Dutch flexibility policy
An analysis of flexibility policy and regulation to accommodate variable renewable energy

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Introduction

Dutch electricity transition picked up speed
- Electricity generated by RE: 19% 2014 \(\rightarrow\) 41% in 2023
- New capacity dominated by (offshore) wind

Still strong reliance on gas for flexibility
- Seemingly low urgency for new flex solutions
- But not necessarily in 2030 (or 2050)

How do Dutch (and EU) policy and regulation address the effects of the integration of variable renewable energy on the flexibility of the power system?
- How to adapt policy, regulation, institutions, and markets?
- Positions and arguments in these discussions?
Method

Literature review

- Academic literature
- Dutch and Foreign policy papers
- Reports and position papers

Global energy transition
Dutch energy transition
Flexibility challenges
Flexibility options

Interviews

The positioning and priorities of stakeholders in the Netherlands in flexibility discussions

Not a single solution, but the landscape of interests and ideas
Flexibility:

– Flexibility: ability of the power system to match supply and demand economically and efficiently, both
  – Temporally: ability to match supply and demand in the time dimension
  – Spatially: ability to match supply and demand over space.

– Flexibility challenge: integrating flexible resources and limiting the increase in flexibility needs
... prognosis of energy mix in The Netherlands

Data by Schoots et al. (2016): the national energy survey.
Effects

– Energy supply
  – Ramping needs: In 2023 ±3 GW/h,
    In 2030 max ±8GW/h
  – Min. Residual demand: 2023 0,5 GW
    In 2030 ± -4 GW
  – Further flexible capacity reduction

– Frequency response
  – Increased balancing power needed because of forecast errors / uncertainty

– Congestion
  – Peaks on all grid levels increase
In economic terms

- Integration costs
  - The gap between market value of energy from a VRE technology and the average market price of electricity

- Merit-order effect
  - VRE have low variable costs $\rightarrow$ low bid prices
  - Lowest prices dispatched first
  - Increase in of VRE $\rightarrow$ Lower market prices

- Compression effect
  - Lower market prices cause decreasing capacity factors for e.g. gas-fired power plants

These depressing effects are limited by flexibility options
Interview results: challenges and priorities

– Firstly: No real problem, but “developments that need investments”

– Challenges and priorities
  – Most urgent challenge: congestion, certainly in distribution grids
  – Energy security issues might arise only from 2030
  – Balancing: enough capacity and flexibility

– Developments on track through well-functioning electricity market:
  – scarcity creates price and response

1: Wiersma, TenneT
Flexibility: General

- Most important
  - Demand-side management
  - Market Design

- Policy should not make technological choices, that is the role of the market.
  - Technology neutral
  - Creation of ‘level playing field’
Demand-side flexibility 1

- Dynamic tariffs
  - Effects probably limited for households
  - Incentive dampened by taxes and grid fees → variable tax?
  - Profit too small for manual operation → automation
  - Could induce further congestion in low voltage grid through “artificial peaks”¹
  - Possibly include variable grid fees as well

1: Van Melle, Ecofys
Demand Side Flexibility 2

– More important: aggregators
  – independent? Probably not necessary, just experience in creating “standardized agreements” ¹

– Power-to-x:
  – Tariff structure grid capacity: should vary to open business cases
  – Power to heat: Readily available infrastructure of CHP plants

¹: Samuel Glissman, TenneT
²: Sebastiaan Hers, CE Delft
³: David Plomp, Vattenfall and Jan Luuk de Ridder, EZ

Timme van Melle, Ecofys
Market design 1

– In General:
  – Quite well adapted, and constantly re-evaluated

– Access
  – Pretty well guaranteed
  – remaining barriers remain justified
  – Stimulate industry to actively enter (knowledge)
  – Back-door access through widely applauded passive contributions

– Completeness
  – 15-minute pricing: “Right balance”

– Market pricing
  – Prices caps reduce market effectiveness and should be maximized

1: David Plomp, Vattenfall
Market design 2

- VRE participation
  - SDE+ subsidy scheme well provides for market participation
  - Socio-economically: CO$_2$-pricing optimal $^1$

- EU market Integration:
  - XBID provides necessary ID market liquidity
  - Take away differences, towards a unified system: “independent regional grid operation”? $^2$

1: Frank Wiersma, TenneT  
2: Martijn van Gemert, Vattenfall
Market design 3: locational pricing

- Nodal pricing
  - Theoretically great $^1$ ⇔ politically unfeasible, questionable effectiveness
  - Neglects value of European integration and self-dispatch liberty
  - Big challenge for regulation, possibility of liquidity and market power issues
  - Little structural congestion $\Rightarrow$ small price differences $^2$
- Alternative: smaller bidding zones, partially same issues

1: Machiel Mulder, RUG; Diederik Klip, CIEP; Adriaan van der Welle, ECN  
2: Timme van Melle, Ecofys
Market design 4: capacity mechanisms

- Market wide capacity mechanism
  - Unanimously no wish for it
  - negative impact market: destroys scarcity pricing
  - inefficient
  - opposes technology-neutrality
  - wrong reasoning: over- not undercapacity

1: Machiel Mulder, RUG     2: Jos Sijm, ECN; Diederik Klip, CIEP; David Plomp, Vattenfal
System flexibility: congestion management?

