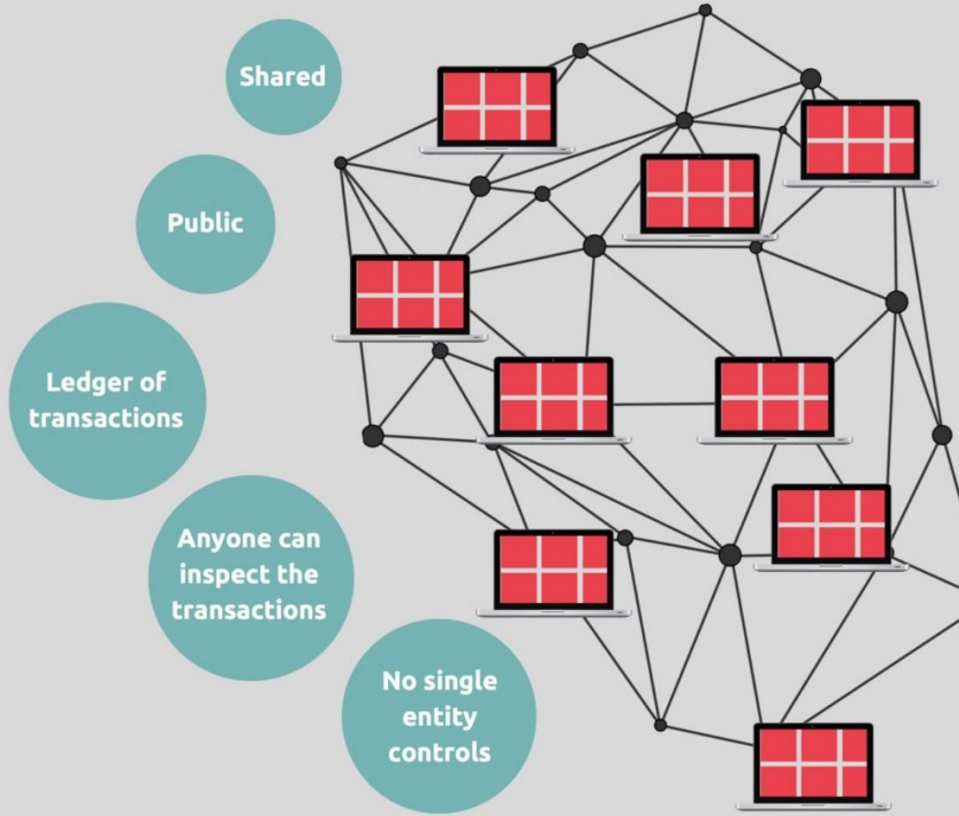
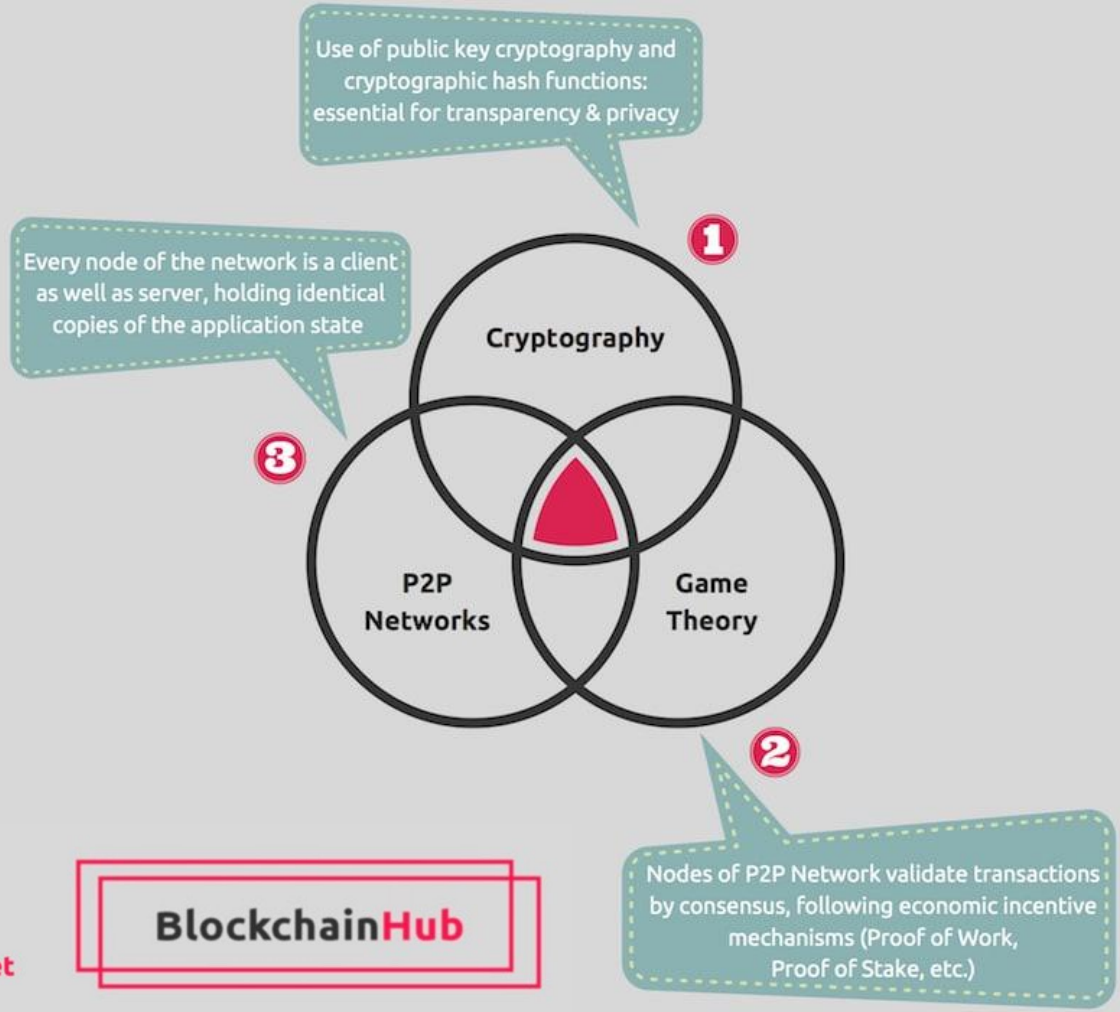
## Like a Spreadsheet in the Sky




