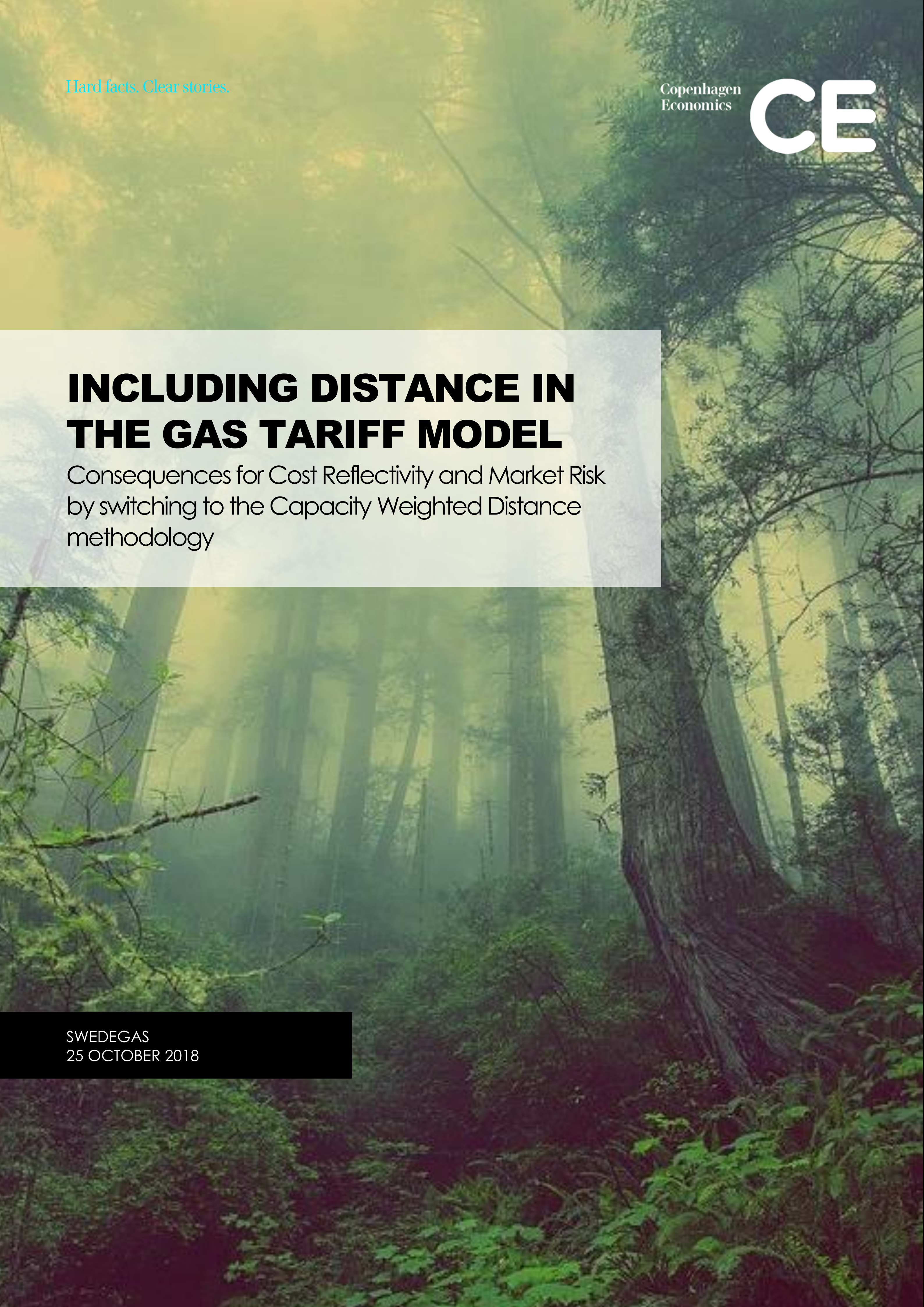

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INCLUDING DISTANCE IN THE GAS TARIFF MODEL

Consequences for Cost Reflectivity and Market Risk by switching to the Capacity Weighted Distance methodology

SWEDEGAS
25 OCTOBER 2018

AUTHORS

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PREFACE

The assignment

Swedegas has asked for an economic evaluation of changing the current reference price methodology (RPM), which is based on a postage stamp tariff (PS), to a capacity weighed distance price methodology (CWD).

In a consultation, Swedegas has developed arguments against such a change of RPM. The European Agency for the Cooperation of Energy Regulators (ACER) has analysed the consultation documents and has in its response asked for more evidence into the arguments put forth by Swedegas, including an assessment of economic effects.

Copenhagen Economics was therefore commissioned by Swedegas to contribute to the assessment. Swedegas has asked for an analysis of the following perspectives:

1. Does the PS model provide a reasonable level of cost reflectivity?
2. Would the CWD model have significant negative effects on the gas market in Sweden, given the implied price differentiation between the northern and southern regions?

These two perspectives are outlined further in the ACER response to the consultation document (ACER 2018).

The analysis of costs, revenues and customers are primarily based upon data provided by Swedegas.

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Stockholm, 25 October 2018

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ABBREVIATION	TERM
ACER	Agency for the cooperation of energy regulators
CHP	Combined Heat and Power
CWD	Capacity Weighted Distance
Ei	Energimarknadsinspektionen
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
PS	Postage Stamp
RAB	Regulatory Asset Base
RP1	Regulatory Period 1 (2015-2018)
RPM	Reference Price Methodology
RV	Replacement Value
TSO	Transmission System Operator
VG	Västra Götaland
ÖVT	Öresundsverket

EXECUTIVE SUMMARY

A CWD would increase market risk, but not cost reflectivity
The evaluation is conducted against the background of the principles set out in the Commission Regulation (EU) 2017/460 of 16 March 2017 which establishes a Network Code on Harmonised Transmission Tariff Structures for Gas (Regulation). In the preambles, paragraph (1) outlines the objectives of the Code: market integration, security of supply and interconnection between gas markets.

In paragraph (3), it is stated that the RPM must be based on specific cost drivers to ensure a reasonable level of cost reflectivity and predictability. In addition, any proposed RPM is to be compared with a CWD as the counterfactual.

In its analysis of Swedegas' consultation document, ACER (2018) considers that the current PS methodology is not compliant with the principle of cost reflectivity, mainly because of cross-subsidisation between customers in different regions. Nevertheless, ACER considers that the PS model can be justified if it can be shown to reflect a reasonable level of cost reflectivity. Another justification is if CWD can be shown to result in negative effects for the whole gas market.

By evaluating the available economic data provided to us from Swedegas, we conclude that the current PS methodology is reasonably cost reflective and that a switch to CWD would significantly increase market risk, including the risk of vicious circles.

1. The current PS methodology is reasonably cost reflective
We conclude that a shift from the PS to the CWD methodology is unlikely to increase cost reflectivity in any meaningful nor predictable way because of three reasons that all underline that distance is a poor proxy for the relevant cost drivers in the Swedegas transmission system.

First, almost the entire transmission system was rolled out during the 1980s and was designed as a first step of a much larger transmission system for natural gas in Sweden that never materialised. A regional grid, only comprising Skåne-Halland, was not considered. From an international perspective, the Swedish transmission system is very small and tariffs are high. From a network economics perspective, it is not relevant to consider the northern region of Västra Götaland (VG) as anything else than an integrated part of the original and indivisible network since the installed capacity in the South necessitated a certain volume to break even.

Second, distance is a poor proxy for the actual cost drivers in the Swedegas transmission grid. Capex, the principal cost driver, is not proportional to distance since the bulk (61 percent) of the regulatory asset base (RAB) is in Skåne, the southern off-take area of the grid. The average distance to the entry point is only about one quarter of the distance compared to VG. The northern area of the grid, VG, is furthest away from the entry point and represents only 17 percent of RAB. An important reason for the discrepancy is that Skåne and Halland, in contrast to VG, have a larger share of branch lines which only serves local customers and hence have no value for customers in VG.

Third, we show that if each region bears its own costs for branch lines under the current PS regime, VG covers the full cost of the trunk lines in VG and, in addition, the relevant share of the trunk line costs in Halland and in Skåne relative to its usage of the trunk lines. With a CWD, however, VG would cross-subsidise trunk lines in both Halland and Skåne to a large extent. A shift to a CWD methodology would therefore increase cross-subsidisation, not reduce it. The current PS method is therefore reasonably cost reflective, and more cost reflective than CWD.

2. A switch to CWD would significantly increase market risk

Introducing the CWD methodology would, for technical reasons, involve a 0-100 entry/exit split of tariffs and a division of the transmission system into four offtake areas (regions) with uniform tariffs. Given the current revenue cap, this would imply a 51 percent increase in transmission tariffs in VG and a corresponding 76 percent decrease in tariffs in Skåne.

Such a relative price change is likely to lead to significant risks of failing demand in VG where the customer base is dominated by large industries that are price sensitive and, in many cases, have alternatives to gas.

Especially critical is the increased risk of losing prospective large-scale users in VG that have not yet reached the expected level of gas consumption. Demand in VG is expected to increase by 235 MNm3, corresponding to 33 percent increase of the total capacity, in the coming 2-4 years.

In the South, Skåne and Halland represent a very limited potential for an increase in the demand for gas, and the market is mature. There are no prospective customers with scale in the region since all major industries with a need for gas since long are connected. Thus, even if tariffs are significantly decreased, we expect a limited demand response.

A switch to CWD is therefore likely to lead to falling volumes in the transmission system and hence the risk of higher tariffs for all users if Swedegas is to recuperate its costs. If one large customer is lost, tariffs would have to be increased to compensate for the revenue loss, thereby increasing the likelihood of more customers leaving. In such a scenario, the risk of a vicious circle, with falling volumes and successively higher tariffs as the most price sensitive customer drops out, is imminent.

Swedegas may consider not to raise tariffs in VG if a CWD methodology is adopted to protect volumes from falling. Even if such a strategy is successful in protecting today's volumes, revenues would fall by more than one quarter. Today, Swedegas is only able to recoup 77 percent of the revenue cap – this share would then fall even further.

