Energy market on the move

Thinktank on Energy Market Reform
Phase 1 - The Electricity Market

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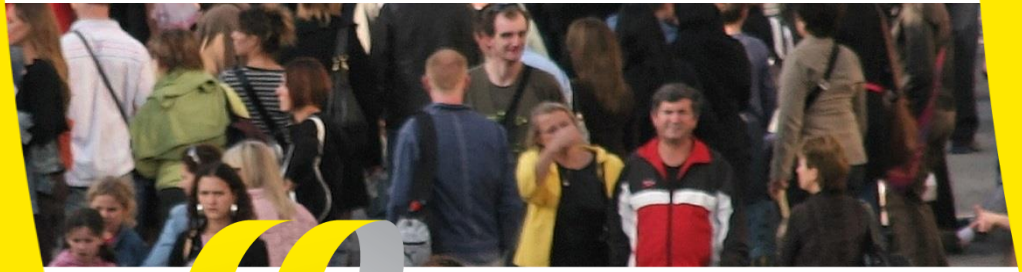


CE Delft

Thinktank on Energy Market Reform

Discussion of consequences for the energy system 2020-2030.

What's in store with market rules unchanged and growing penetration of new technologies?

- Large-scale generation becomes unprofitable.
- Numerous renewable, intermittent sources.
- Electricity prices sometimes very low or high.

What are the consequences for security of delivery?

- Who will still be investing?

What are the consequences for grids (gas, electricity, heat)?

What market rules need reforming to maintain an affordable, reliable and clean energy supply?

This report is the sole responsibility of CE Delft. While covering issues discussed by the thinktank, it does not necessarily reflect the opinions of all its members.

Why thinktank?

- Premise: The energy transition has major consequences for the energy system.
- Question: Does today's market need restructuring?
- Analysis: Does today's market structure properly incentivize market players to achieve a clean, reliable and affordable supply?
  - Electricity market trends 2020/2030:
    - more solar/wind (intermittent, limited price sensitivity); consequence: risk of overproduction of solar/wind; declining volumes and margins for conventional capacity; growing need for flexibility on various time scales;
    - more LV feed-in (exceeding grid capacity, systems operations in market segments);
    - changing sales patterns (electrification of heating & transport).
  - Heat market trends 2020/2030, particularly role of natural gas:
    - major CO_2 emission reductions;
    - electrification & heat supply.

- Relevant issues discussed by a broad group of partners.
- Collective discussion has increased understanding, but also spawned new questions.
- Discussion has clarified interrelationships between component issues.

Thinktank procedure

- Joint discussions by numerous stakeholders has improved understanding of the diversity and multiplicity of interactions between the various energy markets.
- For both electricity and gas/heat/transport, we have looked at potential trends in supply, demand, storage (short & long term), transmission, distribution, and social & political trends vis-à-vis sustainable development, energy efficiency, CO_2, customer interests (industry & consumers), market regulation targets, investment climate, business models, cost allocation, taxation, etc.
- Conclusion: for continued attainment of societal objectives (affordable, clean & reliable) changes to market rules are desirable and necessary.
- This report concerns Phase 1, focused on the electricity market. The report on the gas/heat market follows mid-2015.

Premise: major changes in energy system

It is in society's interests to have an energy system that is:

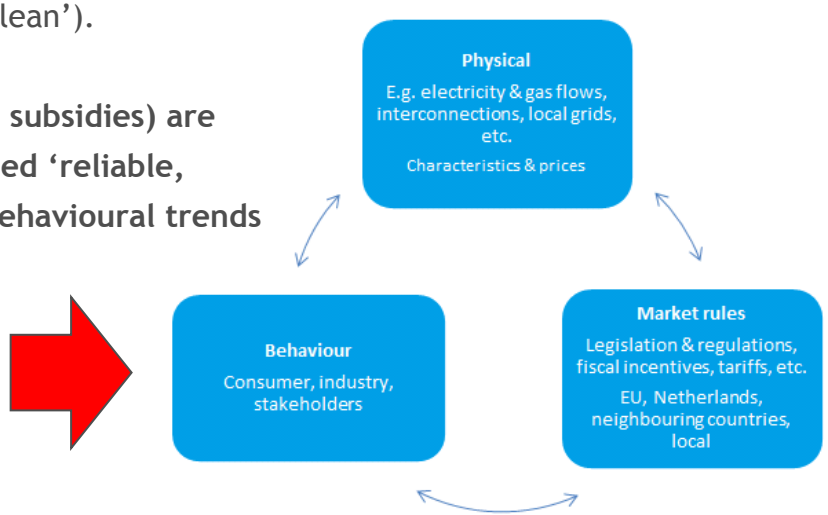
- Reliable.
- Affordable.
- Clean.