All network transactions get stored in the blockchain

# Combination of three technologies




**Authors:** Shermin Voshmgir, Valentin Kalinov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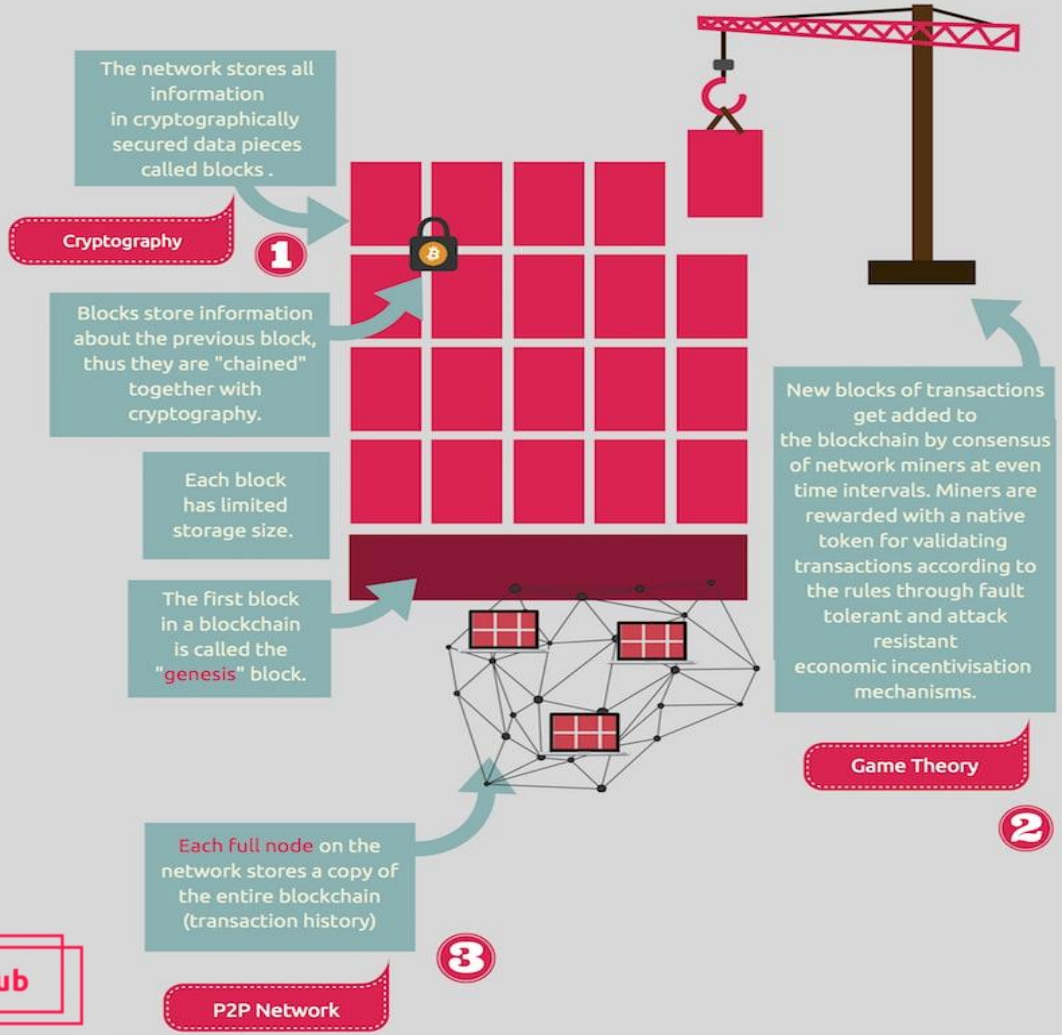
# Why is it called a blockchain?




**Authors:** Shermin Voshmgir, Valentin Kalinov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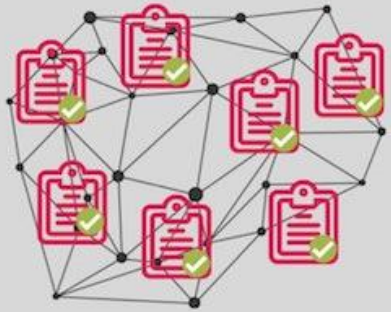
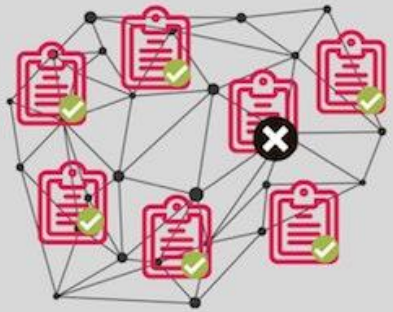
# Why is Blockchain Tamper Resistant?



Each network participant keeps a copy of the entire blockchain - the file where all past transactions are recorded. Consensus of network validators verifies new transactions. In the Bitcoin network transactions are validated by network miners who are incentivised to verify transactions through PoW (Proof of Work).



If a malicious party makes unauthorized changes to his copy of the blockchain on one computer, other members of the network will refuse the transaction since that malicious version of the blockchain data will differ from the rest of the network.

**To manipulate data on the blockchain, one will have to manipulate data on the majority of the network. This is possible, but prohibitively expensive, especially if you need to manipulate old data and go back many blocks!**

**Authors:** Shermin Voshmgir, Valentin Kalinov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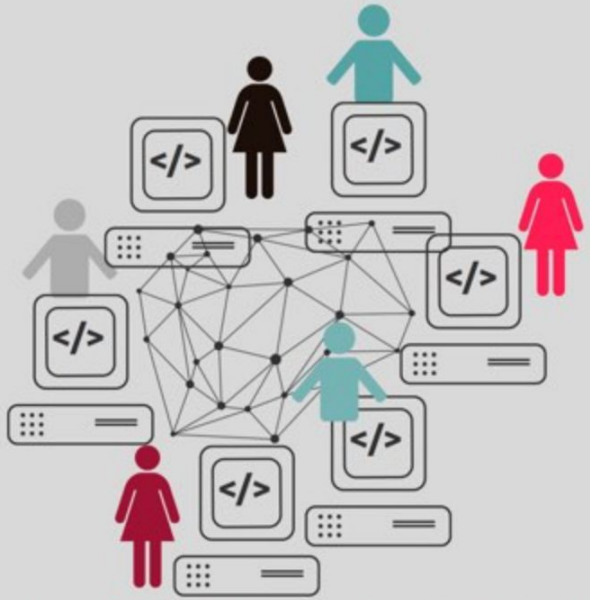
# Data Monarchy <> Data Democracy