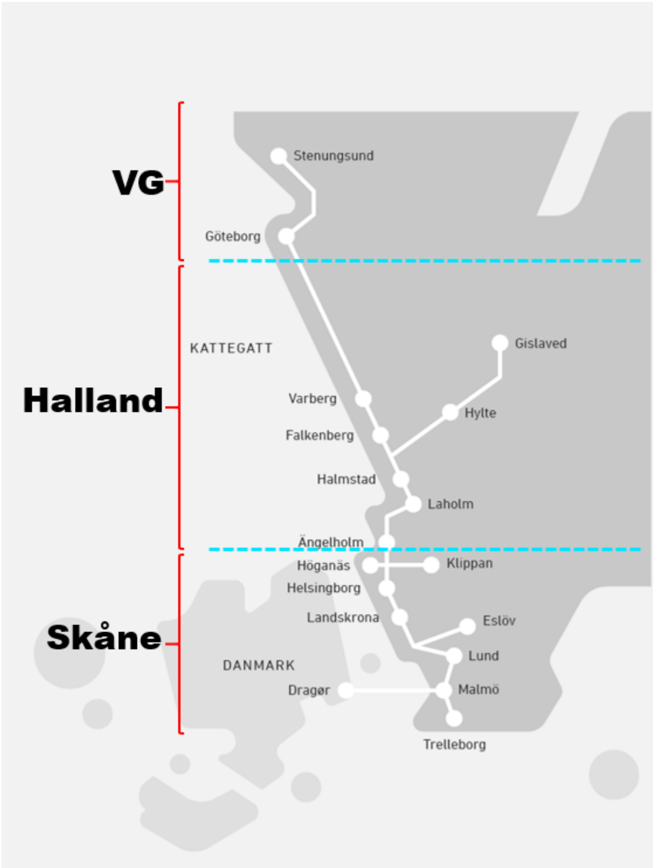
In conclusion, a shift to the CWD methodology is therefore likely to introduce significant risk of falling demand and higher tariffs for remaining customers, thereby endangering the future prospects of the Swedish market for natural gas.

CHAPTER 1

THE SWEDEGAS TRANSMISSION SYSTEM

The transmission system in Sweden was mainly built in the 1980s and was spurred by the planned decommissioning of Sweden's nuclear power plants. The single international entry point was built with the Dragør - Klagshamn sea pipe. The trunk line was built predominately in 1985 and extended northwards soon after. Several branch lines were installed in Skåne in the second half of the 1980s. By 1988, the trunk line had reached Göteborg, see Figure 1.

Figure 1
Key characteristics for Swedegas' transmission system



Key grid stats

- Active since 1985
- 601 km pipe
  - Skåne 257 km
  - Halland 264 km
  - V. Götaland 80 km
- No transit
- 1 entry in Dragør

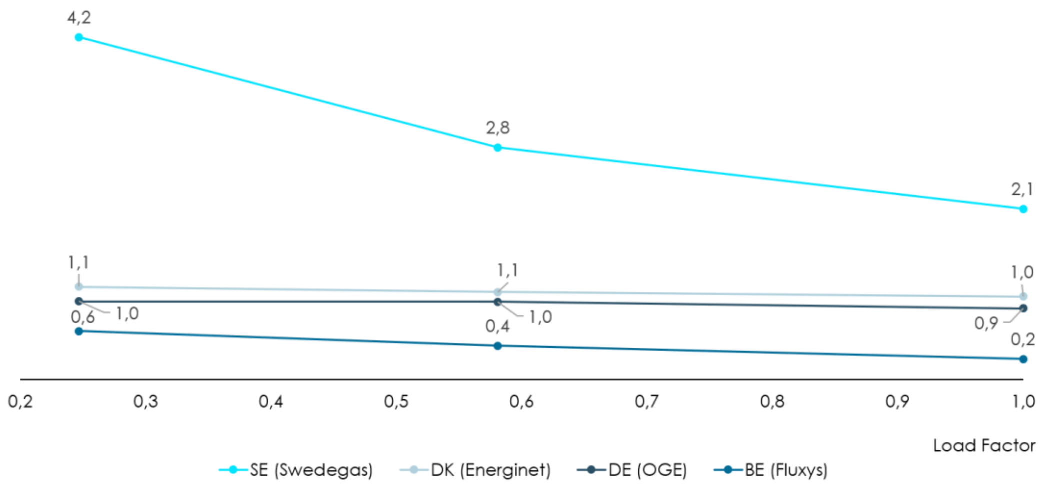
Note: No transit means that Sweden does not export gas, i.e. there is no flow of gas from Sweden to Dragør
Source: Swedegas

Thereafter, the transmission grid did not see any major instalments of capacity for years. In 2002, the Gislaved branch line was installed. In 2004, the trunk line was extended north of Göteborg to Stenungsund and its cluster of petrochemical industries.

When the transmission system was designed, it was envisaged as the first step of a much larger system that would reach significant parts of southern Sweden. Dragør and the Danish transmission infrastructure was regarded as the major supply system. Sweden therefore contributed financially to increase capacity in the Danish grid to solve bottlenecks. During the 1990s, connections to both Norway and Poland were considered, but never materialised.

The total length of the transmission line is therefore small from an international perspective, comprising 601 km of pipes (Starfish 2015). Given the small scale, the grid's economies of scale are lower than for most other gas transmissions systems in Europe. Tariffs are therefore significantly higher in Sweden, especially for low loadings, than in Belgium, Germany and Denmark, see Figure 2 below, which shows an example of a directly connected industrial customer. It shall also be noted that the Swedish gas consumers also need to pay the Danish transport fee to have the gas transported to Sweden.

Figure 2
Transmission cost by load factor
EUR/MWh



Note: The figure depicts gas prices for different load factors. A load factor is a utilization measure of the net: a low load factor indicates a low utilization of the net while a high load factor indicates a high utilization of the net. These are figures from the gas year of 2017/2018

Source: Swedegas

CHAPTER 2

REASONABLE COST REFLECTIVITY

The rationale for using distance as a proxy for costs is the implicit assumption that it is an accurate measure of the share of the underlying capital base used by customers at different locations along the grid.

The assumption can be questioned on two grounds.

First, if the transmission system was built and designed as one integrated step of a much larger system, it is from a network economics perspective wrong to treat the transmission system as consisting of a series of increments, since any smaller part of the system would never have materialised. In Section 2.1, we show this is the case for the Swedegas transmission grid.

Second, the capital base may not be proportional to distance. This could happen if there are more branch lines in one part of the transmission system, the pipe has a larger dimension closer to the entry point, or if it has been more expensive to build for certain stretches. In Section 2.2, we find that distance is a poor proxy for cost drivers in the Swedegas transmission system.

In addition, in Section 2.3 we estimate the degree of cross-subsidisation between regions. We find moderate cross-subsidisation under the current PS tariff and that a shift to the CWD methodology would *increase* the degree of cross-subsidisation considerably. We therefore conclude that the PS is reasonably cost reflective.

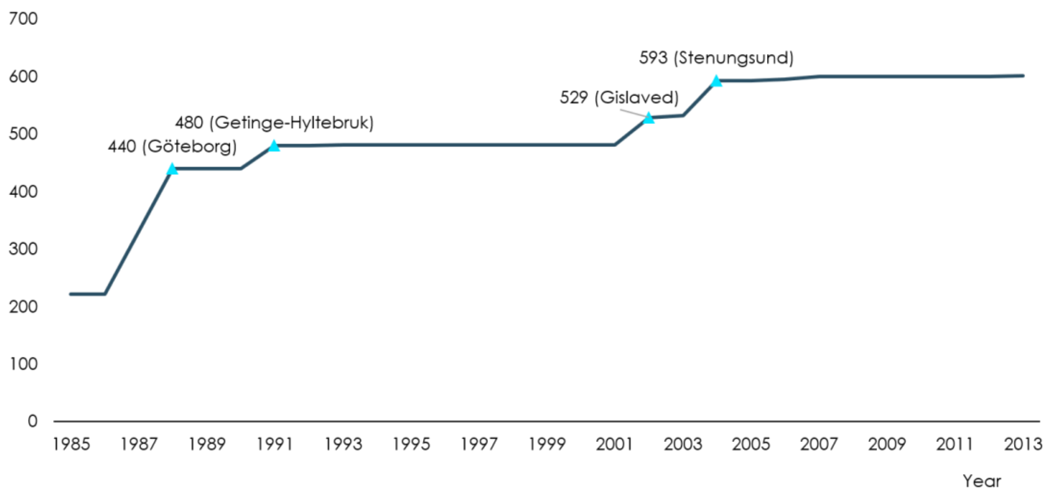
2.1 THE TRANSMISSION SYSTEM WAS ESTABLISHED AS ONE NETWORK IN THE 1980S

In this section, we consider how the transmission system developed over time and if can be regarded as one integrated network or not. Since the economic life time of the transmission system is very long[1], the decisions taken at the time of its construction are of high relevance also today.

We therefore consider the historic expansion of the transmission grid. The sea pipe from Dragør to Klagshamn was established in 1985. Onwards, the total length of the transmission system evolved rapidly until 1988 when Göteborg was reached. The major extensions thereafter, including the 40 km Getinge – Hyltebruk branch in 1991, the 47 km Mosshult – Gislaved branch in 2002 and the 57 km Göteborg – Stenungsund trunk line in 2004, did not come anywhere near the initial vision for the transmission system in Sweden. The total length of the system therefore did not change much after 1988, which is outlined in Figure 3 below.

[1] The depreciation time are 90 years for transmission lines and 40 years for MR-stations.

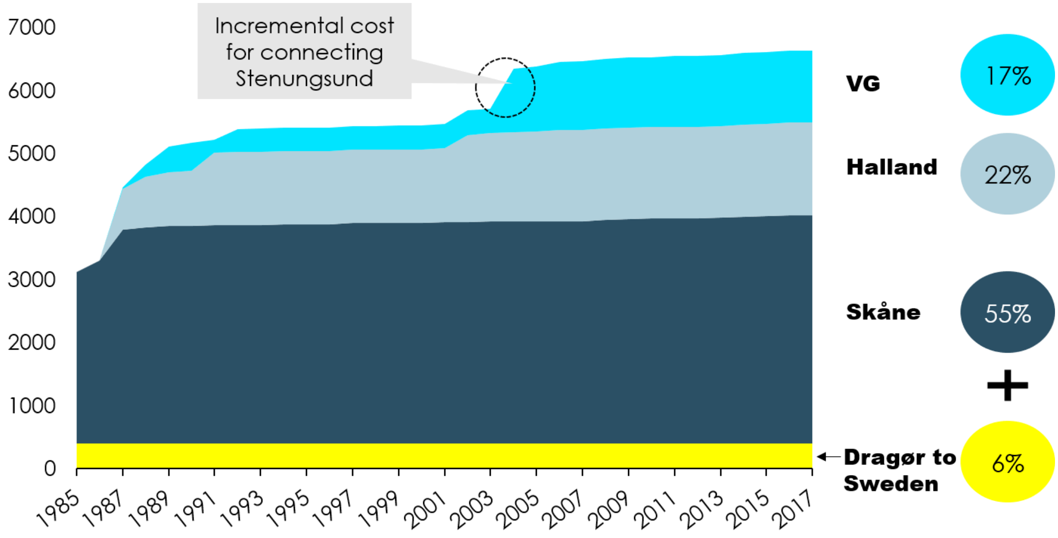
Figure 3
How the total length of the grid evolved
Total length of the grid (km), including trunk and branch lines



Note: The figure shows the development of the total length of the grid, with the major extensions marked. Göteborg was reached in 1988, Getinge-Hyltebruk in 1991, Gislaved in 2002, and the last extension to Stenungsund in 2004. Both the trunk and the branch lines are included in the total length
Source: Swedegas

The evolvement of the RAB since 1985 is depicted in Figure 4 and illustrates the same point – capital formation did primarily take place between 1985 until the early years of the 1990s. The only significant increase in the RAB thereafter was the extension of the 406 mm trunk line to Stenungsund in 2004. Another observation is the static appearance of capital formation of the grid in Skåne: the RAB has been almost constant for the last 30 years.