The balance between these three elements is a political choice, following debate within society, which may change over time.

What are the impacts of:

1. Physical trends (technology, society…).
2. Behaviour/choices (by small- and large-scale energy users).
3. Market rules.
4. Changing societal objectives (in particular: 'clean').

What changes to market rules (including taxes & subsidies) are necessary and/or desirable to guarantee continued 'reliable, affordable & clean', regardless of physical and behavioural trends and societal objectives?

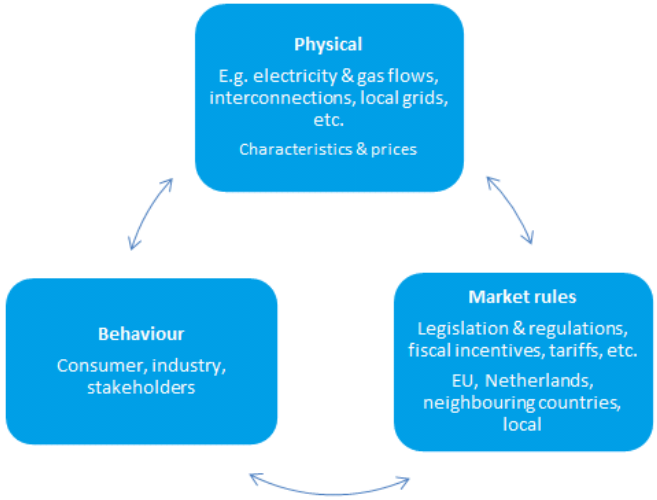


Societal objectives

- High degree of reliability.
- Competitive energy costs for industry, affordable for households.
- CO_2 targets:
  - EU target: 80-95%total CO_2 emission reduction in 2050, 40% in 2030, 20% in 2020 (rel. to 1990);
  - EU-ETS in force for industry & electricity producers;
  - but built environment & transport also have targets to meet .
- Renewables:
  - 20% average share of renewables in 2020:
    - for the Netherlands: 14%.
  - SER agreement has 16% target for 2023;
  - EU has a 27% target for 2030.
- Energy efficiency:
  - 20% efficiency gains in 2020;
  - 27% in 2030.

Physical trends

Given numerous autonomous physical trends, current market rules may no longer serve to secure societal objectives and may hamper exploitation of opportunities emerging as a result of physical trends.



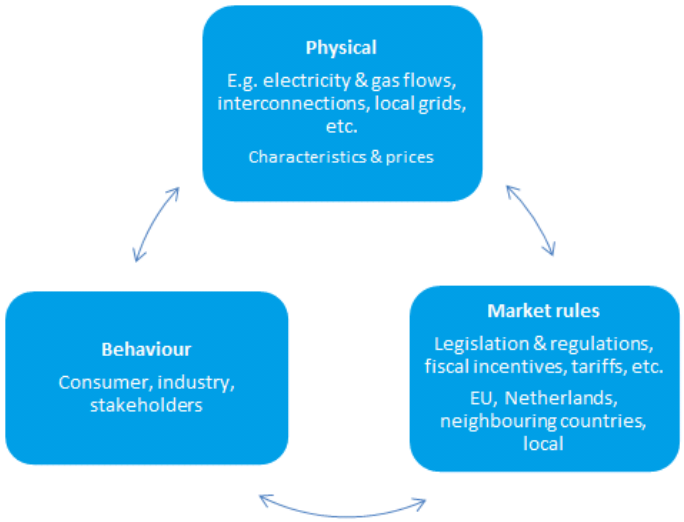
- Technological innovation:
  - vastly more efficient technologies (LED, domotics).

