



**Nationwide Population Coverage  
for the Third Network in Norway**

Response to Telenor's comments of 11<sup>th</sup> May 2012

Submitted to:

**Post- og teletilsynet**

Norwegian Post and Telecommunications Authority

May 2012

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## **1 INTRODUCTION**

Earlier this year, CSMG was engaged by Tele2 and Network Norway to quantify the socio-economic surplus of building a third network that provides nationwide coverage versus 75% of the population. The report setting out our approach and findings, titled “Nationwide Population Coverage for the Third Network in Norway: Socio-Economic Cost Benefit Analysis”, was published on NPT’s website on 27<sup>th</sup> March 2012. Industry stakeholders were invited by NPT to comment on the report.

On 11<sup>th</sup> May 2012, Telenor wrote a letter to NPT detailing its assessment of the CSMG report. The letter suggested that the report contained calculation errors, and also challenged some assumptions used in the report.

This document sets out CSMG’s response to the challenges in Telenor’s letter.

Section 2 shows that CSMG’s original calculations are indeed correct and Telenor is mistaken in its assertion. We provide a detailed explanation of the calculations to disprove Telenor’s claim. Section 3 offers comments on the assumption challenges made by Telenor. The document concludes in Section 4 that Telenor’s letter provides no grounds for changing the conclusions of the original report.

Note that in this document, the term ‘the report’ refers to CSMG’s original report of March 2012.

## **2 COMMENTS ON CALCULATIONS**

### **2.1 Introduction**

Telenor claims that several major calculation errors are present in the report, causing an overestimation of the socio-economic benefit. This conclusion was arrived at through Telenor’s attempt to recreate the model used by CSMG, on the basis of the information available in the report.

Having reviewed Telenor’s comments, we have determined that these findings do not reveal any errors in the report’s original calculations. Telenor’s conclusion regarding calculation errors appears to be due to a mixture of misinterpretation and incorrect assumptions made by Telenor when recreating our analysis.

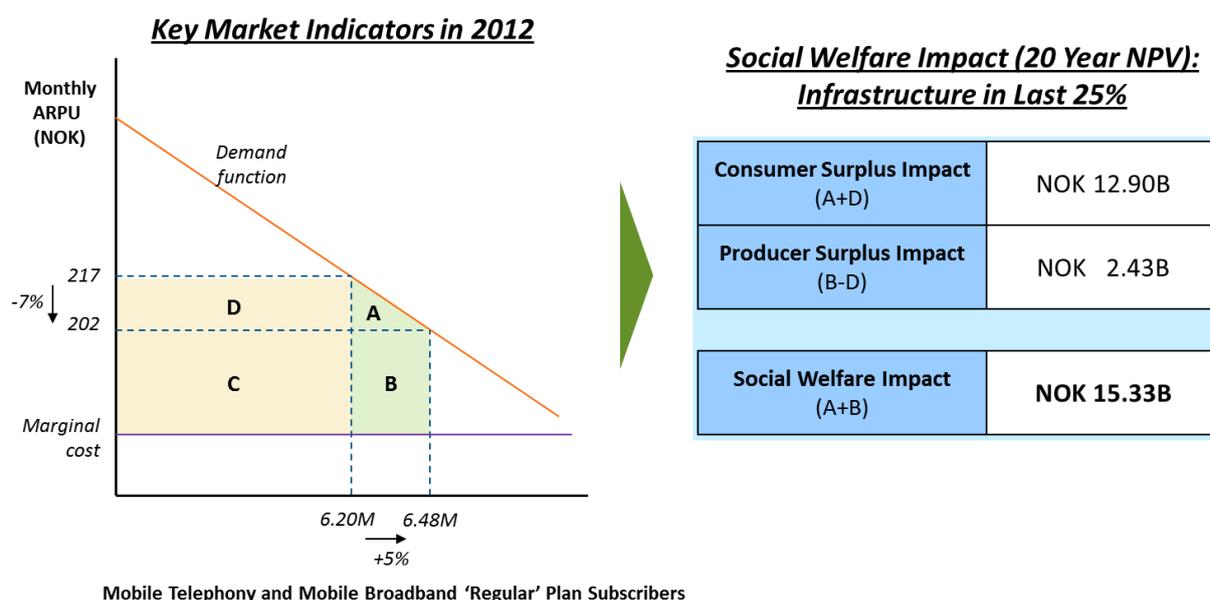
The following sections provide a more detailed walkthrough of the original calculations, so that Telenor and others can follow the calculations and see that no errors exist.

### **2.2 Network Infrastructure in the Last 25% Coverage Area**

Telenor contends in section 3.2.2 of its letter that the report contains a significant error in the calculation of the socio-economic benefit due to Tele2/Network Norway’s network infrastructure in the last 25% coverage area; that the producer surplus impact should be negative rather than positive; and that the total welfare benefit should be NOK 4.686B rather than NOK 15.3B.