Figure 4
Swedegas transmission RAB in RV, 1985-2017
Million SEK



Note: The figure shows the replacement value (RV) of the RAB for 2013 price level. Dragør to Sweden is indicated separately because it is an underwater pipe connecting the Danish grid to Sweden. To the right, we indicate the percentages of the total RAB for 2017

Source: Swedegas (data) and Copenhagen Economics (calculations)

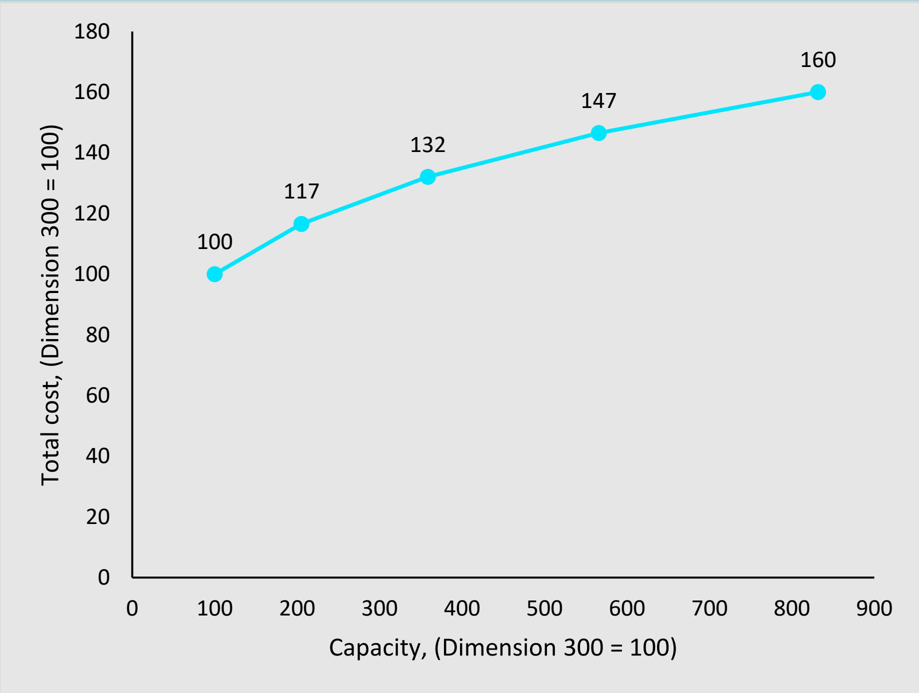
The Swedegas transmission system can therefore be seen as having been built in one integrated phase. It was designed as a first step of a much larger transmission system for natural gas in Sweden that never materialised. A regional grid, only comprising Skåne-Halland, was not considered. The grid therefore has spare capacity and is designed to handle a market of over the double size of today (>20 TWh).

Another reason for the spare capacity is construction economics: the extra cost of increasing the pipe diameter is low in comparison with the increase in capacity. This strongly suggests that it is cost-effective to ensure sufficient spare capacity for any future demand increase.

The relationship is illustrated in Box 1 below, which is based on cost estimates referring to the Stenungsund project in 2004. The numbers are estimates and should be regarded with caution. The principal relationship is, however, fairly robust also for similar projects: For every larger pipe dimension, the increase in capacity is about five to six times larger than the increase in total costs.

Box 1 How total cost increase with larger pipe dimensions and capacity

Since several costs items are the same irrespective of the dimension of the pipe, the relationship between total construction cost and capacity is decreasing. An indication of that relationship is illustrated below. In comparison with a 300 mm pipe, the 400 mm pipe has more than double capacity (105%), but only 17% higher costs. The same pattern is evident when a 400 mm pipe is compared to a 500, a 600 or a 700 mm pipe: for each step, total costs increase by 9-13%, whereas capacity increases by 47-75%, which is about 5-6 times more.



PIPE DIMENSION (mm)	INCREASE IN PERCENT (compared with previous dimension, e.g. 100mm) TOTAL COST	CAPACITY
300	-	-
400	17%	105%
500	13%	75%
600	11%	58%
700	9%	47%

Note: Capacity is approximated as: Dimension^2,5.

Source: Swedegas

We also know that the Swedegas grid by international standards is very small and that tariffs are relatively high.

Taken together, the evidence strongly suggests that the Swedegas transmission system should be regarded as an indivisible network in which all participants should share the costs in proportion to their individual use. From a network economics perspective, it is therefore not relevant to estimate each participant's use of the network in a relative sense since the counterfactual network, of a smaller scale, would never have existed. Likewise, cross-subsidisation is not relevant as long as every member in the network pay the same tariff for enjoying access to it, irrespective of distance. In particular, it does not make sense to suggest that customers should pay tariffs linked to the distance to Dragør: without a customer base in VG it is unlikely that customers in Skåne would ever had access to any gas provided through Dragør in the first place.

The fact that the system was later extended in discrete steps involving the three major extensions outlined above, does not change this conclusion. In addition, the customers of these extensions were obliged to enter into binding agreements with guaranteed minimum volumes for a number of years. The duration of the agreement was set in order to guarantee full financing of the investment. Should the customers fail to consume the agreed volumes, they would be liable to compensate Swedegas with the full value of the commitment. Hence, these customers have already contributed to the marginal increases in the overall length of the transmission system.

2.2 DISTANCE IS A POOR PROXY FOR COSTS

Above we concluded that the Swedegas transmission system should be regarded as one indivisible transmission network since any smaller segments of it never would have been built. It is therefore not relevant to differentiate the tariff structure based on the entry-exit point distance.

If the opposite is true, i.e. if a smaller segment of the existing transmission grid would be feasible, distance as a basis for tariffs may still be problematic if it is a poor proxy for cost drivers in the transmission system. In this section, we review the relationship between distance and cost drivers.

A principal cost driver for gas transmission systems is Capex. This is because of the long economic lifetime of the grid, 90 years, and of the limited running costs for distributing gas in pipelines. A fuller picture of costs and revenues is presented in Table 1 below. The bulk of the transmission system costs are accrued in Skåne, including both Capex and Opex. Furthermore, actual revenues in Skåne of 754 MSEK is almost at par with actual revenues in VG which are 705 MSEK.

Table 1
Costs and revenues for the Swedegas transmission system

AREA	CAPEX		OPEX		REVENUE CAP		REVENUES[2]	
	MSEK	*% of total*	*MSEK*	*% of total*	*MSEK*	*% of total*	*MSEK*	*% of total*
Skåne	956	61	226	52	1182	58	754	47
Halland	349	22	64	15	414	21	139	9
VG	272	17	147	34	419	21	705	44
Total	**1 577**		**437**		**2 015**		**1 598**	

Note: Capex, Opex and Revenue Cap refer RP1 (2015-2018, updated version from June 2018). Revenues are the average of the last two gas years multiplied by 4, nominal values. Opex consists of OH and Operation and maintenance costs (O&M). OH are allocated by volume and the O&M costs by RAB. The relative usage by VG and Halland of the transmission line upstream is not considered in this table, but is analysed in Section 2.3 below.
Source: Swedegas (data), (Ei, 2018). and Copenhagen Economics (calculations)

The running costs of the grid, Opex, consist of OH and operational costs, and are further explained in Box 2. Skåne's share of Opex (52 percent) is larger than their share of revenues (47 percent); in contrast, VG's share of revenues (44 percent) exceed their Opex share (34 percent). As a consequence, VG contributes more to the revenues per unit of Opex, and vice versa for Skåne.

Box 2 Decomposition of Opex

Opex for Swedegas can be categorised in two groups

I. Operations and maintenance – These costs are expected to grow with the length or value of the grid. The costs are distributed by offtake area RAB.
II. OH costs – These are joint costs for the system, for example administration or advertising. The OH costs are distributed by offtake area volume.

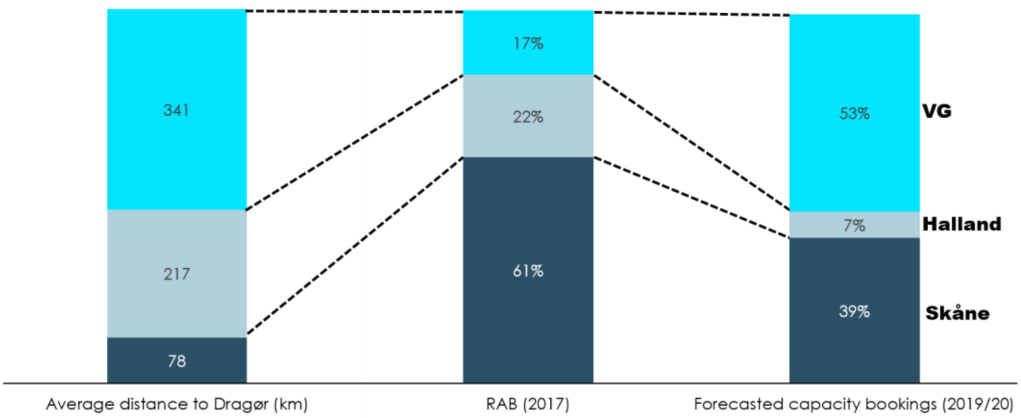
Source: Swedegas

Figure 5 below depicts how the distribution of RAB across offtake areas correlate with distance and forecasted capacity bookings. Distance is used as an input in the CWD model and is calculated as the average distance from all exit points in each offtake area to Dragør. The distance to Skåne is only about one quarter of the distance to VG. On the other hand, 61 percent of RAB is located in Skåne. In terms of volumes, expressed as forecasted capacity bookings – also an input in the CWD