- Cost-cutting technologies:
  - solar PV, wind, electrical/hydrogen vehicles, energy storage.

- More distributed heat/power production plant.
- ICT developments, big data.
- LNG in freight transport, CNG in passenger transport.
- Technological trends affect choices by consumers, industry & stakeholders, both positively and negatively.
- Technological trends are stimulated or hampered by existing market rules and impact the balance between the objectives of ‘clean, affordable & reliable’.

Demand-side trends

- Citizens and industries are changing their energy consumption behaviour:
  - making greater use of (new) technologies;
  - producers as well as consumers;
  - undermining current consumer profiles; or
  - (unconsciously) generating costs not offset by benefits.

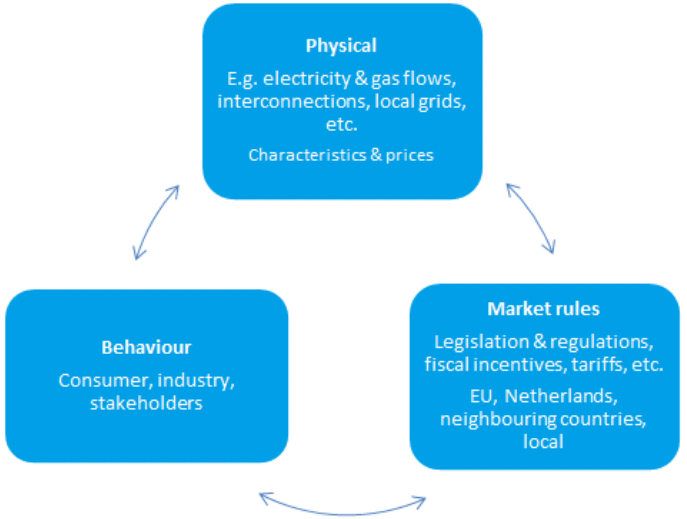


- Increasingly, citizens and industry are seeking:
  - to make their own moves to meet energy needs;
    - more distributed production plant for heat and/or power;
  - technical understanding and consumption control options;
  - privacy, but are often unconcerned about personal data on internet.
- Diversity of needs and behaviour is growing, as is conviction that all needs should be met and all behaviours facilitated.
- Barriers to meeting new needs and responding to new demands-side behaviour are often institutional; technologically there is vast potential.

Analysis of market rules

Changes in the three dimensions analysed for :

- electricity market;
- heat market (low- and high-temperature), where gas is now the main energy source.



Electricity market

- Numerous physical trends, limited demand-side change, new societal objectives.
- Without market rules being changed to maintain affordability & reliability.
- Increasing international market interconnection, so changes also required on international scale.

Heat market

- Numerous physical possibilities, limited demand-side change, but above all still no clear change in market rules for securing societal objectives on 'clean' (mainly CO_2 emission reduction).
- Still too little incentive for achieving desired transition in heat supply.
- 'Affordable' and 'reliable' are therefore not (yet) problematical.
- No level playing field for the diverse energy carriers due to differing legislation and fiscal rules.

Electricity market (summary)

- Changes in electricity market (1+2)
- Escalation of impacts of solar PV
- Escalation of impacts of wind power
- Need for flexible solutions
- Need for investment security
- Core issues