In fact, the original calculations in the report are correct. There appears to have been a misunderstanding regarding how Tele2 and Network Norway’s change in cost base is included in the calculation. We explain below how to use the data in the report to perform the calculation correctly.

Note first that the price/quantity diagram in Figure 12 of the report (repeated below) is a simplified view, designed to clearly show the movement in key market indicators (ARPU and subscribers) between the factual and counterfactual cases in 2012. The figure for marginal cost is not shown here, as this figure changes between the Factual and Counterfactual cases due to Tele2 and Network Norway’s change in cost base, as described on p22 and p23 of the report, and as noted by Telenor. Because of this change in marginal cost, the areas B and C in this figure cannot be calculated directly from the diagram.



**Figure 12<sup>1</sup>: Impact of Tele2 and Network Norway’s Entry at the Infrastructure Level**

As described on p16 of the report, consumer surplus is defined as the difference between the maximum amount that consumers are willing and able to pay for a good or service, and the market price, multiplied by the quantity of that good sold. Producer surplus is the difference between total revenue and the total marginal cost of producing the market quantity.

Note that in a case with static marginal cost, the change in producer and consumer surplus can be calculated using the simple geometry of areas A, B, C and D as shown in Figure 12 of the report.

However, given different marginal costs in the Factual and Counterfactual cases, calculation of the social welfare impact requires the producer and consumer surplus to be determined independently for the two cases. The social welfare impact is then the difference in surplus between the two cases.

We use the following inputs for 2012, as noted correctly by Telenor:

<sup>1</sup> Number refers to that in the original report

Input	Factual	Counterfactual
Monthly ARPU (NOK/sub/month)	217.1	202.9 <sup>2</sup>
Subscribers (millions)	6.20	6.48
Tele2/NwN subscribers (millions)	1.31	2.16
Telenor & NetCom subscribers (millions)	4.89	4.32
c <sub>1</sub> - Marginal cost of Telenor and NetCom (NOK/sub/month)	94.8	94.8
c <sub>3</sub> - Marginal cost – Tele2/NwN (NOK/sub/month)	151.6	94.8
a (intercept of the demand curve)	527.2	527.2
b (gradient of the demand curve)	-50.0	-50.0

**Table 1: Calculation Inputs**

In the Factual case, monthly consumer surplus may be calculated as:

$$CS_f = 0.5 * (a - \text{ARPU}) * \text{total subs} = 0.5 * (527.2 - 217.1) * 6.2 = \text{NOK } 961\text{M}$$

In terms of the diagram in Figure 12, this is effectively the area of the triangle above the ARPU = 217 line.

Producer surplus in the Factual case is not directly shown on the diagram in Figure 12, as, due to the difference in marginal cost, it requires a distinction between the quantity generated by Tele2/NwN and that generated by Telenor and NetCom.

Telenor’s calculation appears to omit this distinction, and instead use Telenor and NetCom’s marginal cost for the entire market. This is likely to be the reason why Telenor’s calculation resulted in an incorrect output.

The correct calculation for producer surplus in the Factual case is:

$$\begin{aligned} PS_f &= [(ARPU - c_1) * \text{Telenor \& NetCom subs}] + [(ARPU - c_3) * \text{Tele2/NwN subs}] \\ &= [(217.1 - 94.8) * 4.89] + [(217.1 - 151.6) * 1.31] = \text{NOK } 684\text{M} \end{aligned}$$

In the Counterfactual case, consumer surplus is:

$$CS_{cf} = 0.5 * (527.2 - 202.9) * 6.48 = \text{NOK } 1051\text{M}$$

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<sup>2</sup> We note a presentation error in Figure 12 of our report, where this ARPU of 202.9 is rounded to 202 rather than 203. This will have had a small but immaterial impact on Telenor’s calculation. The precise figure is used in all calculations in the report and this document.

Producer surplus in this case is a simpler calculation, as the three firms now have equal marginal cost:

$$PS_{cf} = (202.9 - 94.8) * 6.48 = \text{NOK } 701\text{M}$$

The annual social welfare impact for 2012 is then:

$$\begin{aligned} \text{Social welfare impact} &= 12 * [(CS_{cf} - CS_f) + (PS_{cf} - PS_f)] \\ &= 12 * [(1051 - 961) + (701 - 684)] = \text{NOK } 1286 \text{ M} \end{aligned}$$

This calculation is repeated for each year between 2012 and 2031 inclusive and the results discounted to give a present value of NOK 15.3B, as shown in the report. Telenor’s conclusion that this result should be NOK 4.686B is therefore incorrect.

The calculation also reveals that the producer surplus is, in fact, positive:

$$\text{Producer surplus impact} = 12 * (PS_{cf} - PS_f) = 12 * (701 - 684) = \text{NOK } 204\text{M}$$

We note that in the calculation used by Telenor to conclude that producer surplus impact should be negative, the marginal cost was set to zero. As marginal cost is non-zero, and changes between the Factual and Counterfactual scenarios, a calculation assuming zero marginal cost is not meaningful in this context.