**Server:**
Unique Point of Failure!




**P2P Network:** If parts of the network fail, the rest of the network will still be functional and safe

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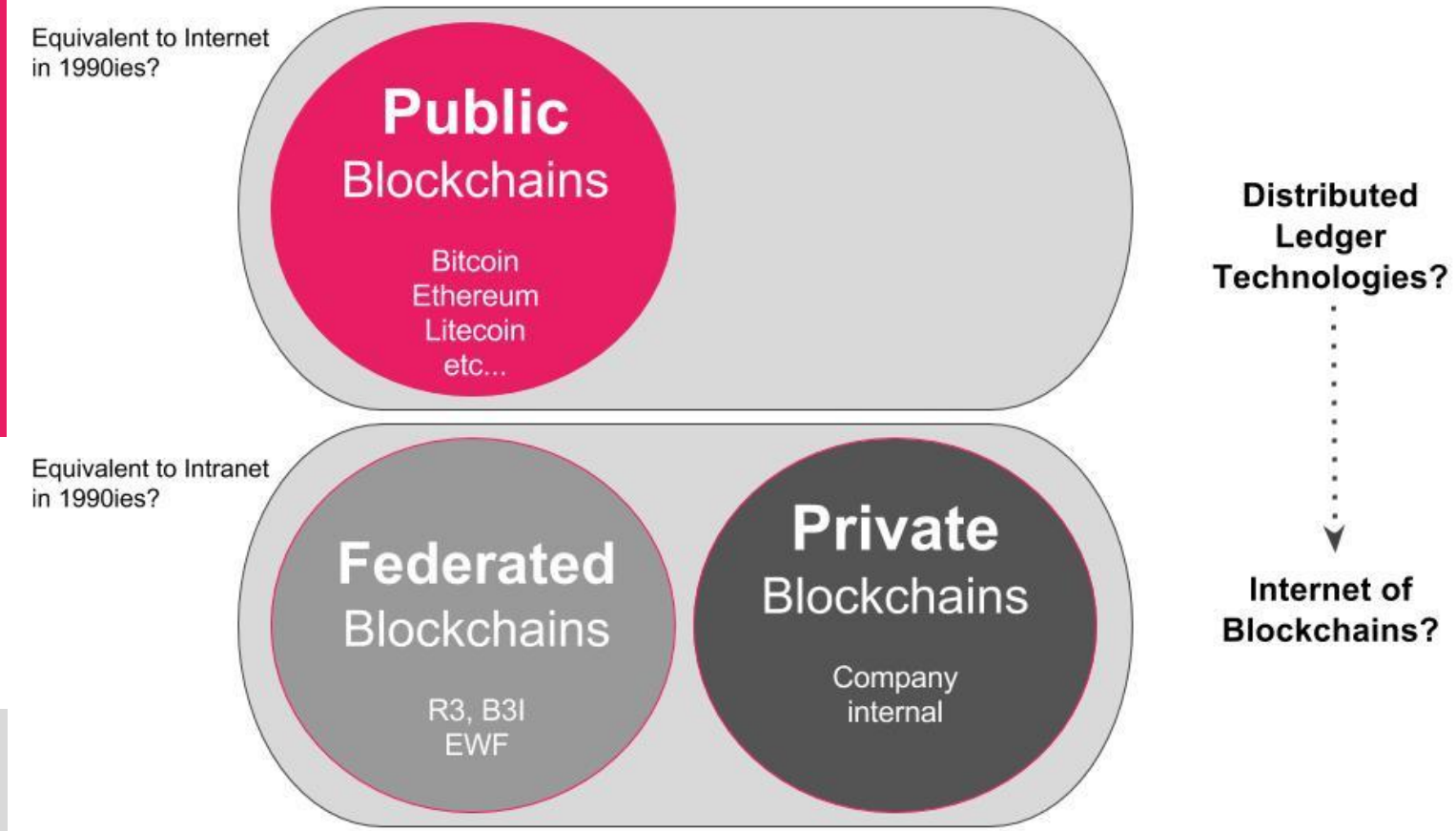
# Types of blockchains

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**Smart Contracts**
not a new idea


Coffee


“Let’s commit now that if this event happens this transaction will be triggered automatically.”

…….

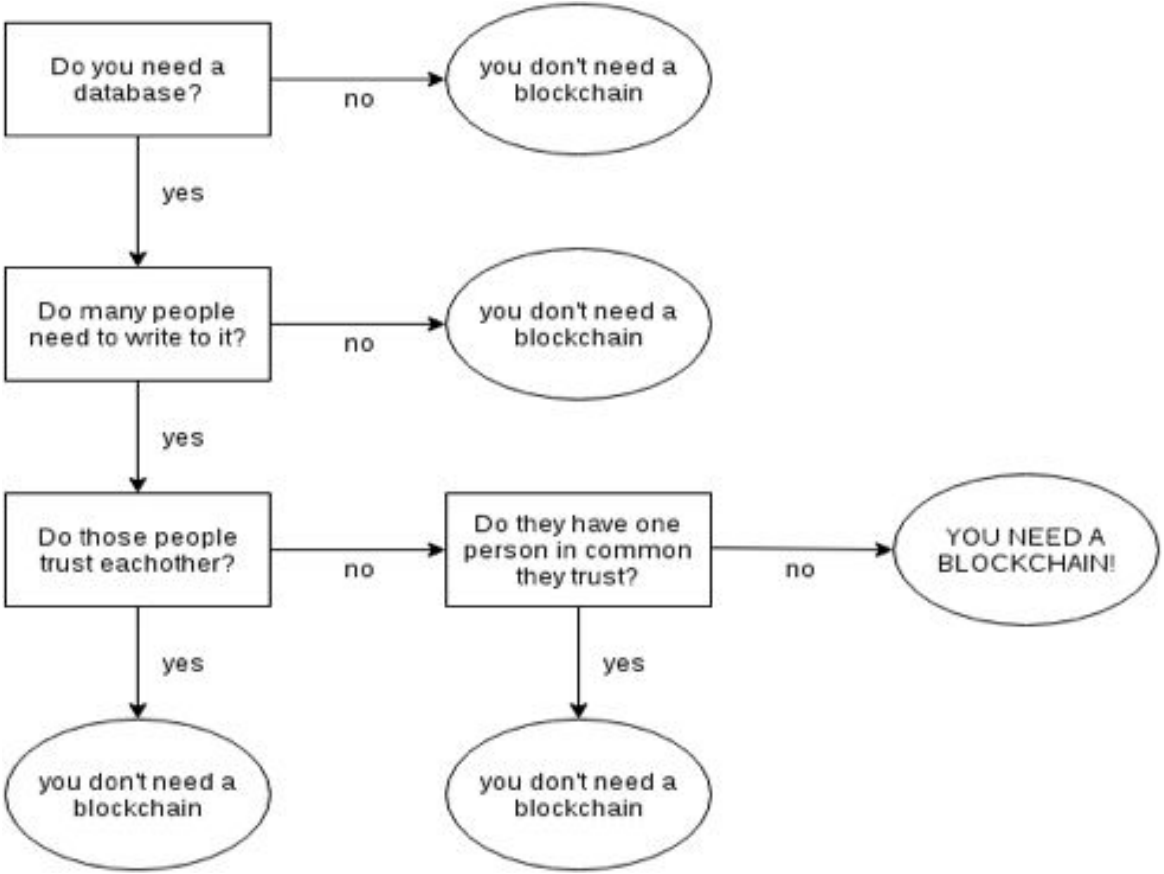
…….