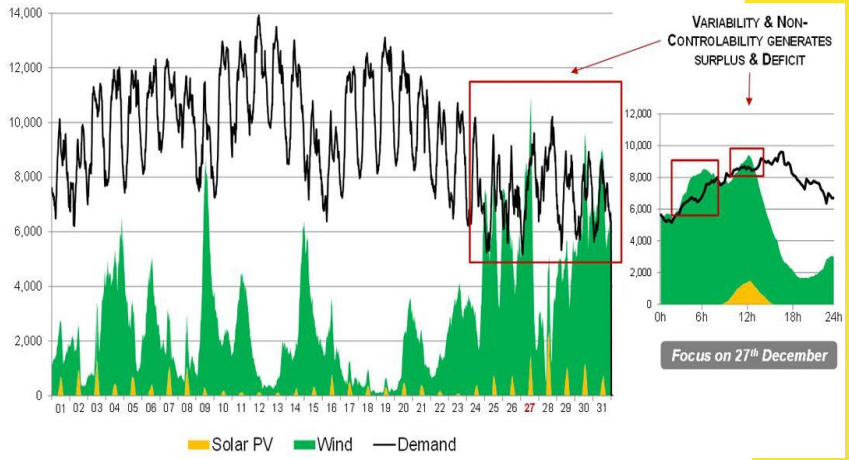
Changes in electricity market (1)

- Overriding factor driving fundamental change in electricity system dynamics is growth of intermittent sources (onshore and offshore wind, solar PV). In Germany today, solar and wind output already exceed demand during certain periods. This is in store for the Netherlands, too.

Consequences:

- Depending on weather conditions, either surplus or deficit of output from renewables.
- Frequent simultaneity of wind/solar leads to substantial decrease in market value of renewably sourced power.
- Subsidies for wind and solar PV will therefore rise.
- Profitability of conventional capacity will fall.
- Consequences for security of delivery?

- *See also Appendix 1, Structural changes in the energy market.*



Changes in electricity market (2)

- Besides growing share of solar and wind, also other developments:
  - energy consumers will be investing increasingly in local (heat & power) plant;
  - in certain areas, solar PV can lead to substantially heavier loads in LV grids;
  - electrical heat pumps require more robust LV grids:
    - at present, users have no incentive for demand-shifting
  - electric transport may drive major increase in demand, necessitating grid reinforcement.
- Grid costs may rise substantially, though extra capacity is used only limited hours per year.

- Dutch 'Programme Responsibility' system is working well.
- Cost causation and tariffs are no longer always in line.
- Standard profiles of small-scale consumers are no longer realistic if they switch *en masse* to new technologies like solar PV and heat pumps (electrical or other).

Example: impact of solar PV

Solar PV contributes to ‘clean’, but means escalation for ‘reliability’ and ‘affordability’.

Cost-price reduction

Uniform profile

Growth of solar PV

Clean

Grid reinforcement
Higher profile costs

Reliable

Affordable

Declining tax base

Net metering

Less government revenue or higher tax rates

Affordable

Losses for power suppliers

Example: impact of wind power

Wind contributes to ‘clean’, but means escalation for ‘reliability’ and ‘affordability’.

Affordable

Higher RE subsidy costs (SDE+)

SDE+

Declining value

Clean

Share of solar + wind

Surpluses

Deficits

Reliable

Flexible options

Lower costs for industry

Affordable

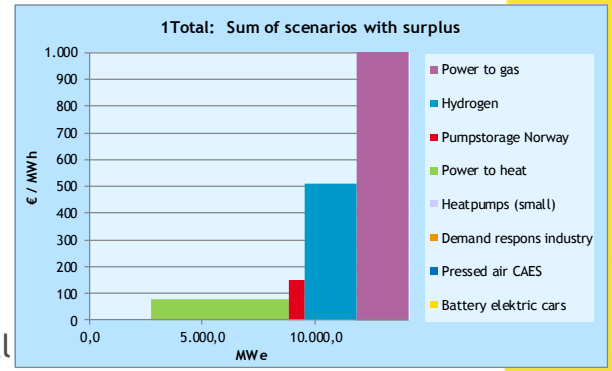
Declining profitability of power stations

