



“Second opinion: cost compensation method for network operators with distributed generation”

On behalf of Energiekamer, NMa

Final Report

Bonn, 5.03.2010

E-Bridge Consulting GmbH
www.e-bridge.com
Tel.: +49 228 90 90 6-0
Fax: +49 228 90 60 6-29

E-Bridge
competence in energy

Disclaimer

Contents

Distributed generation is not adequately considered in today's regulatory framework

- A significant amount of generation capacity is connected to the distribution networks in The Netherlands. This generation capacity is referred to as "distributed generation - DG". The amount of DG varies significantly among the distribution network operators (DNO).
- There are no feed-in tariffs for the use of the network - neither for centralized nor decentralized generation - nor is DG considered in the determination of the regulated revenues of the DNOs. The regulated revenues of a DNO depend solely on its demand and do not consider any connected generating capacity.
- However, DG influences the network design and operation and therefore has an impact on the DNO's costs. These additional costs resulted already in financial problems, for instance for Westland Infra. Energiekamer reduced the x-factor of Westland Infra by nearly 6 % in order to keep the company financially viable. However, this is considered a temporary solution only and Energiekamer seeks a structural and sustainable solution to deal with distributed generation in the future.
- Energiekamer asked *Netbeheer Nederland* to develop an appropriate approach to consider distributed generation in the calculation of the allowed revenues ("*Samengestelde Output*"-SO). *Netbeheer Nederland* developed an approach and responded to the request of Energiekamer on December 8, 2009.
- Energiekamer asked E-Bridge to provide a limited review of the approach developed by *Netbeheer Nederland* in form of a "second opinion".

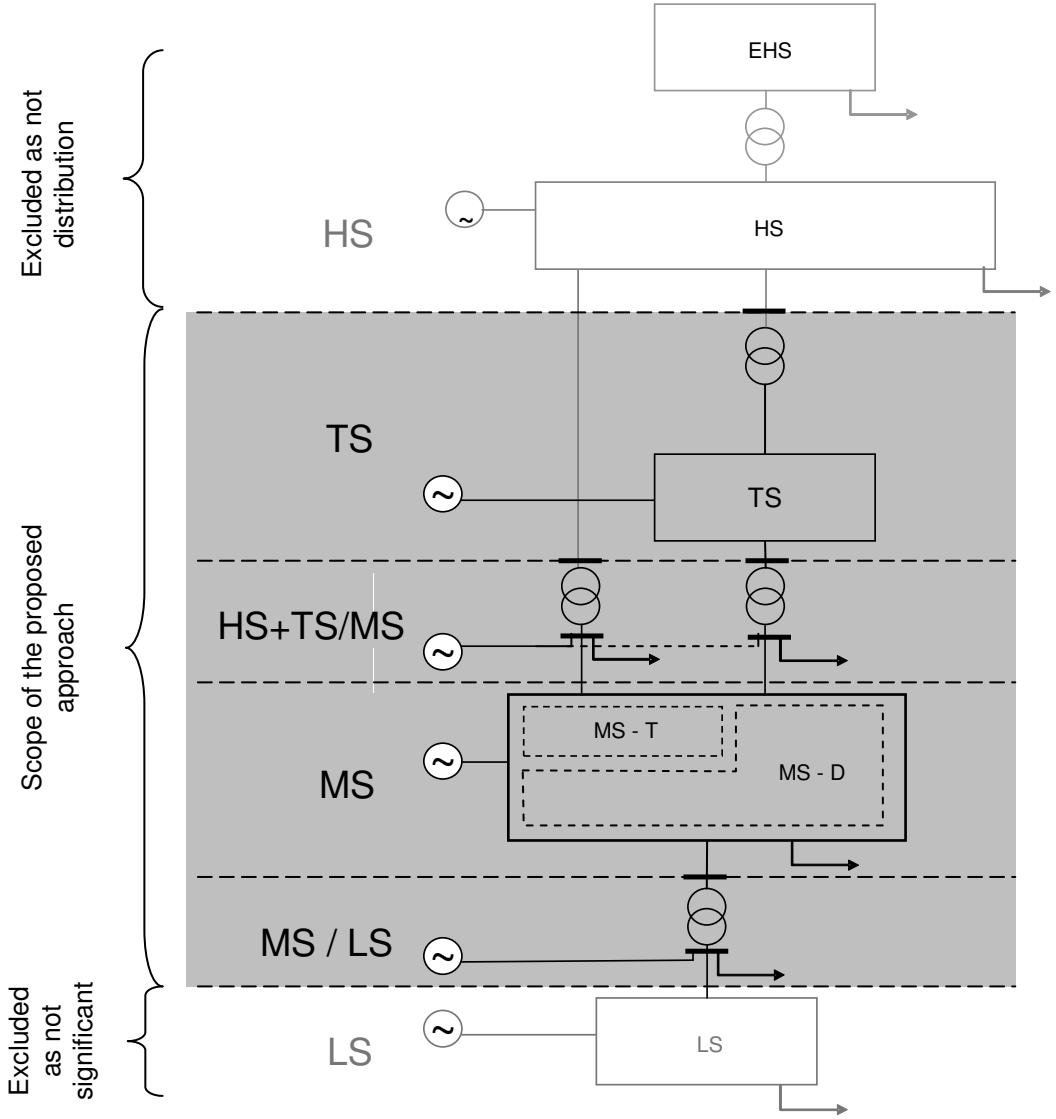
Focal Point of the regulatory approach is a modification of the *Samengestelde Output*