[2] Note that revenues for 2015-2018 is not equal to the forecasted capacity bookings. Today's revenues do not include the growth in the VG market; hence the difference between 44% of revenues today and 53% of forecasted capacity bookings. In addition, in the CWD model revenues are calculated using forecasted capacity; thus, it is not appropriate to compare revenues for 2015-2018 with the revenues in the CWD model, see Appendix 4.1.

model – VG has more than half of total volumes, which is contingent on a relatively small share of RAB, only 17 percent.[3]

Figure 5
How distance correlate with RAB (2017) and forecasted capacity bookings
Km (first column) and share of total (second and third column)



Note: The figure depicts how cost-drivers in the CWD model, Average distance to Dragør and Forecasted capacity bookings, correlate with the RAB for each offtake area. Average distance to Dragør is the average distance of all exit points in the specific offtake area. Forecasted capacity bookings are the expected capacity based on forward bookings and expected increase in demand
Source: Swedegas (data) and Copenhagen Economics (calculations)

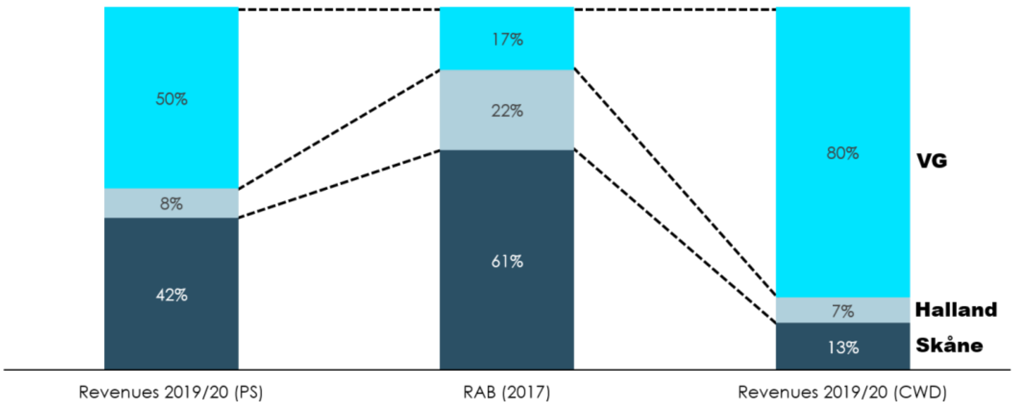
Distance is therefore a poor proxy for the most important cost driver of the transmission system, the RAB. The same conclusion is evident when RAB is compared to the distribution of actual revenues across regions using the two different RPMs, see Figure 6 below. The left bar reveals that VG represents 50 percent of revenues, measured as forecasted capacity bookings (2019/20), and only 17 percent of RAB, whereas Skåne has 42 percent of revenues and 61 percent of RAB.

The mismatch between share of RAB and revenues is considerably larger when a CWD model[4] is applied, which is seen in the right bar. We here assume constant revenues, that are distributed according to distance in compliance with the CWD model. Here, VG would represent 80 percent of actual revenues and still only 17 percent of the RAB. In contrast, Skåne's share of revenues would fall to 13 percent despite its RAB share of 61 percent.

[3] Note that this relationship does not include the additional RAB contingent to increasing VG volumes included in forecasted capacity bookings. A back-of-the-envelope calculation yields that these volume increases is estimated to result in 42,8 MSEK additional RAB. Over the next four years (next RP), this cost will amount to about a 14,5 MSEK increase in Capex, which constitutes below 1 percent (14,5/1577) of current capex. This is negligible for our analysis and conclusions.

[4] For more details see Appendix 4.2.

Figure 6
How RAB correlates with revenues, PS vs. CWD
Share of total



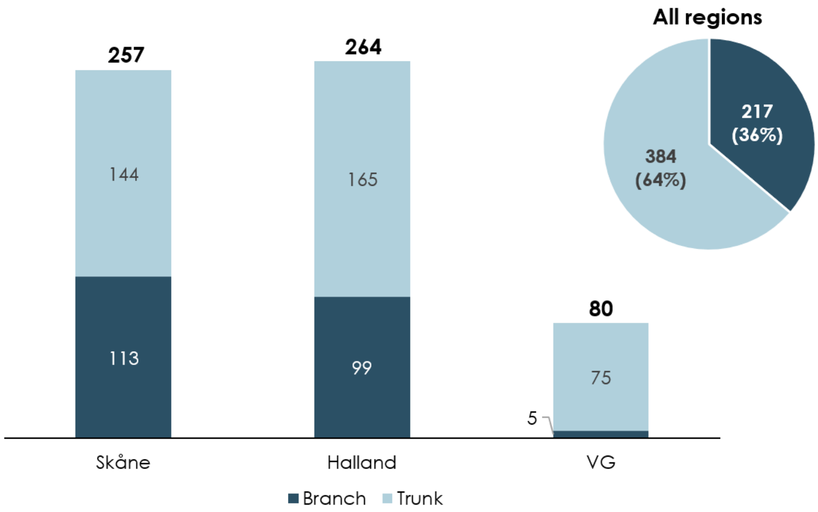
Note: The distribution of revenues in the CWD model is analogous with the cost weight for each offtake area. In order to compare Revenues (PS) with Revenues (CWD), revenues are based on the forecasted capacity bookings for 2019/20, used as an input when estimating the RPM (see Appendix 4.1 for details)
Source: Swedegas (data) and Copenhagen Economics (calculations)

We conclude that Skåne represents a significant share of RAB and a proportionally much smaller share of actual volumes and revenues.

One explanation for the large share of RAB in Skåne and Halland is the weight of branch lines in these regions compared to VG. A closer scrutiny of the relative shares of branch and trunk lines across regions confirms this hypothesis and is presented in Figure 7.

As can be seen in the histogram, almost half of the total length of the system in Skåne consists of branch lines, compared to only a minor share in VG. In Halland, about one third consist of the Gislaved branch line. Of the total length of 601 km, 217 km are branch lines, corresponding to 36 percent.

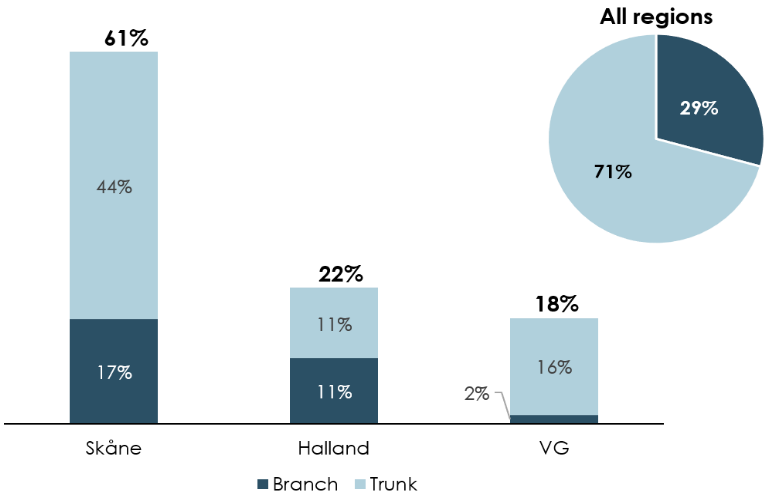
Figure 7
Length of the grid divided into branch and trunk lines, per region in 2015
Length (km)



Note: The figure shows the distribution of branch and trunk lines in km for the gas grid
Source: Starfish (2015, p. 58-59) and Copenhagen Economics (calculations)

The same pattern emerges when RAB is divided into trunk and branch lines, see Figure 8. The branch lines in Skåne represent 17 percent of the total RAB. The corresponding share for Halland is 11 percent. In comparison, the share of branch lines in VG only amounts to 2 percent. In total, 29 percent of the RAB consists of branch lines.

Figure 8
RAB divided into branch and trunk lines, per region in 2015
Share of RAB



Note: The figure shows the distribution of branch and trunk lines over the RAB. This is informative about the respective share of main transmission grid (trunk) and local grid (branch) contingent to each offtake area. For VG, the RAB share for branch lines is approximated by pipeline distance
Source: Starfish (2015, p. 58-59) and Copenhagen Economics (calculations)

We conclude that distance is a poor proxy for cost drivers in the transmission system, at least with respect to the principal cost driver, Capex, since it is not proportionally distributed along the transmission grid. An important reason for the mismatch is the extent of branch lines, which are prominent in Skåne and Halland, but not in VG.

2.3 LESS CROSS-SUBSIDISATION WITH THE PS THAN WITH THE CWD

In the section above, we show that distance is a poor proxy for the relevant cost drivers in Swedegas transmission system, which is primarily driven by Capex. It is therefore uncertain whether a shift to a CWD would increase cost reflectivity. In this subsection, we take the analysis one step further by directly approximating the extent of cross-subsidisation. The principle adopted in the approximation is to let each region pay for the relative usage of the trunk lines upstream. This principle implies that a heavy burden of total costs for the trunk line is allocated to the most distant region, i.e. VG.

The calculation involves the following steps:

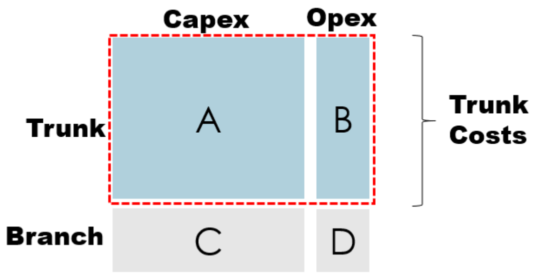
1. *Costs for trunk lines per region*
   We estimate each region's contribution to the trunk lines, after deducting the costs for the branch lines in each region. The rational for deducting branch lines is to remove the part of the transmission system that is not used by other regions. Trunk costs are then weighted by

the relative use for each region upstream. Consequently, VG's trunk costs reflect trunk costs in all three regions, whereas Skåne's trunk costs only includes costs from Skåne.

2. *Contribution to the trunk cost per region*
   The measure captures the revenues left for covering the trunk costs after the costs for the branch lines have been deducted.
3. *Cross-subsidisation per region*
   The contribution to trunk less trunk costs in the same region proxies the extent of cross-subsidisation. If positive, the region cross-subsidises other regions, and vice versa.

First, the relevant trunk costs are derived by deducting Capex and Opex for the branch lines from the total costs, see Figure 9.