Signed. Signed.


Enter Ethereum.


Ethereum uses a scripting language called Solidity to allow simple drafting of smart contracts which are executed (for a fee) on the Ethereum blockchain.

# Finally the key question: (When) do you really need a blockchain?

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# Why is blockchain more than another IT-solution?

Understanding Blockchain as an institutional technology - with two Nobel laureates in Economics

# What are Institutions?

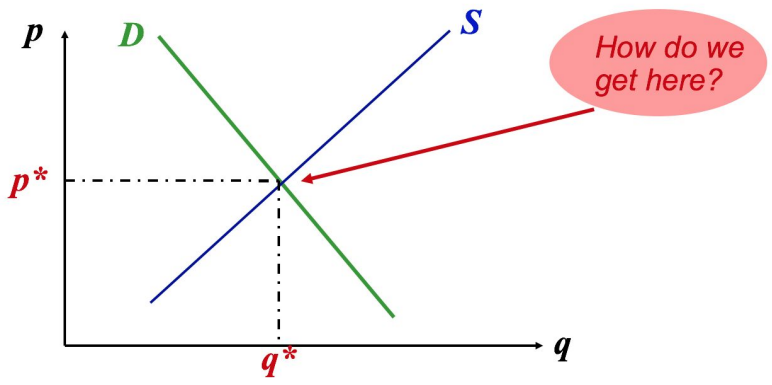
Institutions are...

*"...rules of the game of society" (Douglas C. North)*

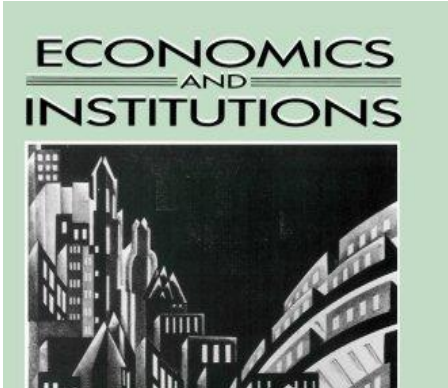
*"...systems of established and prevalent social rules that structure social interactions"*
(Geoffrey Hodgson)

# Markets as institutions

More than a price mechanism




“A market is an organized and institutionalized exchange with a set of mechanisms and processes that structure, organise and legitimate the contractual agreements and property rights transfers (Hodgson 1988)



# What is an institutional Technology?

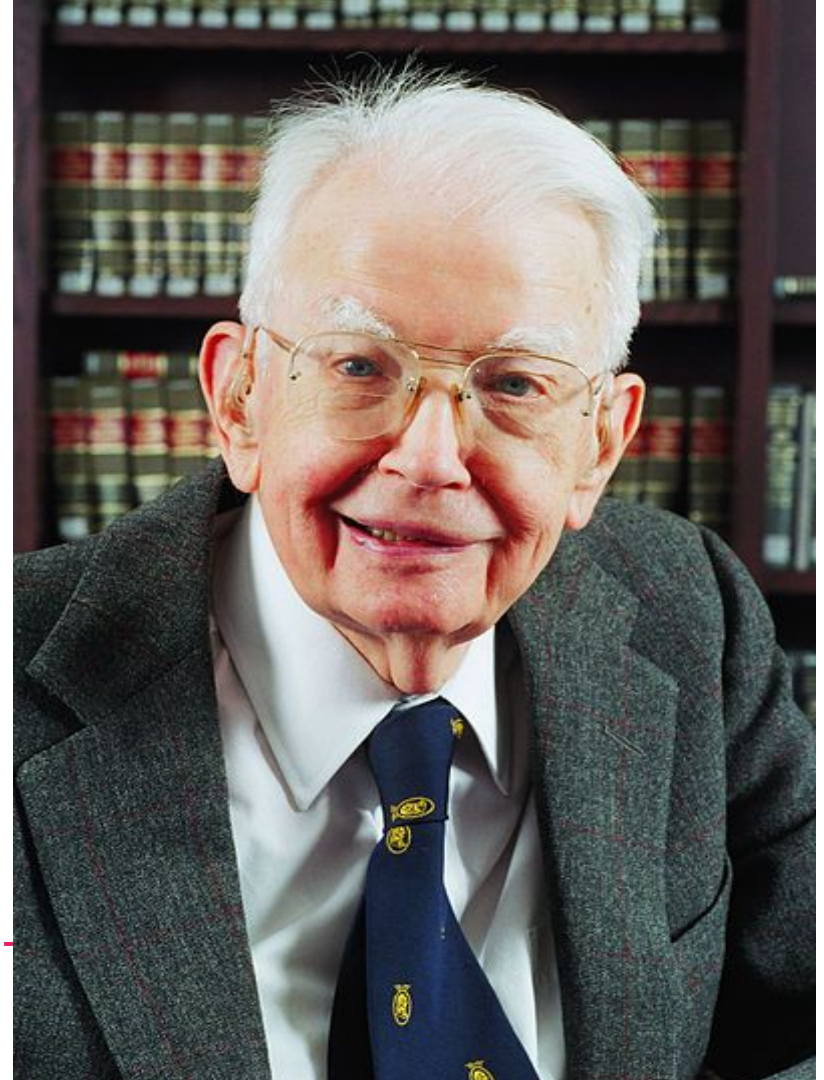
# How do we solve coordination problems?



