12th SDewES Conference on Sustainable Development of Energy, Water and Environment Systems

12th SDewES Conference Dubrovnik 2017

October 4-8, 2017
Dubrovnik, Croatia

SCHEDULE

Note that some changes can still be made to the schedule. This page holds the current schedule of the conference. If you have any doubts or questions on the schedule do send an email to: sdeves2017@sdeves.org

Enter paper ID or surname and hit Enter

Wednesday, October 4

0800 - 1700 Registration
CONTENT:

1. Introduction: Motivation
2. Method of approach
3. How variable renewables impact prices in electricity markets
4. The core problem of capacity payments
5. The role of flexibility and sector coupling
6. Balancing groups: A future market design
7. Subsidizing RES: How long?
8. Conclusions
1. INTRODUCTION

Motivation:

* Climate change $\rightarrow$ Paris agreements

* Targets for renewables

* Competition & democracy

* It is not possible to squeeze variable renewables into the system by violence system integration
Introduction:
Electricity generation EU-28

- Solid Fuels
- Petroleum
- Gases
- Nuclear
- Renewables
Old thinking

- Generation
- Grid
- Supply
- Demand

Flexibility options
- Storage
Core objective

... to identify the major boundary conditions to integrate even larger amounts of variable renewables into the electricity system

Very important:

Our reflections apply in principle to every electricity system world-wide

.... are based on electricity economic point-of-view
2. METHOD OF APPROACH

• Identification of hourly residual load over a year for various scenarios with large quantities of variable renewables;

• Applying a fundamental model to calculate (static) hourly residual loads and electricity spot market prices;

• Integration of flexibility in a dynamic framework for price calculation;
Expectation of 

prices = Short-term marginal costs

(Short-term marginal costs = fuel costs)

due to huge depreciated excess capacities at the beginning of liberalisation!
3 HOW VARIABLE RENEWABLES IMPACT THE ELECTRICITY SYSTEM AND PRICES IN ELECTRICITY MARKETS
Example: prices without and with PV

Price = System marginal costs

Supply curve w/o PV

Price with PV!

PV

Supply curve w/ PV

Demand $D_t$
Key term of the future: Residual load
(base load is “dead”)

Residual load = Load – non-flexible generation

Under coverage
Excess electricity
Deviation from STMC-pricing in spot markets

Scarcity prices

Electricity price spot market

$p_{t1}$

New price spreads

$\rightarrow$ These price spreads provide incentives for new flexible solutions!!!!

Low average price (3cents/kWh)

Negative prices

$\rightarrow$
Remark: Cold - dark – Lull („Kalte Dunkelflaute“)

Maximum price: ca. 85 EUR/MWh
Classified residual load over a year

- Under coverage

- Surplus due to excess generation
Classified residual load

How to cover
Cold - dark – Lull („Kalte Dunkelflaute“)?
There are two extreme positions:

By a regulated capacity „market“ with STMC pricing?

or

By competition between supply-side and demand-side technologies and behaviour (incl. Storages, grid and other flexibility options) with correct scarcity pricing signals?
4 THE CORE PROBLEMS OF CAPACITY PAYMENTS

All regulatory capacity payments for power plants distort the EOM and lead to wrong price signals for all other options.

Price peaks at times of scarce resource should revive the markets and lead to effective competition.

We should strive to retain system resource adequacy by ensuring correct price signals and without capacity payments.
Cost duration curve

Ensure correct price signals!

Generators stay in the market if:

\[
\sum_{t=1}^{n} (p_{ele_t} \cdot q_{ele_t} - c_{f_t}) > (c_{cy} + c_{O&M_y})
\]
Given a price pattern, showing excess and scarcity prices it would be attractive for a sufficient number of flexible power plant operators to stay in the market!

→

REVISED ENERGY-ONLY MARKET
5 THE ROLE OF FLEXIBILITY AND SECTOR COUPLING

FLEXIBLE GENERATION

STORAGES (CENTRAL, DECENTRAL, POWER-TO-HEAT)

GRID EXTENTION

SMART GRIDS

DEMAND-SIDE MANAGEMENT (TECHNICAL)

DEMAND RESPONSE (PRICE SIGNALS)
Flexible coverage of residual load

- Extension Transmission grid
- Very high prices (2000 EUR/MWh!)
- Load reduction due to Demand response to prices
- Load reduction due to Demand-side management technical (e.g. cycling)

Flexible power plants

Capacity without ensured payments

Hours/year

Flexible coverage of residual load
Storing every peak?

High excess capacity at very few hours!

- e.g. 20% less capacity stored → 1% less electricity stored!
6. IS THE TIME FOR SUBSIDIZING RENEWABLES OVER?

As long there is no price on CO2 ….
Grid parity: PV-costs and household electricity prices

- Costs
- Household price

Grid parity

- Energy Economics Group
- TU Wien
Assessment of Grid Parity

\[ E_{\text{Own}} \times P_{HH} + E_{\text{Feed-in}} \times P_{\text{feed-in}} > \text{Annuity} \]

Savings/revenues

Costs

Grid parity term

Subsidy still necessary?
Share of own consumption
New Thinking: Making the electricity system more democratic

Flexibility options

Balancing Group/Supplier

Prosum-agers *

*) R. Green
Tenant electricity model and Blockchain

PV-System on the roof

Tenant electricity model: Contracted PV-electricity

Balancing Group/Supplier

Customer 1

Customer 2

Customer 3

Meter

Blockchain

Tenant electricity model:
Contracted PV-electricity
Peer-to-peer
7. CONCLUSIONS

- Sustainable electric. system → integration of a broad technology portfolio & demand-side options
- Larger market areas favourable
- Very important: correct price signals (incl. CO2)
- Most urgent: exhaust full creativity for flexibility of all market participants incl. decentralised PV systems
- Capacity payments: Any CP will distort the system towards more conv. and less RES capacity
- New key player: Balancing group (Supplier), no more the generator