Four regulatory options to consider distributed generation in the allowed revenues:

Option A Feed-in tariffs	Option B Modified *Samengestelde Output*	Option C *Objectiveerbare Regionale Verschillen*	Option D *Aanmerkelijke Investeringen*
Feed-in tariffs for DG lead to a) a participation of distributed generators in the network costs and b) to a modified efficiency assessment through a modification of the average sector tariffs ("gemiddelde sector tarieven-ST"). As this option requires a revision of the current legal framework, it is not (yet) considered for implementation.	DG is considered in the calculation of the aggregated output (SO). This option is a preferred option of Energiekamer and it falls within the boundaries of the current legislation. It constitutes the focal point of the proposed approach.	The additional costs incurred by DG are tagged as "*objectiveerbare regionale verschillen-ORV*". ORV are compensated on cost basis. Additional costs of DG would not be considered in the x-factor calculation. This option may not comply with the criteria of ORV and is not a preferred option of Energiekamer.	The additional investment costs associated with the expansion of DG are tagged as "*aanmerkelijke investeringen – AI*". AI are regulated on cost basis. The costs associated with the expansion of DG do hardly comply with the criteria of AI. While AI may be applied under extraordinary circumstances, it is not an appropriate mean to regulate the common costs of DG.

This report focuses on Option B and shall evaluate, if the approach developed by *Netbeheer Nederland* provides an acceptable solution to compensate for the costs incurred by DG

DG refers to generating plants connected to any network level between TS networks and MS/LS transformer stations



Assumptions

- Basis of the analysis is the approach developed by *Netbeheer Nederland* and described in the presentation "*Methode ter bepaling van de compensatie voor netbeheerders voor invoeding op regionale netten*", dated 30 November 2009.
- Also, one discussion meeting took place with Energiekamer on 2.02.2010.
- A meeting with *Netbeheer Nederland* has not been arranged. Energiekamer may consider to discuss the interpretation of the proposed approach and the evaluation with *Netbeheer Nederland*, before drawing final conclusions.

1. Background and Scope of the report

2. The proposal of *Netbeheer Nederland*

3. Evaluation of technical cost drivers

4. Summary

The main cornerstones of the proposal of *Netbeheer Nederland*

Main Assumptions	Regulatory Model
A kW of distributed generation has the same impact on the costs of an infrastructure as a kW of demand.	The DG sector tariff is calculated on the same basis as the demand sector tariff
Distributed generation above a certain level may lead to increased costs of the upper network level.	The sector tariff for DG shall reflect the costs of the connection network level as well as the costs of the next upper network level.
Extra costs occur only in case generation is larger than demand at a specific connection.	Only consider generating capacity exceeding demand (annual maximum capacities) at specific connections.
DG shall only be considered if it has a material effect on the cost allocation and if it is objectively measurable.	Only distributed generation with a capacity of more than 100 kW is to be considered.