Figure 9
Trunk costs



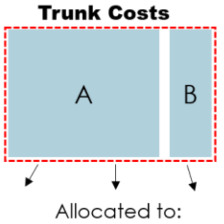
Note: A-D combined represent the total cost for the transmission system. A and B are the trunk costs while C and D are the branch costs. See Table 4 in Appendix 4.4 for a description of each element
Source: Swedegas (data), Starfish (2015 p.58-59) and Copenhagen Economics (calculations)

Figure 10 illustrates the relative usage of the grid. We use forecasted capacity bookings as proxies for relative usage. Hence, Skåne uses 39 percent of the trunk in Skåne, and zero in both Halland and VG; Halland uses 7 percent of the grid in Skåne and 12 percent in Halland; VG use 53 percent of the trunk in Skåne and 88 percent in Halland, and is the only region using the trunk in VG.[5] The bottom histogram in Figure 10 shows how trunk costs are distributed between regions in the PS model.

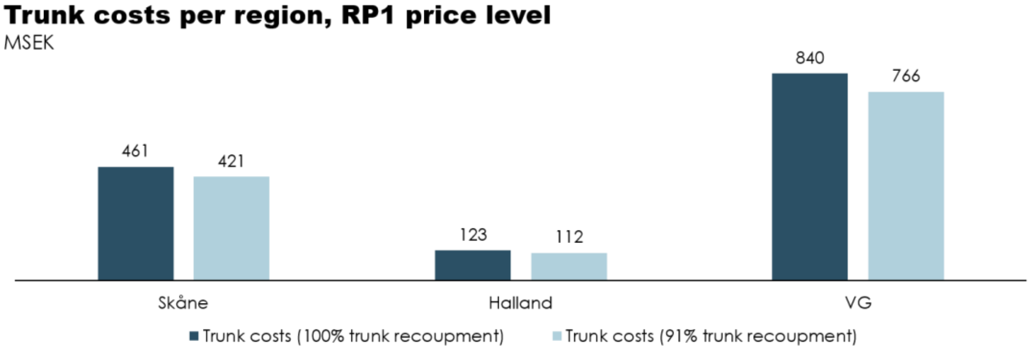
We calculate two measures of trunk costs per region. *First,* 100 percent recoupment refers to the case when all trunk costs are recovered by revenues. *Second,* 91 percent is recoupment, accounts for the fact that actual revenues do not fully cover trunk costs. Hence, we can compare the intended and expected recoupment trunk costs.[6]

[5] The analysis is replicated using historical max capacities as a proxy net usage, see the Appendix 4.4. The conclusions are robust for this alternative weighting.
[6] Note that expected recoupment refers to the revenue measure which is based on forecasted capacity bookings. That is, the revenues have not been realised yet.

Figure 10
Trunk costs distributed by grid use, PS model



Grid use in:	Skåne	Halland	VG	
Skåne	39%	7%	53%	**=100%**
Halland	-	12%	88%	**=100%**
VG	-	-	100%	**=100%**

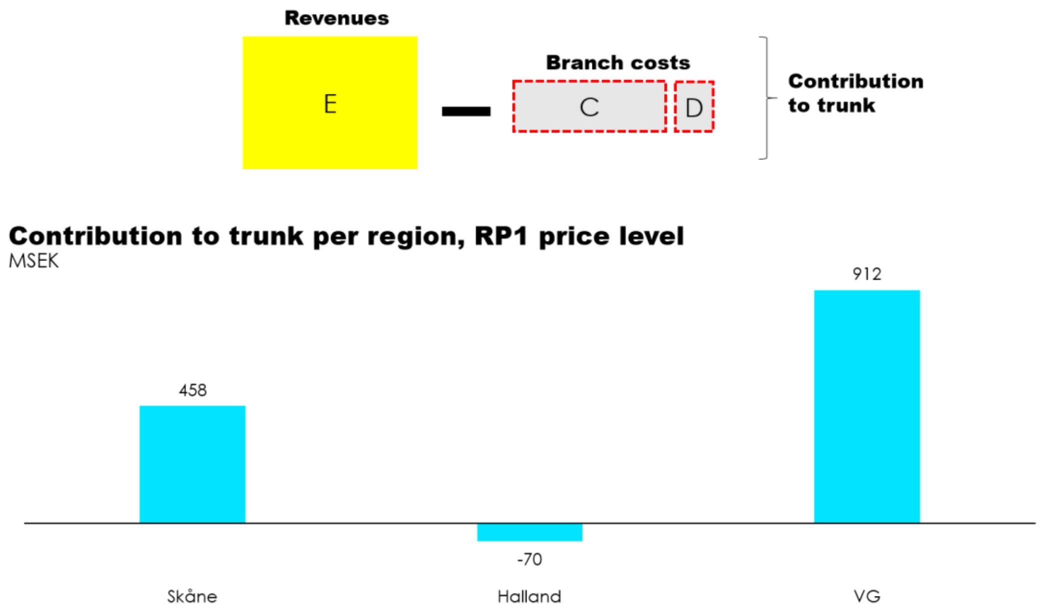


Note: The grid use per region are the relative forecasted capacity bookings for each region. For example, of the volume being transferred through Skåne, 39% are being allocated to Skåne, 7% to Halland and 53% to VG. The bottom histogram shows the resulting trunk costs per region for both recoupment levels mentioned in the text (100% and 91%).

Source: Swedegas (data) and Copenhagen Economics (calculations)

Second, consider the revenues each region accrues. Since the PS model should be compared to the CWD model, the relevant revenue measure is the one used as an input in the CWD model. If the branch costs are subtracted from revenues, the region's *contribution to trunk* is left, see Figure 11. The contribution to trunk show how much revenues are left to cover the trunk costs.

Figure 11
Contribution to trunk

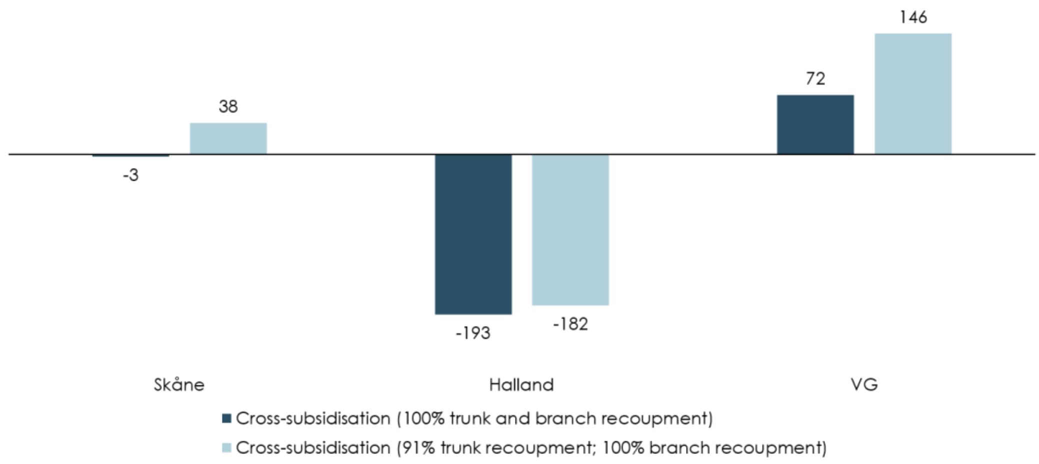


Note: The figure shows how the contributions to trunk are calculated per region. Revenues, denoted by E, are based on the forecasted capacity bookings of 2019/2020 and indexed to the same year's price level as the revenue cap. The difference between E and C + D is the contribution to trunk costs. The bottom histogram shows how the contribution to trunk are allocated between regions

Source: Swedegas (data) and Copenhagen Economics (calculations)

Third, the trunk costs can be subtracted from the contribution to trunk, which leaves the cross-subsidisation per region, see Figure 12. The cross-subsidisation essentially shows how much revenue is left after all costs pertinent to the region are covered. If positive, the region subsidizes other region's trunk costs, and if the cross-subsidisation is negative, a region cannot cover its own trunk or branch costs.

Figure 12
Cross-subsidisation per region PS model, RP1 price level
MSEK



Note: The figure shows cross-subsidisation between regions (see Table 4 in Appendix 4.4 for step-by-step calculation). Cross-subsidisation with 91% trunk recoupment corrects for the fact that the revenue cap is not fully recouped. Hence, 9% of the revenue cap is missing and should not burden any particular region. However, the 100% recoupment case illustrates how the actual shortfall in revenues affect cross-subsidisation
Source: Swedegas (data) and Copenhagen Economics (calculations)

Skåne is close to zero for both recoupment levels. Halland cannot cover its own trunk and branch costs[7] regardless of recoupment. VG is the only region that shows a significant positive cross-subsidisation; its cross-subsidisation to other regions is about the twice as high with 91 percent recoupment.

The interpretation of Figure 12 is that in a fully cost reflective system, cross-subsidisation per region equals zero; thus, cross-subsidisation close to zero indicates little to no cross-subsidization, which is the case for Skåne. Furthermore, a positive cross-subsidisation entails that the region can cover its own grid costs while also cross-subsidising other regions, which is the case for VG.

It is also relevant to set the cross-subsidisation measure in relation to the overall revenue cap. In this case, Skåne's positive cross-subsidisation is slightly below 2 percent of the total revenue cap[8], which is negligible in a large network. This underpins the fact that cross-subsidisation is mainly occurring from VG to Halland.

With a shift from PS to CWD, the degree of cross-subsidisation increases strongly as illustrated in Figure 13.

7 It is evident from the histogram in Figure 11 that Halland's contribution to the trunk is negative, thus part of their cross-subsidisation is branch costs.
8 This is calculated as the cross-subsidisation divided by the revenue cap (38/2 015).

Figure 13
Cross-subsidisation per region CWD model, RP1 price level
MSEK

Note: The figure shows cross-subsidisation between regions for the CWD model (see Table 4 in Appendix 4.4 for step-by-step calculation). Cross-subsidisation with 91% trunk recoupment amend the fact that the revenue cap is not fully recouped. Hence, 9% of the revenue cap is missing and should not burden any particular region. However, the 100% recoupment case illustrates how the actual shortfall in revenues affect cross-subsidisation

Source: Swedegas (data) and Copenhagen Economics (calculations)

The reason is that tariffs are increased in VG and reduced in Skåne and Halland. With a CWD, VG heavily cross-subsidises both Skåne and Halland. The negative values for Skåne show that they are subsidised by 518-559 MSEK, which is 26-28 percent of the revenue cap. The corresponding figures for Halland are 195-206 MSEK and 9-10 percent of the revenue cap.

We therefore conclude, *firstly*, that the PS method, given the forecasts of the coming years, results in a moderate degree of cross-subsidisation. In essence, VG pays for its relative use of the trunk lines in all regions, whereas Skåne pays for its part of the trunk line. The conclusion holds for different specifications of costs and revenues.