## The Nature of the Firm

By R. H. Coase

Economic theory has suffered in the past from a failure to state clearly its assumptions. Economists in building up a theory have often omitted to examine the foundations on which it was erected. This examination is, however, essential not only to prevent the misunderstanding and needless controversy which arise from a lack of knowledge



# Markets vs. firms...

from Lee & Vonortas (2004). *Business Model Innovation in the Digital Economy*. p. 174

*"Transaction costs theory (Coase, 1937; Williamson, 1975, 1985) suggests that a firm will tend to expand precisely to the point where "the costs of organizing an extra transaction within the firm become equal to the costs of carrying out the same transaction by means of an exchange on the open market."*

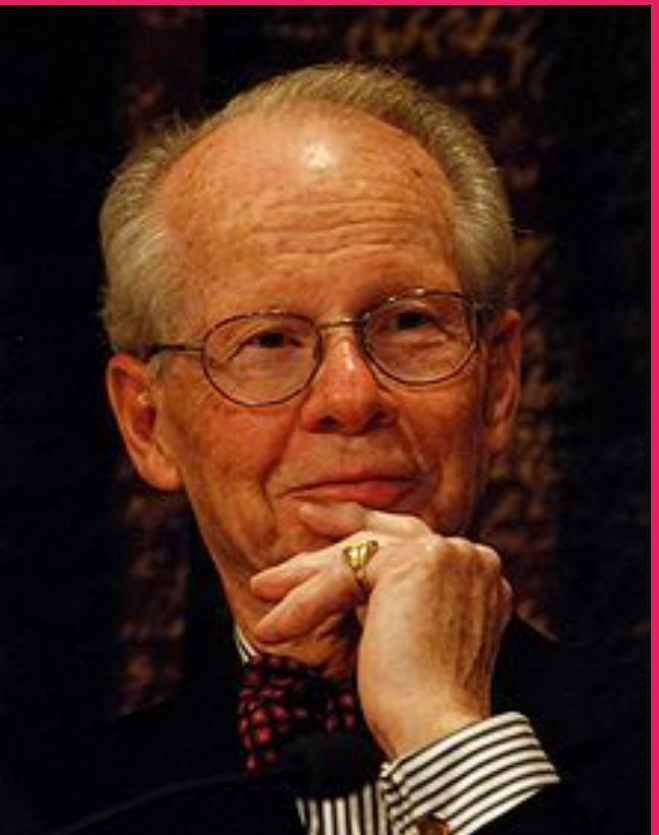
# … or Blockchain: The third way

Source:Blockchains and the Boundaries of Self-Organized Economies: Predictions for the Future of Banking

"Blockchain is fundamentally a technology of decentralization and is therefore better understood as a *new institutional technology* for coordinating people - i.e., for making economic transactions –which then *competes with firms and markets."*

# The impact of falling transaction costs on governance

# Williamson on Governance



*Governance structures are ''‘institutional arrangements serving public interests’.*

*According to Williamson (1985), Governance means to* "organize transactions in order to minimize transaction costs"

Source: European Journal of Law and Economics (2005): Is Transaction Cost Economics Applicable to Public Governance?