The proposal of *Netbeheer Nederland* leads to a new term in the SO formula

$$SO_n = \sum_j \left(\frac{\sum_i \ddot{\bar{p}}_{i,j} \cdot \ddot{r}v_{i,j}}{\sum_i \ddot{r}v_{i,j}} \cdot \ddot{r}v_{n,j} \right) + \sum_k ST_k^{DG} \cdot Vol_{n,k}^{DG}$$

(1) $\frac{\sum_i \ddot{\bar{p}}_{i,j} \cdot \ddot{r}v_{i,j}}{\sum_i \ddot{r}v_{i,j}}$ = ST_j (2)

(5) = SO_n; (3) = ST_k^{DG}; (4) = $Vol_{n,k}^{DG}$

SO = aggregated output
$\ddot{\bar{p}}$ = tariffs
$\ddot{r}v$ = volume
i = network operator
j = tariff element (demand)
k = tariff element (generation)
ST = sector tariff

1 The total revenues	2 The average sector tariffs (demand only)	3 The sector tariff for distributed generation	4 The volume element for distributed generation	5 The *samengestelde output*
▪ The costs of each network level are cascaded down. ▪ The total revenues of each network level should in principle cover the costs of this network level plus the costs cascaded down from upper levels.	▪ The average sector tariff (ST) for each tariff element of a network level is calculated by dividing the aggregated revenues by the respective total volumes[1)].	▪ The sector tariff for DG reflects the costs of the connection network level plus the costs of the adjacent upper network level(s)	▪ The volume of DG is the maximum contracted feed-in exceeding the maximum contracted load.	▪ The aggregated output of each network operator ("samengestelde output - SO") is the sum of the product of the sector tariff times the individual volume of all tariff elements.

New DG term in the SO formula

1): Please note that is not clear if the proposal of *Netbeheer Nederland* also suggests to change the current sector tariffs for demand. We assume that the current sector tariffs for demand shall remain unchanged. It is important that this interpretation is confirmed by *Netbeheer Nederland.*

1. Background and Scope of the report

2. The proposal of *Netbeheer Nederland*

3. Evaluation of technical cost drivers

4. Summary

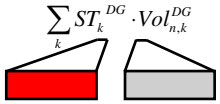
The evaluation will analyze the DG sector tariff and the DG volume factor separately

$$SO_n = \sum_j \left(\frac{\sum_i \ddot{\bar{p}}_{i,j} \cdot \ddot{r}v_{i,j}}{\sum_i \ddot{r}v_{i,j}} \cdot \ddot{r}v_{n,j} \right) + \sum_k ST_k^{DG} \cdot Vol_{n,k}^{DG}$$

Does the DG tariff factor appropriately reflects the specific DG costs?

Does the DG volume factor appropriately mirrors the relevant cost drivers of additional DG?

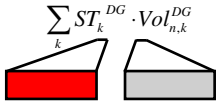
The calculation of the DG sector tariff - Overview



Cornerstones of the approach	Evaluation
▪ The DG sector tariff is a postage stamp rate, which is based on the costs of a network level divided by the sum of maximum connection capacities at the connection points.	▪ The network and transformer station costs are driven primarily by the number and maximum capacity of the connection points. The use of the annual peak capacity seems therefore **reasonable**.
▪ The DG sector tariff shall reflect the **net** costs of a network level only. Net costs are the costs of a network level, excluding any cascaded costs from upper network levels.	▪ This assumption is **reasonable.**
▪ The DG sector tariff shall reflect the net costs of the connection level as well as the net costs of the adjacent upper network level(s)[1)].	▪ Strong feed-in from DG may have an impact on the costs of the upper network levels. It is a **simple and pragmatic** approach to consider only the adjacent upper network level(s)
▪ The net costs are estimated as the difference between the postage stamp rate of the connection level (including cascaded costs from upper network levels) and the postage stamp rate of the adjacent upper network level.	▪ This approach will be analyzed on following slide.

1) Actually, the costs of the HS level are not cascaded down for connection to the TS level and the costs of two upper network levels (the HS+TS/MS level as well as of the MS-D level) are cascaded down for connections to the MS/LS level.

The proposed method to estimate the net network costs lead to structural underestimation of the DG sector tariff



The DG sector tariff shall reflect the net network costs of the connection level and the adjacent upper network level. This calculation method is based on two assumptions.