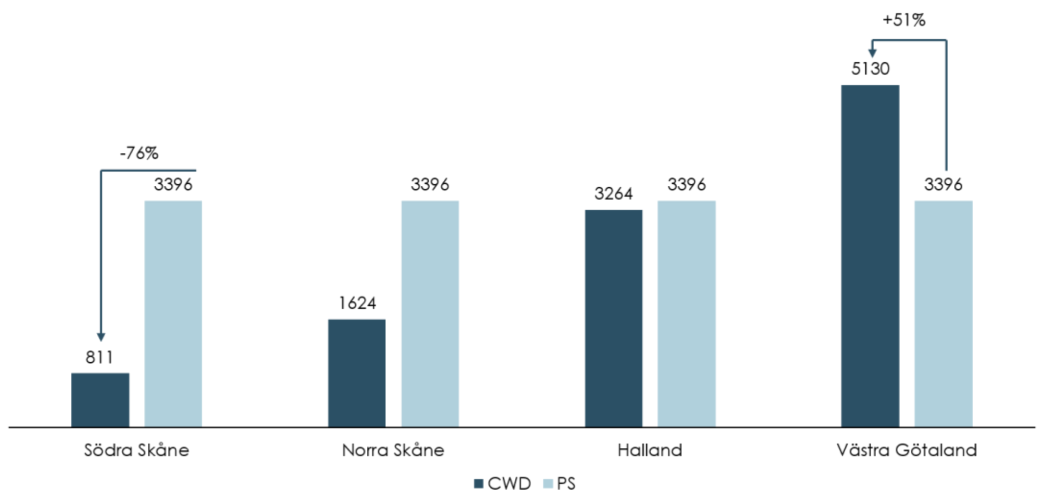
Secondly, a shift to a CWD would not decrease cross-subsidisation: on the contrary, it would increase it. The analysis therefore suggests that the PS methodology is less prone to result in undue cross-subsidisation than a CWD methodology. Under all circumstances, CWD is not more cost reflective than the PS tariff model.

CHAPTER 3

MARKET RISK

A switch from a PS to a CWD methodology would involve price differentiation among customers based on distance from the entry point at Dragør. Swedegas has approximated the effects of a shift to CWD assuming four offtake areas with uniform prices, a 0-100 entry/exit split of tariffs[9] and bookings that correspond to the current level of the revenue cap. The approximation spots a 51 percent increase in tariffs in VG and a 76 percent decrease in Södra Skåne, see Figure 14 below.

Figure 14
Tariff comparison PS vs CWD
SEK/Nm3/h/y



Note: The figure presents the baseline case for the PS and CWD model, using 0/100 entry/exit split. In our calculations, we use the updated revenue cap from 2018, see Ei (2018). For further details see Appendix 4.2.
Source: Swedegas (data) and Copenhagen Economics (calculations)

The changes in tariffs are substantial. It is therefore warranted to examine closer the possible demand responses to such a change.

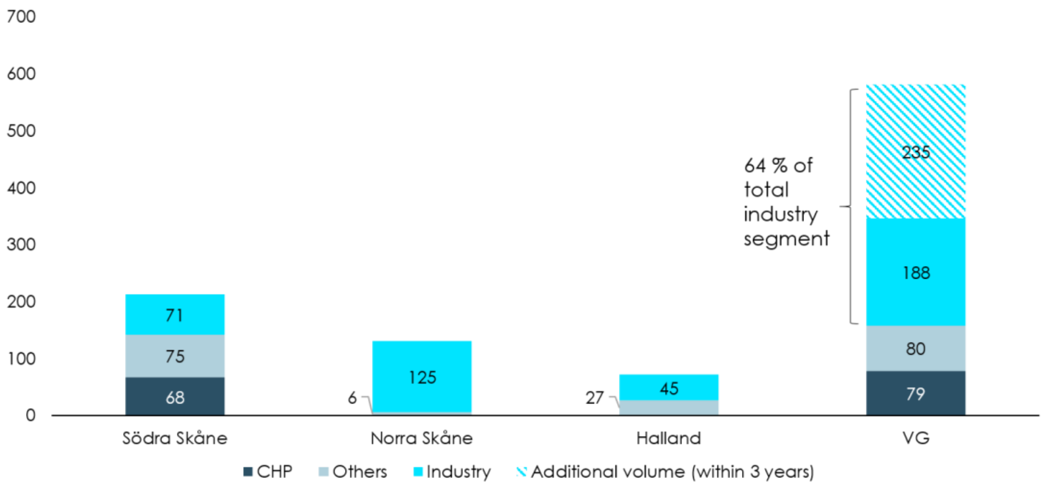
3.1 A LARGE POTENTIAL IN VG, BUT NOT IN SKÅNE

Swedegas conducts as a part of their business and investment planning detailed assessments of prospective new customers and increased volumes. The general picture, which is supported both by factual evidence on market characteristics as well as on historic demand, is that there exists a large, partly untapped, potential for larger volumes in VG, whereas the market in Skåne is mature and is unlikely to demand larger quantities of gas, even if tariffs are reduced.

9 Such a split is necessary given that Dragør is not bookable and because of the legal restrictions in Sweden.

In Figure 15, we describe how the volumes of delivered gas is distributed between regions and customer segments. The dominance of industry clients in VG is strong, which represent 42 percent of the total customer volume. Also important are Combined Heat and Power plants (CHP), which are located in Malmö (Skåne) and in Göteborg (VG), together representing 15 percent of the total customer volume.

Figure 15
Gas volume within customer segments
Volume 2019/20 MNm3



Note: Additional volume within 3 years is the potential increase in the specific region. VG's potential volume are planned increased capacity for current customers as well as new industrial customers (see Table 3 in Appendix 4.3)
Source: Swedegas

The same figure also depicts the prospective volumes that Swedegas has identified. For VG, there is a considerable potential of a volume increase that has been deemed possible. The potential consists both of large new customers and of current customers for gas. In Table 3 in Appendix 4.3, the potential is described on a customer-by-customer basis. For all these companies, investment decisions are already taken and in some cases also realised. The total potential for these six customers within three years is 235 MNm3.

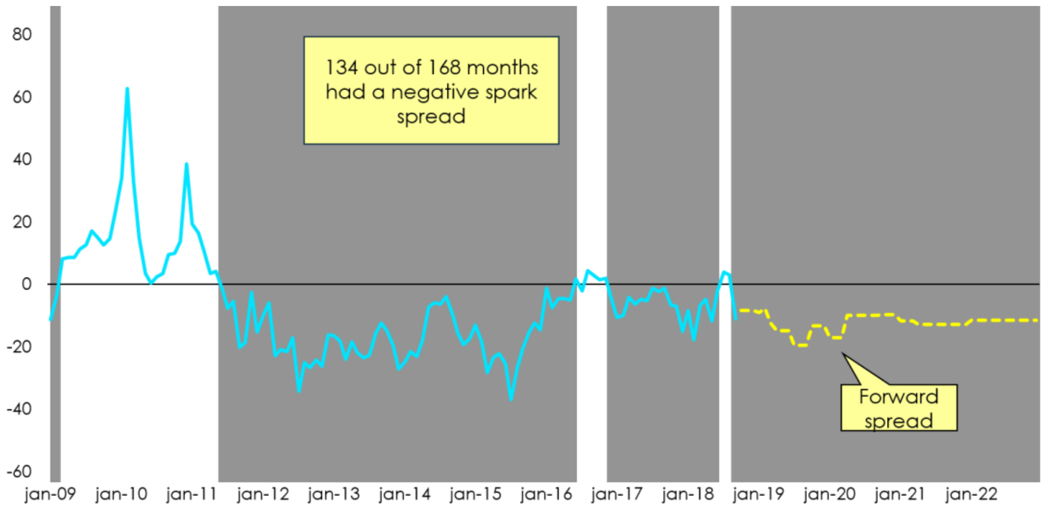
There is no potential for expanding volumes in Skåne if tariffs are reduced. The industries in Skåne have not had a positive volume trend in the last five years and would presumably not increase demand for gas in any significant way if tariffs were reduced. In the period, 2016-2017, gas prices were lower than previously, but any positive volume response from industrial customers in Skåne did not happen. There are no major relevant industrial users in the region that are not already connected to the system.

The largest potential resides in Öresundsverket (ÖVT), a CHP that has not been in operation since March 2016 when its heating contract expired.[10] The likelihood of ÖVT returning to the market,

[10] Gas-fired CHPs in the market are reliant on a heating contract to supply district heating in addition to produce electricity.

however, is limited given the current market prices. In particular, the spark spread which is the relevant short-term cost margin for producing power and heat, has been negative for years, see Figure 16 below. To resume operations, ÖVT would require a clear view of a consistent positive spark spread after covering gas transport costs and fixed costs. Indeed, that scenario is unlikely according to market expectations.

Figure 16
Spark spread Sweden-Europe, 2009-2018
EUR/MWh



Note: The spark spread is calculated as the difference between the electricity spot price (Malmö) and the natural gas spot (Netherlands). The outlook over the coming years is based on current forward prices and is expected to continue to be negative. The market situation would need to change fundamentally for ÖVT to come back into commercial operations. The spark spread is exclusive of transportation and distribution costs (including tariffs)

Source: Nordpool spot for electricity (SE4) and TTF (Netherland's spot market for gas)

The situation for ÖVT is by no means unique for Sweden – the same situation applies also for many countries in Europe where many similar plants have been mothballed or closed since 2011[11], see Box 3. We therefore do not expect ÖVT to return to operations and become a major customer for natural gas.[12]

[11] Caldecott and McDaniels (2014).

[12] ÖVT may still find a balancing role in the energy system, which would represent some demand for gas, but the volumes are small.

Box 3 CHP – Future prospects

Combined Heat and Power is used as a fuel to produce both electricity and district heating. It can also be designed for gas (CCGT – Combined Cycle Gas Turbine) or other fuel types and combinations. The potential for growing demand from CHP in the Swedegas transmission grid is low due to:

- Fierce competition – mothballing and closures have increased steeply in Europe
- A negative spark-spread – The difference between gas and electricity prices is a key factor for CHP production. It has been negative for the last seven years
- Current market deters investment – Today it is problematic to recapitalize investments in CHP plants, which is likely to deter further investments in plants

Source: Caldecott and McDaniels (2014)

The industrial complex in VG, especially in Stenungsund, contains mainly petrochemical plants which are almost absent in the other regions, the only significant exception being Kemira in Helsingborg. There are large industrial energy users in the area still not connected to the gas grid. Discussions to connect these prospective customers have progressed in recent years. A large volume potential resides in the refinery industry where customers such as Preem and St1 recently has taken final investment decisions to build hydrogen production units to produce biodiesel. The hydrogen production requires natural gas and/or biogas as input. This industrial subsegment is expected to grow substantially as the decarbonisation of the transport sector gains momentum.