**Hypothesis: Peer-to-Peer Transactions without a middleman**

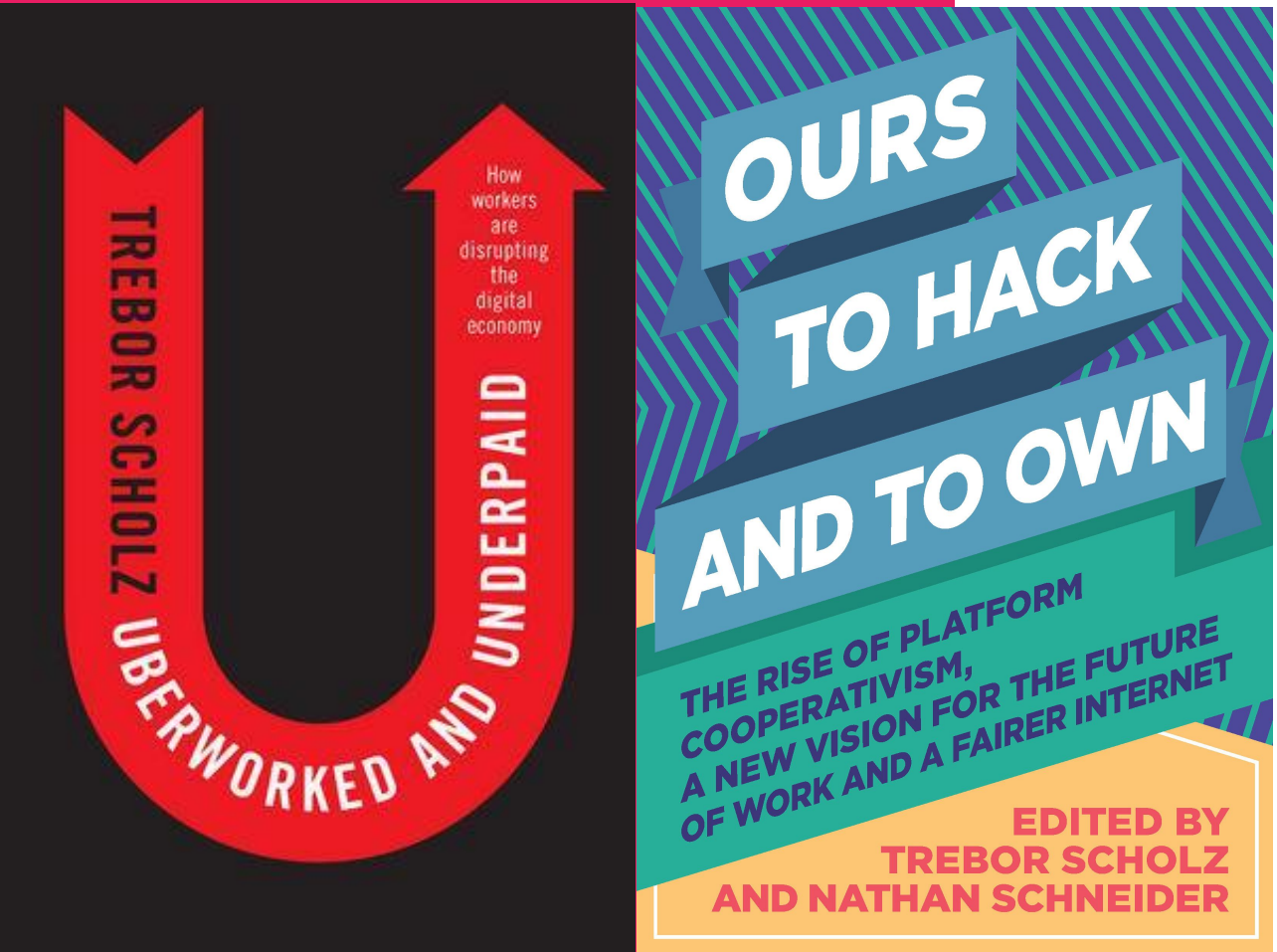
= Democratization of the energy sector

# The Platform quote that became an Internet Meme:

Source: *Tom Goodwin, Havas Media, 3.3.2015, "The Battle Is For The Customer Interface"*

*"Uber, the world's largest taxi company, owns no vehicles. Facebook, the world's most popular media owner, creates no content. Alibaba, the most valuable retailer, has no inventory. And Airbnb, the world's largest accommodation provider, owns no real estate. Something interesting is happening."*

# **Disrupting the Disruptors:**
# **Peer-to-Peer** Transactions
# without a middleman on the blockchain




*"Every Uber has an Unter"*

Trebor Scholz

# From aggregation economy...

Tapscott & Tapscott: Blockchain Revolution (2016)

*"Today's sharing economy is "a nice notion (...). But these businesses have little to do with sharing. In fact, they are successful precisely because they do not share - they aggregate."*

# NETWORKED MONOPOLIES

## THE PROCESS OF CROWDSOURCING MONOPOLY POWER

BUDDING NETWORK EFFECT

GROWING NETWORK UTILITY

FULL-FLEDGED NETWORKED MONOPOLY

# … to a real sharing economy

Tapscott & Tapscott: Blockchain Revolution (2016)

*"Imagine instead of the centralized company Airbnb, a distributed application - call it blokchain Airbnb or bAirbnb - essentially a cooperative owned by its members."*

# BUSINESS LANDSCAPE

## A COMPARISON OF EXISTING AND EMERGENT BUSINESS MODELS


### TRADITIONAL

Business model is based on resource extraction. Value is created by products or services. Consumers and workers have minimal power over technology.

### PLATFORM

Not based on extraction. Value is created by users sharing content in an online network, giving them power over technology to communicate.

### SHARING PLATFORM

Consciously not based on resource extraction, but rather on facilitating the exchange of resource. Value is created by users - consumers and workers - sharing access to underused assets or human resource as part of an online network. An intermediary connects users and oversees activity on a platform, but users have some power over technology to change how they live and work.

### CO-OPERATIVE SHARING PLATFORM

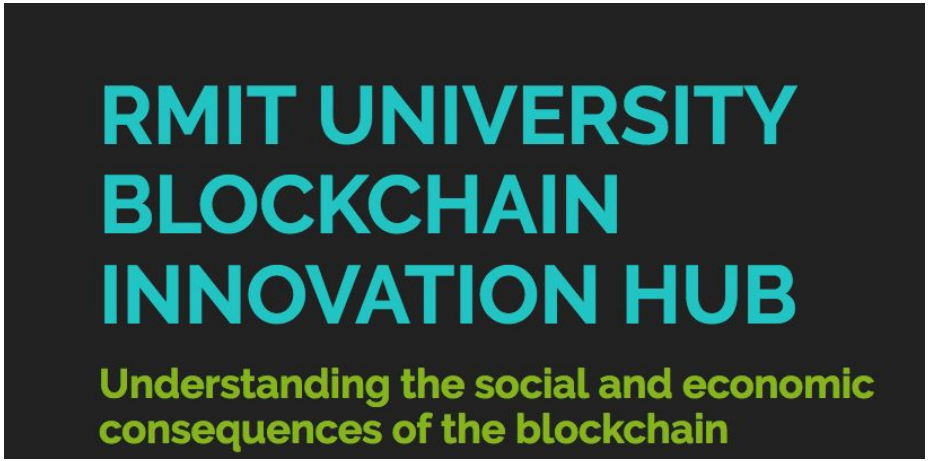
Similar to a sharing platform, but the online network is co-operative. No intermediary is needed, in some cases because of blockchain technology. Users, but particularly workers, have power over technology to change how they live and work.

# Blockchain as Commons 3.0

Source: Potts, De Filippi & Davidson: The Economics of Blockchain (2016)

*"Blockchain is Commons 3.0 in that it provides a technical solution (cryptographic consensus) to the problem of cooperation in joint or group production at scale (...)"*

# Research




http://sites.rmit.edu.au/blockchain-innovation-hub/

# DENMARK:
# The Energy Collective

DTU - Technical University of Denmark
http://the-energy-collective-project.com/

## Professor: Deleøkonomi på vej i elforsyningen

Privat ejerskab af solceller og batterier åbner muligheden for at decentralisere
demokratisere elforsyningen på en helt ny og 'disruptiv' måde, mener DTU-pro