Assumption A
The cascaded volume is the same as the volume in the connection level

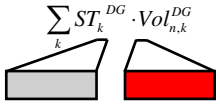
- The sum of the maximum demand capacities of each connection point of a network level is usually higher than the maximum demand at the connection to the upper network level. The reason for this is that the maximum demand at all connection points do not occur at the same time.
- The same applies to generation.
- Simultaneous demand and generation will further reduce the volume received from (or delivered to) the upper network levels.
- The approach of *Netbeheer Nederland* therefore overestimates the volume – and therefore the costs - cascaded down from upper network levels the connection level.

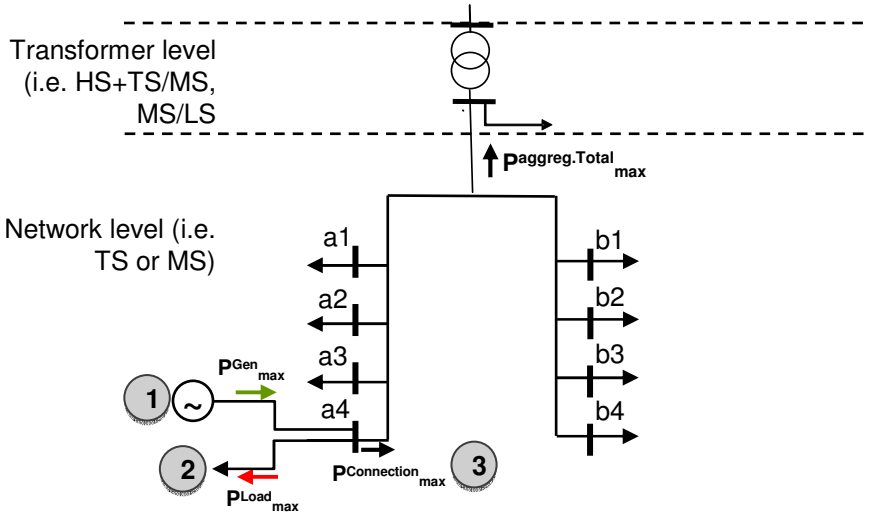
Assumption B
The postage stamp rate for the upper network levels is the same for all network operators

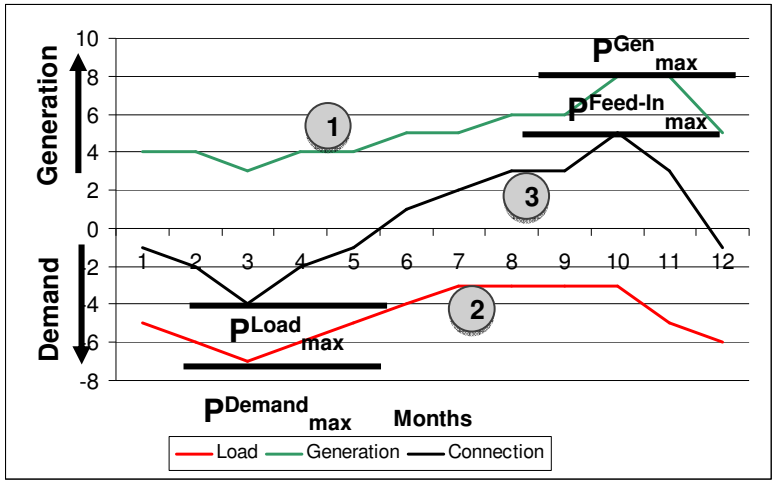
- Some of the HS+TS/MS levels are connected to the TS level, whereas others are connected to the HS level.
- The postage stamp rate of the TS level is higher than that of the HS level.
- The approach of *Netbeheer Nederland* assumes that all HS+TS/MS levels are connected to TS and that the postage stamp rate from the TS level can be applied. This leads to an overestimation of the cascaded costs from upper network levels.

Both assumptions lead to an **underestimation** of the DG sector tariff

The DG volume factor is related to generation at each connection point







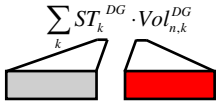
- The proposed DG volume factor is the maximum feed-in capacity at a connection, which exceeds the maximum load capacity[1)].

$$\mathrm{Vol}_{\mathrm{DG}} = Max(0, P_{\max}^{Feed-In} - P_{\max}^{Load})$$

- The proposed volume driver for the costs of the upper network level is the sum of the DG volume factors in the lower level.