Some of the industries in VG, which use natural gas as a fuel source, have the ability to switch to other fuel types and are hence very responsive to relative price changes. Industrial customers with gas as feedstock have no short-term price elasticity, but on a longer term, these plants need to be competitive on a regional/global level to prove its case versus production sites in other countries. A sudden tariff increase would increase the risk of these plants relocating.

We therefore conclude that Skåne is a mature market whereas VG is a market with a considerable growth potential.

Another consideration for an increase in supply is the planned LNG terminal in Göteborg. However, based on the production value chain for LNG in Sweden, it is deemed unlikely that LNG will be able to compete with gas transmitted from pipes.

Instead, the planned LNG terminal will provide an alternative source of fuel to shipping, truck transports, and industries without access to the gas grid. Hence, the connection to the grid would provide security of supply. Added volume to the transmission grid is expected to be negligible because it is not competitive, see Appendix 4.5.

For these reasons, we expect that a significant increase in tariffs in VG may jeopardize the growth prospects represented by new customers and also reduce existing demand from current customers. On the other hand, we do not expect that a significant decrease in tariffs in Skåne would result in a demand increase that would come anywhere near neutralising the negative effect in VG.

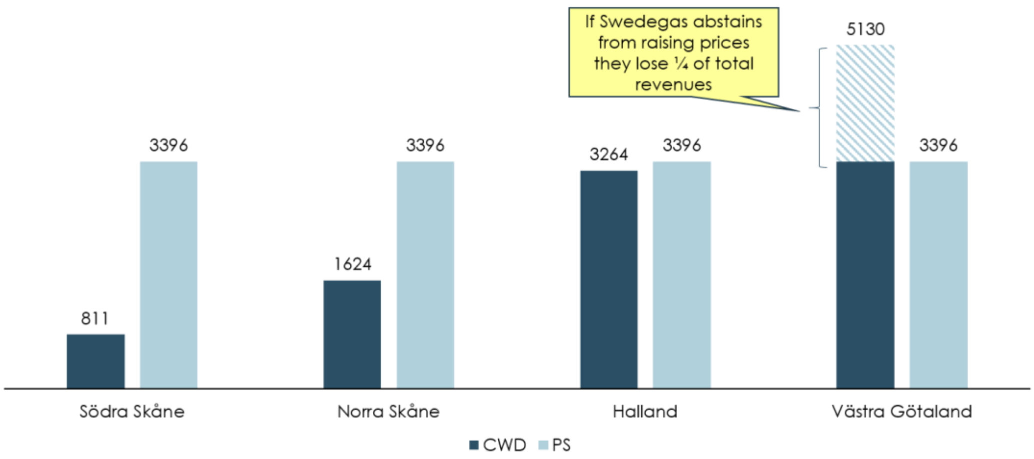
3.2 SCENARIO ANALYSIS AND THE RISK OF VICIOUS CIRCLES

A switch to CWD is therefore likely to lead falling volumes in the transmission system. To protect recoupment of costs, Swedegas would need to increase tariffs. This would ultimately harm all remaining customers. That is a particular feature of the tariff model that may lead to vicious circles: if one large customer is lost, prices surge further, thereby increasing the likelihood of more customers leaving.

To mitigate the risk of a vicious circle, Swedegas may choose not to raise tariffs in VG when a CWD tariff has been put in place. The purpose would be to protect volumes from existing and prospective customers. In fact, the strategy is already adopted today – Swedegas are currently protecting volumes and recoups only 77 percent[13] of the revenue cap.

Most importantly, even if the strategy is successful in protecting volumes, revenues would fall. The effect is illustrated in Figure 17. Here, we compare the PS with the CWD tariffs, as in Figure 14, but we let VG tariffs be the same in both RPMs. Under constant volumes, Swedegas would then lose about 27 percent of its revenues.

Figure 17
Tariff effect on price recoupment, 2019/22
SEK/Nm3/h/y



Note: The figure shows how much recoupment would fall given that Swedegas abstains from raising prices in VG, following the implementation of the CWD model. This outcome is based on the assumption that volumes are not affected by the change in RPM
Source: Swedegas (data) and Copenhagen Economics (calculations)

13 This is the estimated utilization rate for RP1 (2015-2018), based on RP1 prices (2013).

From both a static and dynamic perspective, a switch to CWD would therefore undermine the ability of Swedegas to recoup its costs compared to the current PS methodology.

If Swedegas increases tariffs in VG in accordance with a CWD, falling volumes are likely, which would result in higher tariffs. To quantify these effects, Swedegas has identified 3 scenarios with falling demand.

The *first* scenario involves a demand decrease in VG by 23 percent, which corresponds to an overall decrease of 12 percent. The demand decrease consists in this scenario of no growth in demand from existing customers and no additional prospective customers. To compensate for the demand shortfall and keep revenue, tariffs would need to be increased by 85 percent in VG and 17 percent in Halland.

In the *second* scenario, demand is further decreased as four of the largest industrial customers exit the gas market in VG, totalling a 74 percent decline of VG's demand. Tariffs would need to be increased by 271 percent in VG, by 136 percent in Halland, and by 17 percent in Norra Skåne.

The *third* scenario emphasises how a negative demand reaction could increase tariffs for the entire market. Here, 99 percent of VG demand exits the gas grid. Tariffs in this scenario would need to be increased for all customers, including Södra Skåne.

The scenarios are summarised in Table 2 below. The exercise shows how "vicious circles"[14] could materialise in the Swedish gas market, given a tariff increase for VG.

Table 2
Summary of scenario analysis

	DEMAND CHANGE		PRICE INCREASE/DECREASE			
	VG	All	Södra Skåne	Norra Skåne	Halland	VG
Scenario 1	23%	12%	-71%	-42%	+17%	+85%
Scenario 2	74%	30%	-41%	+17%	+136%	+271%
Scenario 3	99%	53%	+17%	+133%	+369%	-

Note: See Appendix 4.6 for a more detailed explanation regarding assumptions and the calculation of each scenario
Source: Swedegas (data) and Copenhagen Economics (calculations)

14 The term vicious circle is referred to in ACER (2018).

REFERENCES

ACER (2018), Agency Report - Analysis of the consultation document on the Gas Transmission Tariff Structure in Sweden, 30 Aug.

Caldecott, B. and McDaniels, J. (2014) Stranded generation assets: Implications for European capacity mechainisms, energy markets and climate policy.

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CHAPTER 4

APPENDIX

4.1 REVENUE MEASURES

In the report, three different revenue measures are presented and are informative in different ways. The revenue measures are:

1. *Revenues (actual)* – This is an average of the last two year's revenues, multiplied with a factor of 4, approximating revenues for the current RP (four years).
2. *Revenue cap* – The revenue cap is the allowed revenues for the current regulatory period.
3. *Forecasted revenues* – This is revenues based on the forecasted capacity bookings of 2019/2020 and indexed to the same year's price level as the revenue cap.

Revenues (actual) illustrates how revenues are currently being recouped in relation to the revenue cap. This is not a comparable measure for the CWD model because it is not included as an input in the model.

The *revenue cap* is used throughout the report as the benchmark for 100 percent recoupment of revenues. It is an input in both the PS and CWD model.

Forecasted revenues are the revenues that are expected for the year 2019/2020. This is the appropriate measure when analysing and comparing outcomes using the CWD model. Since forecasted capacity bookings is a direct input in the CWD model, see Appendix 4.2, this is the appropriate revenue measure when comparing the PS and CWD model.

4.2 THE CWD METHODOLOGY

The implementation of the CWD model is defined in the Regulation, Article 8. Swedegas has implemented this for four feasible offtake areas in the Swedish transmission grid: Södra Skåne, Norra Skåne, Halland and VG.

The CWD calculation is documented in the previous consultation response.[15] In this description, the same terminology is used as in the computation file, with references to the denotation in the Regulation Article 8.

All calculations are based on an 0/100 entry/exit split. This is because a 50/50 split is not applicable for the Swedish transmission grid as capacity cannot be booked at the entry point in Dragør.

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[15] See file 'Consultation document Appendix lll CWD' at the consultation website, https://www.swedegas.com/Our_services/services/transmission/TAR-NC-Consultation.

Specification of the CWD methodology
The CWD model has three main components:

1. the *Allowed revenue*[16] (revenue cap), which is set by the regulator, Energimarknadsinspektionen (Ei);
2. the *Average distance for exits (in km)*[17]*,* which is the average for a cluster's exit points to Dragør (entry point); and
3. the *Forecasted contracted capacity (in Nm3/h/y)*[18], which is the expected volume in 2019/2020, assessed by Swedegas, for each offtake area.

Starting with the *Allowed revenue*: the revenue cap was updated by Ei in 2018. The new revenue cap for the regulatory period was set to 2 015 MSEK. In the consultation file, the old revenue cap was used[19], which has been amended in calculations used in this report.

Second, the *Average distance for exits* is the distinguishing feature in the CWD compared to the PS. Here, the average of distance to the entry point from all exit points in each cluster is included as a cost driver. For calculations where Södra Skåne and Norra Skåne has been aggregated to 'Skåne', an average has been calculated for all the exit points in both regions.

Third, the *Forecasted contracted capacity* is the forecasted volume in 2019/2020.[20] This includes increasing/decreasing volumes from current customers and additional volume from prospective customers. Since each region pay in relation to their capacity, higher forecasted volumes lead to lower overall prices, and vice versa.

4.3 INCREASING VOLUMES 2019/2022

In the measure for the forecasted contracted capacity, volume increases from prospective customers within 3 years are included, see Table 3 below for a customer-by-customer description of the potential volume increase.

Each customer represents an actual or prospective volume increase in the business plan. The 'Comment'-column describe the current progress per prospective customer, spanning from already ongoing construction to pending final investment decisions.

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16 Art.8.2.d., this is denoted as R_{Ex}.
17 Art.8.2.a.i-ii. this is denoted as $D_{En,Ex}$.
18 Ibid, this is denoted as CAP_{Ex}.
19 At the time of the initial consultation, the new revenue cap had not been decided by court, and therefore the old revenue cap was used.
20 See Table 3 for a more detailed description of the potential volume increase per region.