Af Sanne Wittrup Følg @Swittrup 12. feb 2017 kl. 14:00

# Thank you!

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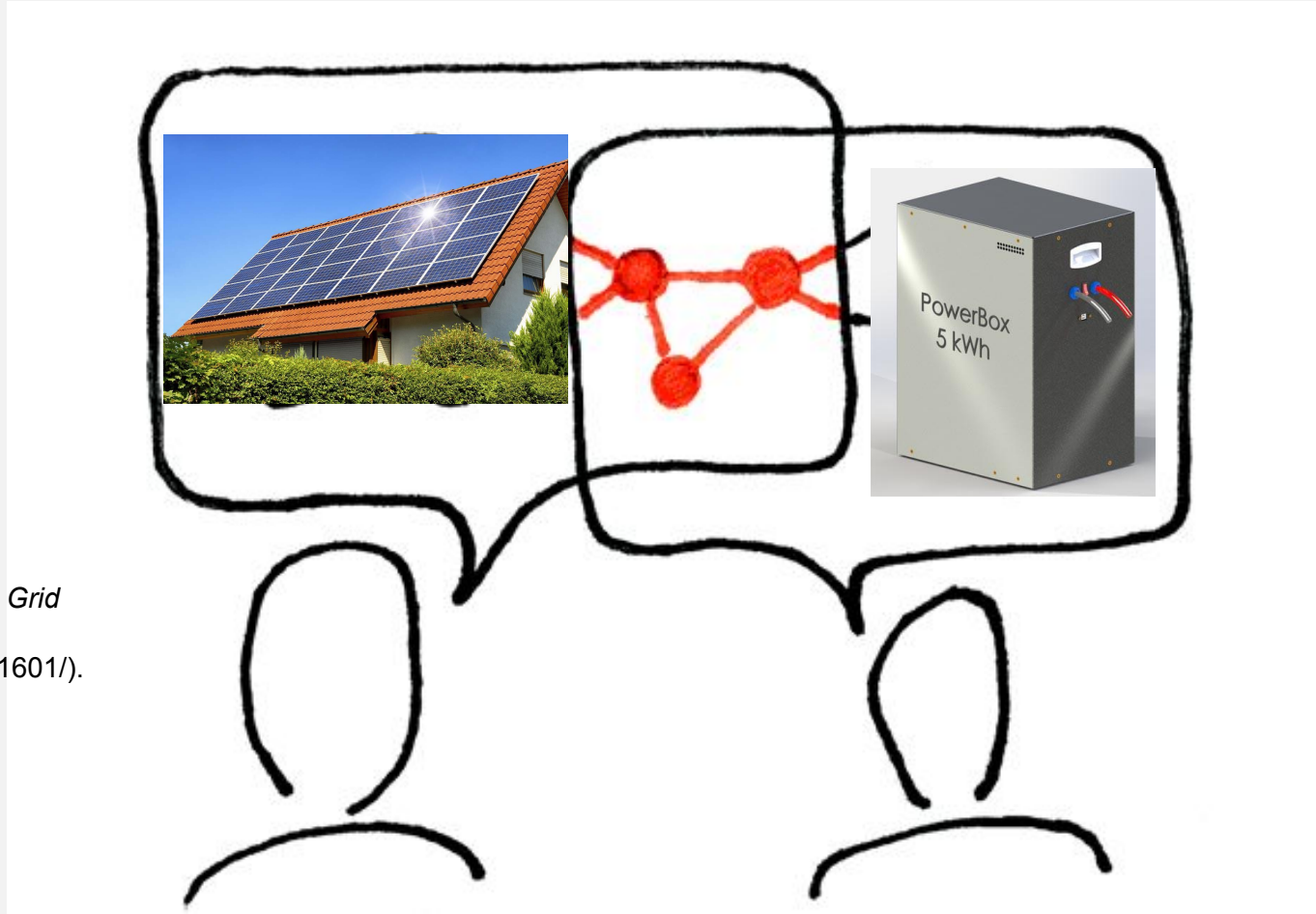
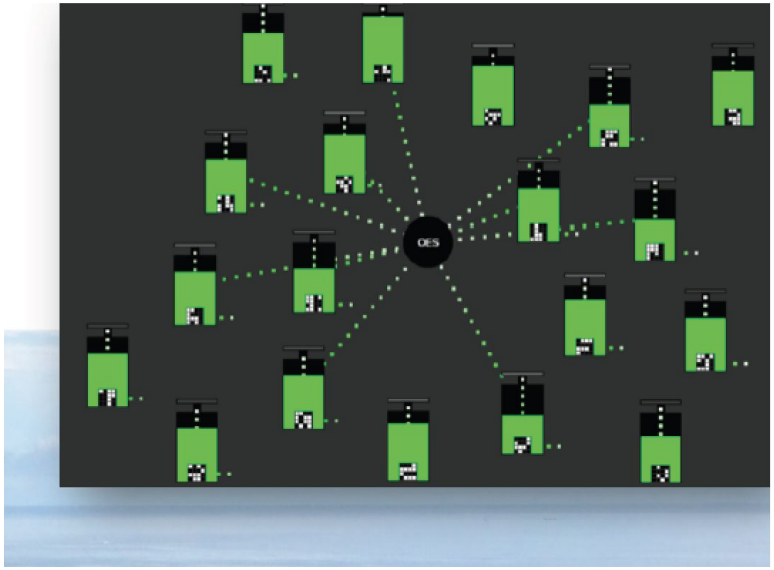
# Extra slides

# The AC/DC coin - a first simulation




Based on:
Werth, Annette, Alexis Andre, et al. 2016. “Peer-to-Peer Control System for DC Microgrids.” *IEEE Transactions on Smart Grid* 1–1. Retrieved (http://ieeexplore.ieee.org/document/7781601/).