[1)]: Please note that the definition is not unambiguous. This interpretation needs to be confirmed. (The proposal states: "… *dat deel van de invoeding dat uitstijgt boven zijn afname…*")

Planning criteria provide an useful indication of important cost drivers



DG Planning Criteria

- Location and capacity of DG determine the network structure and the number and capacity of transformer stations.

- Simultaneous demand increases network costs (or generation respectively)
- Simultaneous demand and generation reduces network costs.
- Demand might be supplied even in case of a shut-down/break-down of a generating unit.

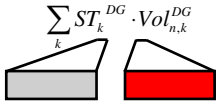
- DG's fault level contribution may require additional investments.

- Significant change of load flows may require additional costs for control voltage.

DG Cost Drivers

1. **Number and capacity of DG connection points.**
2. **Spatial and temporal correlation of DG and demand**
3. **DG's fault level contribution**
4. **DG's impact on voltage control**

The impact of DG depends on the individual situation in each grid



spatial correlation of demand and generation

low — high

temporal correlation of demand and generation

high — low

Q1

- DG is connected largely via new assets in new areas.
- The maximum demand and generation occur at same times.

Q2

- DG is connected largely to existing demand areas
- The maximum demand and generation occur at same times

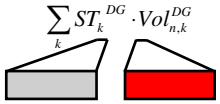
Q3

- DG is connected largely via new assets in new areas.
- The maximum demand and generation occur at different times and are not or even negatively correlated.

Q4

- DG is connected largely to existing demand areas.
- The maximum demand and generation occur at different times and are not or even negatively correlated.

DG volume driver mirrors particularly cost drivers (1) (DG capacity) and (2) (spatial and temporal correlation)



spatial correlation of demand and generation

low — high

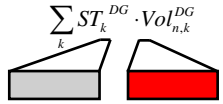
temporal correlation of demand and generation

high — low

Q1		**Q2**
Connection grid ▪ DG volume factor equals maximum DG capacity. ▪ The DG volume factor is **appropriate.**	**Upper Grid** ▪ The temporal simultaneity of demand and DG within a network is ignored ▪ The DG volume factor is **slightly overestimated** for transformer levels	**Connection grid** ▪ Costs caused by DG grow slower with costs caused by demand, as DG compensates demand ▪ DG volume factor is **overestimated** in network levels **Upper Grid** ▪ The temporal simultaneity of demand and DG within a network is ignored ▪ The DG volume factor is **overestimated** for transformer levels
Q3		**Q4**
Connection grid ▪ DG volume factor equals maximum DG capacity. ▪ The DG volume factor is **appropriate**.	**Upper Grid** ▪ DG volume factor equals maximum DG capacity. ▪ The DG volume factor is **appropriate.**	**Connection grid** ▪ Costs caused by DG grow slower with costs caused by demand, as DG slightly compensates demand ▪ DG volume factor is **slightly overestimated** in network levels **Upper Grid** ▪ The DG volume factor is **appropriate**.

On average, the proposed DG volume factor **slightly overestimates** the additional network costs incurred by DG.