- Grid strengthening
  - Mainly in distribution system
  - Just for small amount of hours per year

- Congestion management?
  - Should have more room when economically justifiable
  - Only in predefined set of circumstances: “strengthening, unless”
System flexibility 2

- **Storage**
  - No special status, should engage in level playing field
  - Not most cost efficient option

- **Import/ export:**
  - According to Jos Sijm (ECN): by far strongest flexibility option
  - Only useful in combination with market integration
  - Transmission should move to regional planning
  - As with strengthening: just for small amount of hours per year
Supply side flexibility

- Flexible resources are available, market should define economic solution
- No special regulation to keep flexible resources in the market, strong belief in incentive of scarcity prices
- We cannot look into the future: a technical system should not be designed, the market, however, should
- Coal phase out until 2030: gas flexibility moving towards other resources
Overarching discussions

- Socialization versus cost-causing principle
  - Socialization: everybody pays, value of equality
  - Cost-causing principle: distribution of costs according to use

- Decentralization versus centralization
  - Decentralization: clear connection between people and resources
  - Centralization: cost-efficiency

- Role of policy and regulation: market primacy versus active regulation
  - Market primacy: cost efficiency and incentive based creativity
  - Regulation: stronger control and creating socially acceptable system

- Level of policy making
  - Regional (EU), national (NL) or subnational regulation
Conclusion

- NL moving to (V)RE based system
- Leading to considerable changes in economics and necessary abilities of power system
  - Balancing, energy supply and congestion
- Plethora of flexibility solutions available
  - According to interviewees should not be chosen, nor designed, but selected by the market → market should allow maximum incentive
  - No radical change, rather a slow transformation
- Policy and regulation
  - Non-interventionism and optimism: level playing field, no panic
  - Focus: cost-efficiency, centralized system, towards regional regulation, application of cost-causing principle where desirable
Thank you
Additional slides
Driver: Increase of VRE in power sector...

Data by IEA (2016), CEC (2016), ERCOT (2016)
… plus a decrease in flexible capacity

Data from Entso-e (2016, n.d.)
Effects of VRE integration (2023)

Peak load
(<1500h)
2,5 → 5,5 GW

Middle load
(1500 to 7000h)
≈5 GW

Base load
(>7000h)
11 → 8 GW

By hers et al (2016)
Res. Load drops to 0.5 GW

Downward capacity needed (e.g. DSM or curtailment)

Flexible upward capacity

Significant decrease full-load hours

Effects of VRE integration (2023)

By hers et al (2016)
Flexibility options

Driver of increased flexibility needs

System of Flexibility options

Flexibility options

- Cause of fluctuations
  - Demand variability and uncertainty
  - Contingencies
  - Variable renewables

Fluctuations and needed response

- Power (MW)
- Energy (MWh)
- Ramp rate (MW/s)

Demand side flexibility
- Demand side management
  - Aggregation
  - End-use storage
  - Additional flexible loads
  - Vehicle integration

System flexibility
- Distribution system strengthening and Smart grids
- Market design
- Transmission system strengthening, automation, and import and export
- Energy storage and inertia
- Power system control

Supply side flexibility
- Renewable power plant flexibility
- Conventional power plant flexibility
- Resources diversity and energy mix optimization
Demand-side flexibility

- **Power to x**
  - gas, products, heat, cooling
  - Stimulation by e.g. tax reductions
- **Electric vehicle integration**
- **Dynamic pricing**
  - Enabled by smart-meter roll-out
  - Could be allowed or stimulated
- **Aggregation entities**
  - Independent aggregation discussion
Market design

- Market access
  - For DSM, aggregators
- Market completeness
  - Temporal granularity
- Pricing mechanisms
- VRES participation
  - Subsidy schemes, priority dispatch
- Market coupling/integration
- Representation of grid conditions
  - Nodal pricing?
- Capacity mechanisms
Stakeholder & Interviews

Interviews
- 12 interviews
- 19 people
- 1 - 2 hours per interview

Method
- Questions based on literature review
- record
- transcript
- Code transcripts
- analyze
System flexibility

- Grid strengthening and automation for temporal flexibility
  - Transmission, interconnection
    - smoothing effect,
    - decreasing correlation
    - preventing re-dispatch
  - Distribution grid
    - data provision to enable flexible demand
- Storage
  - Mainly for short-term variations
- For spatial flexibility
  - Congestion management
Supply-side flexibility

- Renewables
  - Exploit flexibility of VRE
  - Increase fully flexible RE

- Increase flexibility conventional park

- Diversification and optimization of supply resources
Interview structure

- Challenges and priorities
  - Urgency, readiness, roles
- Flexibility options
  - Priorities
  - One by one (DSM, Market, system...)
- Mix of general ideas and concrete discussions
- Additional
  - Additional remarks
  - feedback
Market design 2


Passive contributions: widely applauded, though might overshoot

Move to quarter-hourly products (ID already 15 min) → No regret.

Figure Based on data compiled by CE Delft and Microeconomix (2016).
Additional notes

- Risk of political intervention
  - Danger of reversing liberalization
  - Price peaks can be interpreted as insufficiency, should not lead to interventions

- Competition in flexibility needs:
  - TSO
  - Congestion purposes
  - Balancing responsible parties
  - Implicit versus explicit flexibility
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<td>Adriaan van der Welle, Jos Sijm</td>
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