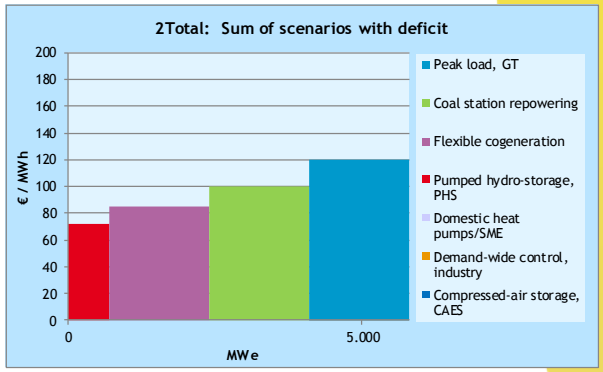
Affordable

Electricity market (3): Flex-options

- Cited trends create need for flexible options for continued match between demand and output.
- Flexible options for solar/wind surplus:
  - extra demand (substitution, demand-shifting, to storage);
  - output reduction (ramping down of wind, curtailment of solar PV).
- Flexible options for deficits:
  - extra output (e.g. gas turbines, from storage);
  - demand reduction.
- Short term (hours, days) & long term (season).
- Both central and distributed.
- Fluctuating weather regime requires rapid-response flex-options.
- Local congestion (more output or demand than LV capacity and/or local demand) can be limited by local flexibility.
- Greater interconnection can increase security of delivery.
- Additional market mechanisms are needed to enable flex-options.

- *See also Appendix 2, Matching supply and demand.*

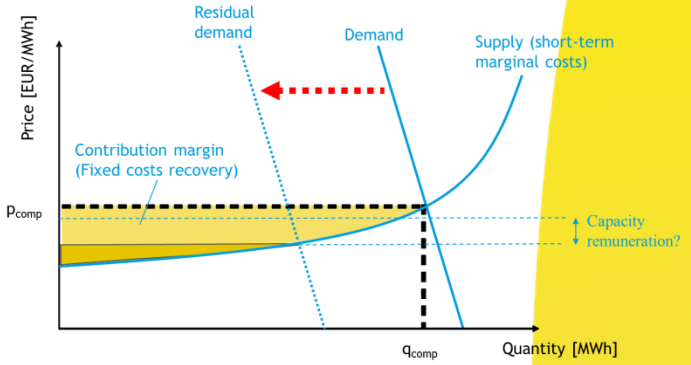


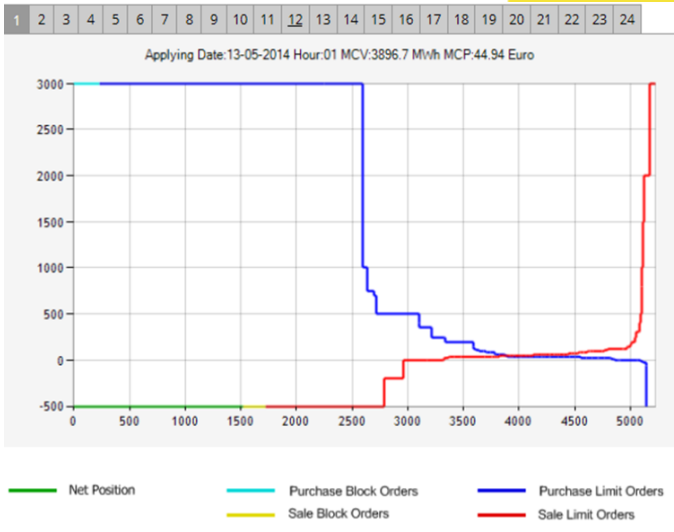


Electricity market (4): Investments

- New investments in conventional capacity, renewables and flex-options are uncertain.
- Conventional:
  - Scarcity pricing can make investment in new capacity profitable (500–2,000 higher-priced hours due to scarcity when solar/wind output are zero).
- Renewables:
  - Cost of solar/wind decreases with each extra kWh output.
  - However … value of kWh output also declines, through increase in simultaneity.
  - Continued subsidization of renewables? Motivation for investing in solar/wind?
- Grids:
  - Connection of local output means substantial rise in grid costs, for only limited number of hours' use annually.