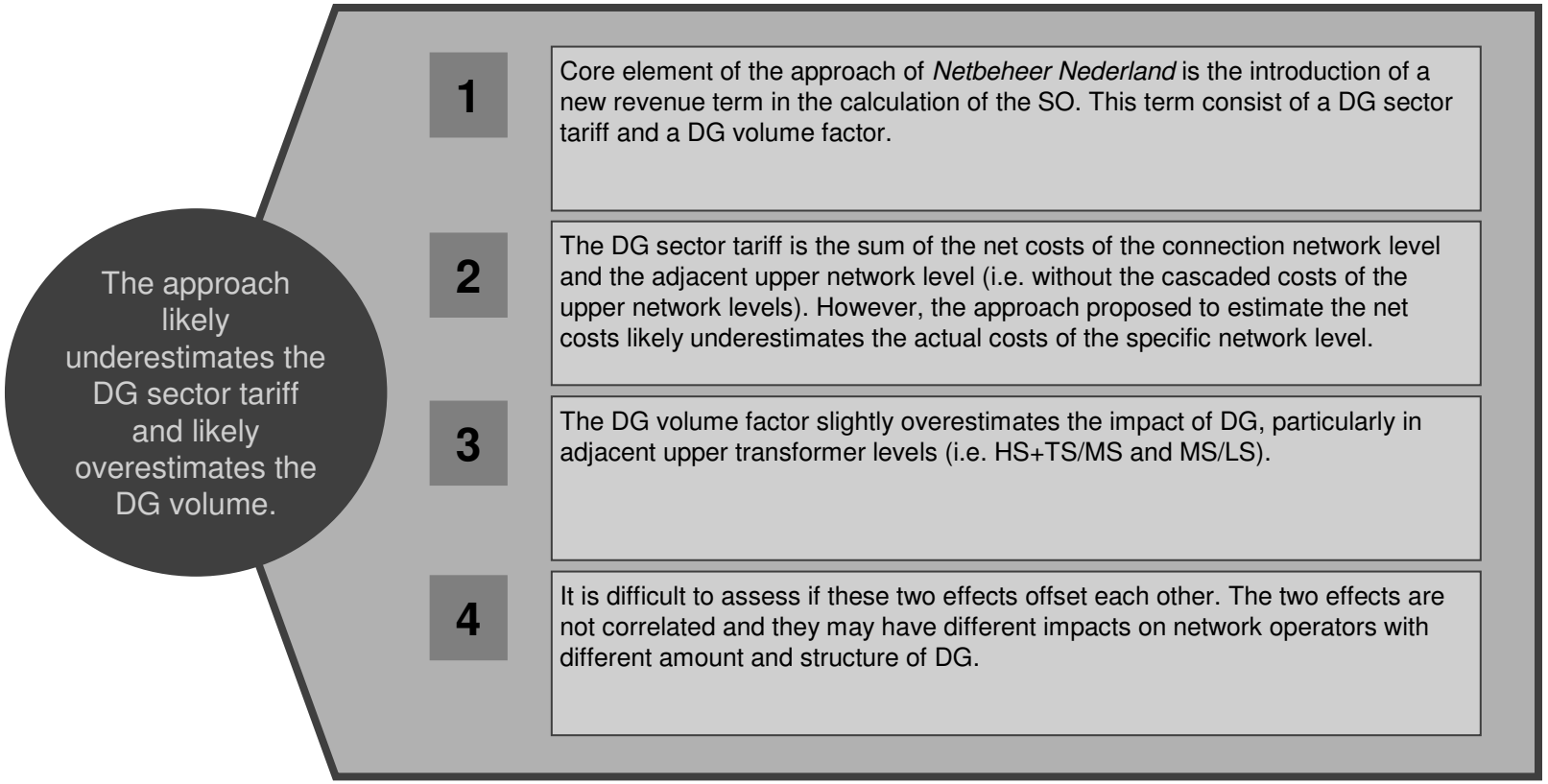
The impact of DG on ③ (fault levels) or ④ (voltage control) are only considered indirectly in the DG volume factor



- Additional DG volume may cause extra costs in the network in order to limit fault levels or to control voltage.
- These costs may occur even in case the DG volume is lower than the maximum demand capacity.
- The costs for fault level control and voltage control are part of the overall network costs. However, the specific costs for fault level control or voltage control may be lower than the average sector tariff.
- The DG volume factor seems therefore to be **slightly underestimated**.

1. Background and Scope of the report
2. The proposal of *Netbeheer Nederland*
3. Evaluation of technical cost drivers
4. **Summary**

Conclusion



- The proposed regulatory approach provides a sensible solution for considering DG induced costs in the SO. However, as this approach involves some simplifications, there is a risk that it may be challenged by some network operators or by a Third Party.

Potential Modifications

- Energiekamer may want to consider two potential modifications to the approach to overcome the apparent short-comings, assuming the data is metered and is available
  - Improve the calculation of the DG sector tariff.
    - A better estimate of the actual net network costs can be reached if the actual cascaded costs are subtracted from the total revenues.
  - Improve the DG volume factor for upper network levels.
    - A better estimate for the use of upper network levels can be reached by using the maximum capacity at the connection points to the upper network levels.
- The regulatory approach must consider the availability of data. It also forms a balance between the applicability of the approach and the fairness of the cost allocation principle. Any improvement in accuracy involves a trade-off between higher method complexity and administration burden.
- Energiekamer may want to consider to discuss this proposal with *Netbeheer Nederland* before making a final decision.