Table 3
Volume increases in VG, 2019/2022

CUS-TOMER	CURRENT VOLUME (MNM3)	INCREASE VOLUME (MNM3)	YEAR	COMMENT
A	117	34	2022	Incremental growth expected in line with current volume trend. 151 MNm3 expected in 2022.
B	31	60	2020	FID (Final Investment decision) and HPU (Hydrogen Production Unit) taken. Construction is ongoing. HPU to start in Q1 2019.
C	24	70	2020-2022	FID HPU taken. Construction ongoing. HPU to start in spring 2019. Full volume expected in 2022.
D		26	2020	FEED (Front End Engineering & Design) study completed in Sep-18. FID expected in Q4 2018.
E		36	2021	FEED study decision expected in 2019.
F		10	2021	FEED study decision expected in Q4 2018.
Total		**235**		

Note: The customers A-F are prospective and current customers of Swedegas. The increasing volumes are included in Swedegas business plan together with an approximate realisation year. The expected volume increases are based on: (i) construction projects, (ii) incoming investment decisions, or (iii) pending due diligence of decisions for projects
Source: Swedegas

4.4 CROSS-SUBSIDISATION

All steps in section 2.3 are delineated in Table 4. Combined with Capex and Opex values in Table 1 and the weights in Table 5 or Table 6, each step of the calculation can be replicated.

Starting from the top, branch and trunk shares allocated to each area by the RAB. Together, A-D constitute the total cost for the transmission system in each region. The trunk costs are reweighted using data in Table 5[21], so that regions are only allocated costs proportional to their relative usage of the grid. The revenues are based on the forecasted capacity bookings for 2019/20 and indexed to the same year's price level as the revenue cap for RP1. For a more detailed description of the revenues, see Appendix 4.1.

Next, we define the three central components in the analysis.

1. *Trunk costs* – Here, A+B are distributed according the weights as described above. This is a correct measure of costs if each region is to pay for grid according to their relative usage.
2. *Contribution to trunk* – Here, E-(C+D) constitute the amount left of revenues after branch costs are subtracted. This provides a measure on how much each region contribute to trunk costs.

[21] An alternative weighting is done using historical max capacities, see Table 6.

3. *Cross-subsidisation* – Here, *Contribution to trunk – Trunk Costs* are what is left after all costs contingent to a region is covered. This measure proxies the degree of cross-subsidisation in the respective region.

Table 4
Step-wise calculation of cross-subsidisation for the PS model

Step	Description	Skåne	Halland	VG
Trunk share	The amount of trunk lines	44%	11%	16%
Branch share	The amount of branch lines	17%	11%	2%
A	Capex costs contingent to trunk (MSEK)	687	181	248
B	Opex costs contingent to trunk (MSEK)	190	50	69
C	Capex costs contingent to branch (MSEK)	269	169	24
D	Opex costs contingent to branch (MSEK)	74	47	7
E (PS)	Revenues 2019/2020	801	145	942
E (CWD)	Revenues 2019/2020	246	132	1 511
Trunk costs	A+B are distributed by grid usage	493	135	797
Contribution to trunk	E – (C+D)	458	-70	912
Cross-subsidisation	Contribution to trunk – Trunk costs	-35	-205	115

Note: The table illustrates each step of the calculation of cross-subsidisation between regions. Note that revenues are defined both for the PS and CWD model. Trunk costs are distributed according the relative use of each region, see Table 5
Source: Swedegas (data) and Copenhagen Economics (calculations)

Weights of grid usage

In Table 6 an alternative weighting method using historical max capacities can be applied. These numbers can be compared to the weights in Table 5. The alternative method does not change the results.

Table 5
Grid use per region using forecasted capacity bookings

	SKÅNE	HALLAND	VG
Skåne	39%	-	-
Halland	7%	12%	-
VG	53%	88%	100%

Note: The grid use per region is set by the respective region's forecasted capacity bookings. Each percentage is calculated as the relative use per region
Source: Swedegas

Table 6
Grid use per region using historical max capacity

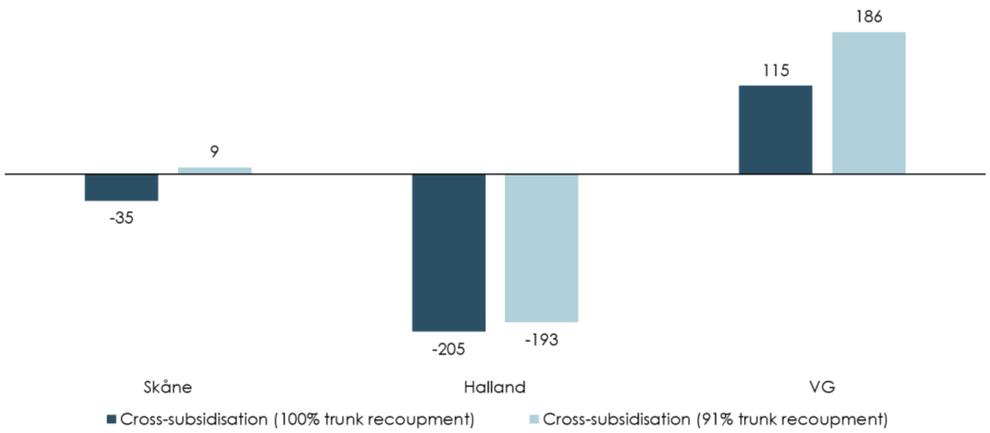
	SKÅNE	HALLAND	VG
Skåne	44%	-	-
Halland	8%	15%	-
VG	48%	85%	100%

Note: The grid use per region is in this table set by the historical max capacities per region. Each percentage is calculated as the relative use per region
Source: Swedegas

Robustness analysis

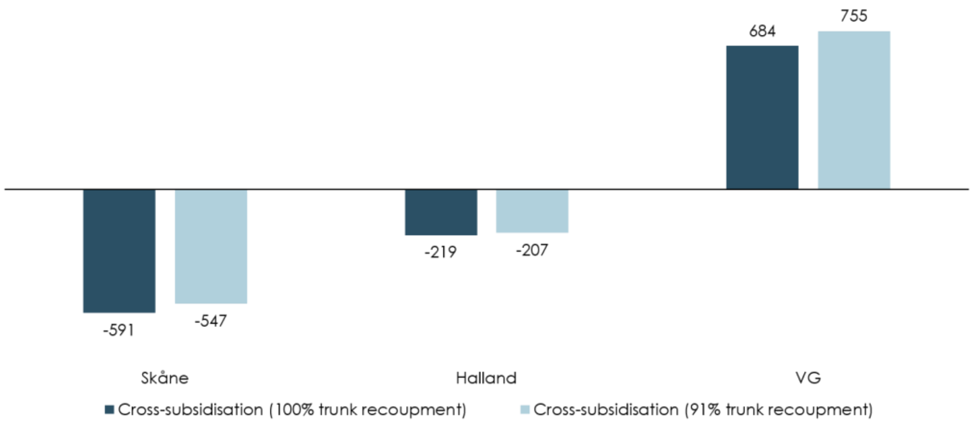
The analysis performed in Figure 12 and Figure 13 is replicated in Figure 18 and Figure 19, respectively, using historical max capacity instead of forecasted capacity bookings. This alternative method only affect how trunk costs are allocated between regions. The conclusions are the same.

Figure 18
Cross-subsidisation per region, PS model (max capacity cost weight)
MSEK



Note: The figure follows calculations in Table 4 are weighted by historical max capacity instead of forecasted capacity bookings
Source: Swedegas (data) and Copenhagen Economics (calculations)

Figure 19
Cross-subsidisation per region, CWD model (max capacity cost weight)
MSEK



Note: The figure follows calculations in Table 4 but use weight use by historical max capacity instead of forecasted capacity bookings
Source: Swedegas (data) and Copenhagen Economics (calculations)

4.5 LNG TERMINAL – THE VALUE CHAIN COMPARED TO PIPELINE GAS

The planned LNG terminal is planned to be an *alternative source* of fuel for shipping, truck transports, and industries without access to the current grid. Due to the value chain for LNG, it is unlikely that the LNG terminal will add more than negligible volume compared to the transmission grid. Below Swedegas value chain is delineated for LNG distribution compared to pipeline distribution.

LNG distribution and regasification value chain includes – TTF + LNG margin, Reloading Zeebrugge + Port fee Zeebrugge + Shipping to Gothenburg + Port fee Gothenburg + Unloading Gothenburg + Storage Gothenburg + Regasification + Transport cost in Sweden. The total cost for this chain depends, for example, on the size of the ship, the size of the LNG terminal, and the utlisation rate. Swedegas estimates a total cost of **10,5-13,5€/MWh** excluding the cost for gas in TTF and excluding the cost of transport in Sweden.

Pipeline distribution value chain from Germany to Sweden includes: TTF + Transport cost in Germany + Transport cost in Denmark + Transport cost in Sweden. The cost for transport in Germany and Denmark is calculated to less than **2€/MWh.**

In conclusion, the value chain for small scale LNG is not competitive enough to compete with pipeline gas.

4.6 SCENARIO ANALYSIS

In our scenario analysis, three scenarios are included. In each scenario, the forecasted contracted capacity in VG is decreased; the likelihood of this happening is qualitatively assessed in Section 3.2.

The scenario analysis has two main assumptions. *First,* the allowed revenue stays the same when implementing the CWD model. Since the revenue cap is decided in advance this assumption is uncontroversial. *Second,* that the average distance for exits are stable when reducing demand in VG. This is likely to hold as long as there as some volume being transmitted to the same bundle of exit points.

Our analysis covers the following scenarios:

1. Scenario 1 – No growth scenario (-23% volume in VG): In this case, the volume increase from current and prospective customers are excluded from VG's forecasted contracted capacity.
2. Scenario 2 – No growth and exit of large industrial customers (-74% volume in VG): Here, large industrial customers in VG exit the gas market.
3. Scenario 3 – VG exits the gas market (-99% volume in VG): This is the end-point if scenario 1 and 2 are realised.

In scenario 1, higher tariffs directly raise tariffs and signal rising long-term costs. There is a risk that higher tariffs could deter prospective customers to proceed with investments. In addition, since most of the increasing volumes are inherent to organic growth of current customers, higher tariffs directly affect the profitability of further gas use, which may affect the overall growth.

For scenario 2, there is no growth and VG's largest industrial clients exit. Since the presence of one large customer significantly affect tariffs, it is reasonable to assume that they will act in unison if they decide to exit the market, because of the spiralling costs of one leaving. Hence, if the initial price increase, and the potential no growth scenario is realized, it may be unprofitable for these large industrial customers to stay in the gas market.

Last, scenario 3, is the case where the entire VG region exits the gas market. This shows how tariffs would evolve with only 1 percent of VG left. This is illustrative in two ways. *First,* it shows the large necessary tariff increases to keep the size of the gas market, given that VG exits. *Second,* the potential for vicious circle are imminent given a large enough loss of demand. The likelihood of this scenario is contingent on the demand response from previous two scenarios.