- *See also Appendices 3 & 4.*





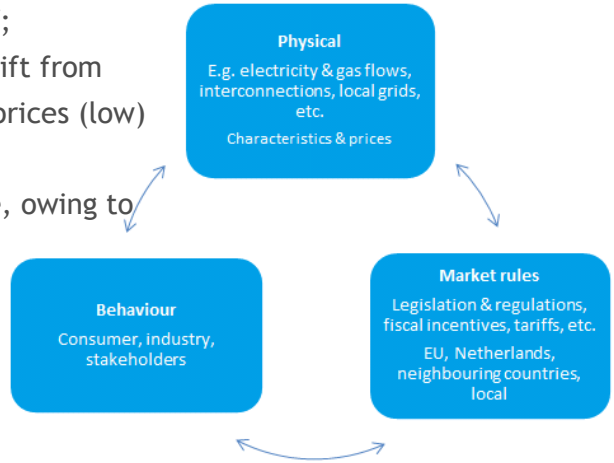
Electricity market (5): Conclusions

- Major changes with respect to physical potential, technologies and costs.
- Potentially major impacts on system reliability and affordability.
- Need for flexible solutions to maintain match between supply and demand.
- Major uncertainties about investments in renewables, conventional capacity and flexible solutions:
  - Current market mechanism: inframarginal revenues (particularly for base load) and scarcity revenues (particularly for peak & mid-load) are main motives for investment.
  - Current market conditions: surplus capacity (due partly to explosive growth of renewables) creates lack of incentive for investment in conventional capacity.
  - Robustness of dynamic efficiency of market mechanism: scarcity pricing may provide strong investment incentives, in the future too, but with a time lag. Mechanism gives no guarantee for continued security of delivery.
  - Besides scarcity pricing, capacity mechanisms may provide solutions, but with complex and far-reaching consequences.

Reflection: Core issues

- Mismatch between market rules, including taxes & subsidies, and societal objectives:
  - today's rules are inadequate for achieving 'affordable, clean & reliable' in the future.
- Electricity market is ever more international because of physical and market interconnection.
- Production, transmission and distribution need to be assessed in *integral* fashion.
- Described trends mean application of cost causation principle in current tariffs needs reforming.

- Examples where today's market rules plus physical and demand-side trends will create major challenges:
  - by 2025, variable solar and wind capacity will far exceed minimum demand;
  - need for flexibility (increased output and/or more/less demand);
  - local grids risk overload on sunny days → need for LV grid reinforcement, solar PV curtailment, storage in local grids, or distributed production;
  - decline in energy-tax revenues due to growing share of solar PV;
  - growing importance of *capacities*, alongside output volumes; shift from operating costs to capital costs; too much difference between prices (low) and costs (high);
  - renewables more heavily subsidized due to lower baseline price, owing to their growing market share;
  - declining profitability of power stations and wind farms.



Reflection (2): What needs to be done?

To secure all objectives (clean, affordable & reliable), market rules need reforming, according to three guiding principles:

1. Charge actual costs to those causing or saving them:
   - electricity consumers and producers should pay for true supply-chain costs:
     - periods of surplus → low price;
     - periods of scarcity → high price.
   - real pricing of emissions and other environmental impacts;
   - due allowance for undesirable distributive impacts.

2. Employ the same principles for all energy system users. Allow individual and regional parties, both existing and new, to generate electricity and thus flexibility on a level playing field, and use the grid for that purpose.

3. Guarantee profitability of investments required in renewable and conventional capacity and in flexible options.

Reflection (3): How does the market need to change?

- What other instruments can help maintain the match between supply and demand?
  - Time-indexed electricity pricing for larger group of consumers?
  - Pricing of generation capacity, energy and transmission capacity?
  - Individual freedom of choice for degree of security of delivery?
  - Open up the market to flex-options on user side by:
    - Separate market access for flexibility?
    - Specific grid tariffs for flex-options?
  - What business models are conceivable for conventional, flex and renewables?

- All the while, allowing for:
  - Equal opportunities for small-scale and large-scale options.
  - Energy-tax revenues.
  - Policies in neighbouring countries.

- A follow-up is in progress on trends in the low- and high-temperature heat market.

Thinktank on Energy Market Reform

Full report: www.ce.nl/ce/notities_+en+_presentaties/919

Appendix 1: Structural changes in the energy market

Appendix 2: Matching supply and demand

Appendix 3: Investment in conventional capacity

Appendix 4: Investment in renewable capacity

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