# Background: P2P electricity exchange is already possible…



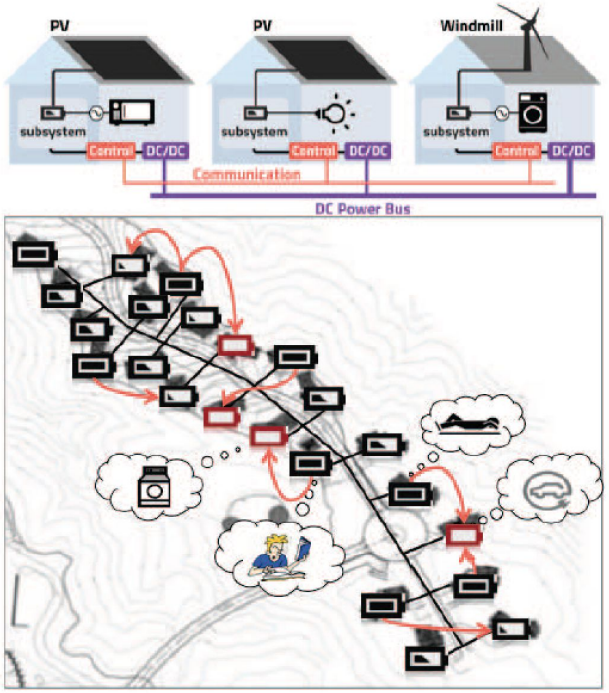
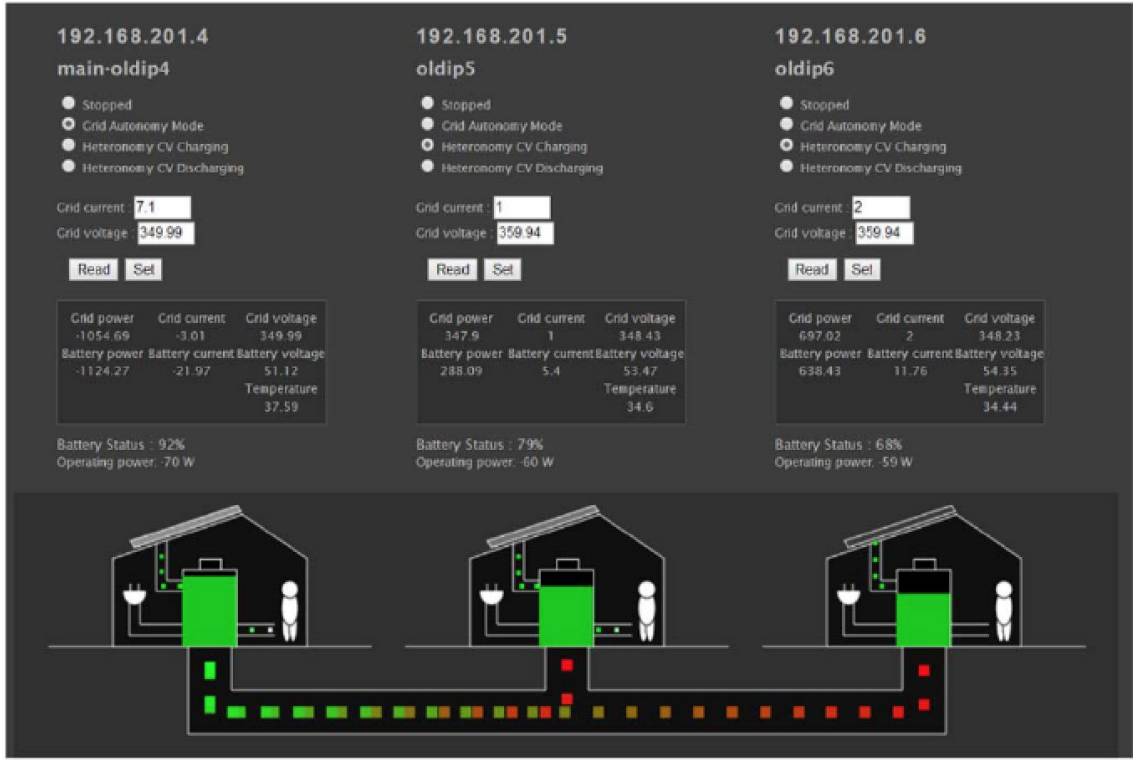



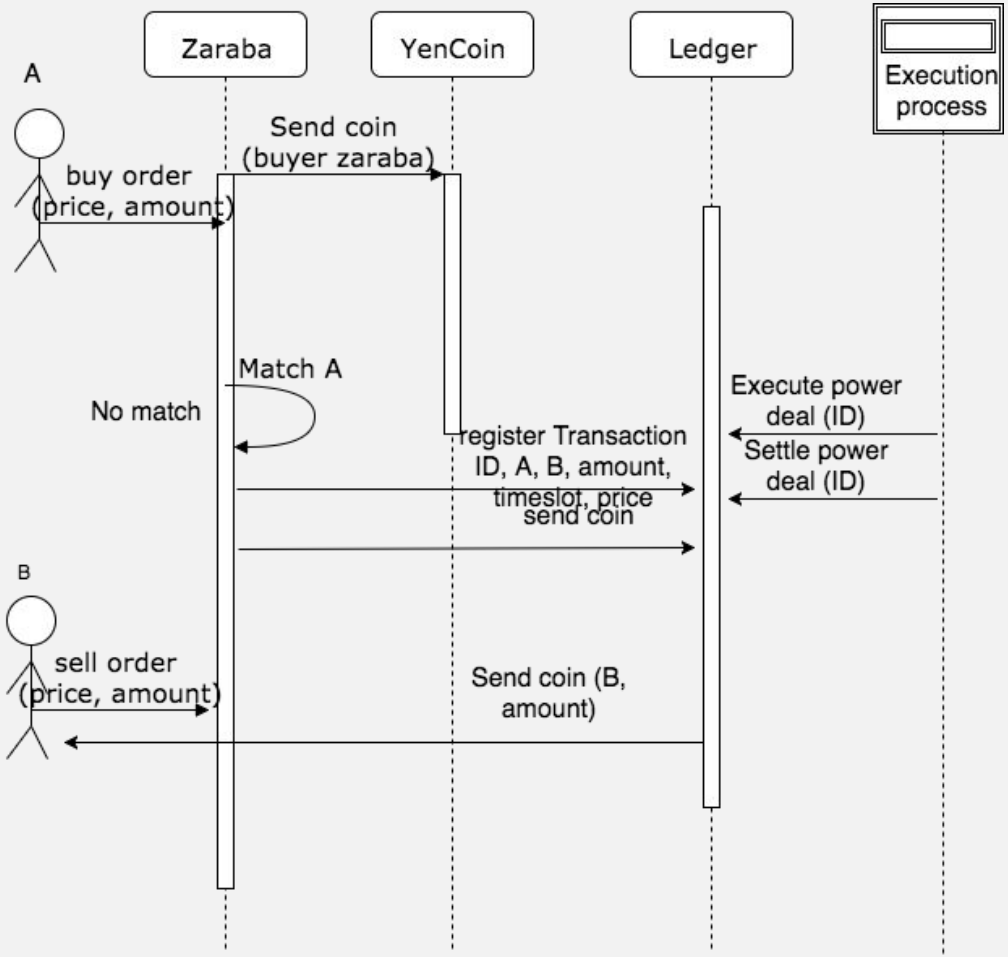

Fig. 1. Basic architecture for two layers. *Top*: Connection between DC subsystems. *Bottom*: Concept illustration for autonomous power exchange based on battery SoC as decision variable

Prototype in Okinawa with 19 households

# … but no payments involved (“energy gifts”)



# Main Flow


Zaraba
YenCoin
Ledger
Execution process
A
Send coin (buyer zaraba)
buy order (price, amount)
Match A
No match
Execute power deal (ID)
register Transaction ID, A, B, amount, timeslot, price
Settle power deal (ID)
send coin
B
sell order (price, amount)
Send coin (B, amount)