### **2.3 Mobile Broadband ‘High Usage’ Plans**

Telenor states that the ARPU/quantity forecast used in the high usage mobile data plan calculation contains an error, and that correcting this error results in a socio-economic benefit of NOK 574 M rather than NOK 1.01 B. They arrive at this conclusion by attempting to recreate the forecast from the formulas and figures presented in the report.

Telenor’s attempt to recreate the forecast was unsuccessful. We describe below the original calculation in more detail, showing the basis of our forecast and contrasting this with the figures that Telenor arrived at. In doing so we show that the original calculations are correct, contrary to Telenor’s claim.

To recap our analysis, we constructed the Factual case using market price and quantity forecasts, for which we used ARPU (real) and subscriber volumes respectively. ARPU forecasts were derived by assuming an initial monthly ARPU of NOK 399 (nominal) for mobile broadband ‘high usage in 2012<sup>3</sup> and a nominal annual ARPU growth rate of -10% for the initial years and 0% from 2015 onwards. We derived subscriber volume forecasts based on the number of dedicated mobile broadband

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<sup>3</sup> We consider the monthly price of Telenor’s 20GB Super Broadband L Package at NOK 399 (as of 21 Feb 2012 inc. VAT) to be representative of the average monthly ARPU for mobile broadband ‘high usage’ plans. On the same day, NetCom’s prices for its 15GB and 30GB packages was priced at NOK 399 and NOK 499 respectively, and Tele2’s largest package with 4GB limit was priced at NOK 239. Please note model inputs exclude 25% VAT.

subscribers from NPT’s market forecasts and a constant proportion of such subscribers on ‘high usage’ plans (35%)<sup>4</sup>. The table below states these forecasts:

Period	Year	Nominal Monthly ARPU (NOK)	Nominal ARPU Growth	Real Monthly ARPU (NOK)	Subscribers
0	2012	319.20	-	319.20	339,166
1	2013	287.28	-10%	280.27	343,094
2	2014	258.55	-10%	246.09	345,897
3	2015	258.55	0%	240.09	347,599
4	2016	258.55	0%	234.24	348,440
5	2017	258.55	0%	228.52	349,210
6	2018	258.55	0%	222.95	349,947
...	...	...	...	...	...
19	2031	258.55	0%	161.73	349,999

**Table 2: Mobile Broadband 'High Usage' Plans: Market Price and Quantity Forecasts**

In comparison with Telenor’s table in Section 3.2.3, we can immediately observe that Telenor’s subscriber volume forecasts for the Factual case are not the same as those used in the report. In fact, Telenor’s subscriber volume forecasts show a downward trend, which is inconsistent with the upward trend apparent in NPT market forecasts. This discrepancy explains how Telenor incorrectly concluded that CSMG had significantly over-estimated the socio-economic benefit. Telenor’s claim that CSMG assumed a negative relationship between ARPU and the quantity demanded over time is also false, because subscriber volumes show an upward trend over time, whereas real ARPU shows a trend in the opposite direction.

We also observe that Telenor’s market price forecasts for the Factual case are again not the same as those used in the report. Telenor incorrectly concluded that in order to arrive at CSMG’s results, it was necessary to reduce the quantity demanded by three years and then return to the same level used in the first period. The table above shows this is clearly not the case. Subscriber volume forecasts have been computed as described earlier, and were not manipulated in any other way.

Finally, we can clarify a number of other details that may have been misinterpreted by Telenor, regarding growth rate, marginal cost and the NPV calculation.

The annual ARPU growth rate of -10% in the report refers to nominal prices, rather than real<sup>5</sup>.

<sup>4</sup> 30% of Verizon’s mobile broadband base already uses LTE (Source: Verizon Quarterly Results, CSMG). 35% of UK mobile broadband subscribers are on an ‘unlimited’ plan (Source: YouGov DongleTracker survey, 2010).

<sup>5</sup> We assumed a nominal annual ARPU growth rate of -10% for the initial years and 0% from 2015 onwards. Nominal ARPU was translated to real ARPU using an expected inflation rate of 2.5% in line with advice from the Norwegian Ministry of Finance.

As described in the report, the marginal cost is derived by calibrating the Cournot model. As quantity demanded and the real market price both change over time, marginal cost varies over time, rather than remaining constant.

We also confirm that the overall social welfare impact is calculated over 20 years in every case, not 21 years.

### **3 COMMENTS ON ASSUMPTIONS**

#### **3.1 Introduction**

Section 3.3 of Telenor’s letter contains comments on some of the assumptions used in the report. This section re-assesses the assumptions used in light of Telenor’s comments.

#### **3.2 Model Options**

In the section headed “Model Options”, Telenor correctly points out that CSMG excluded MVNOs from the model and did not account for the differences in market shares between Telenor and NetCom. Telenor also comments that CSMG implicitly assumed that subscribers would be able to seamlessly switch between operators.

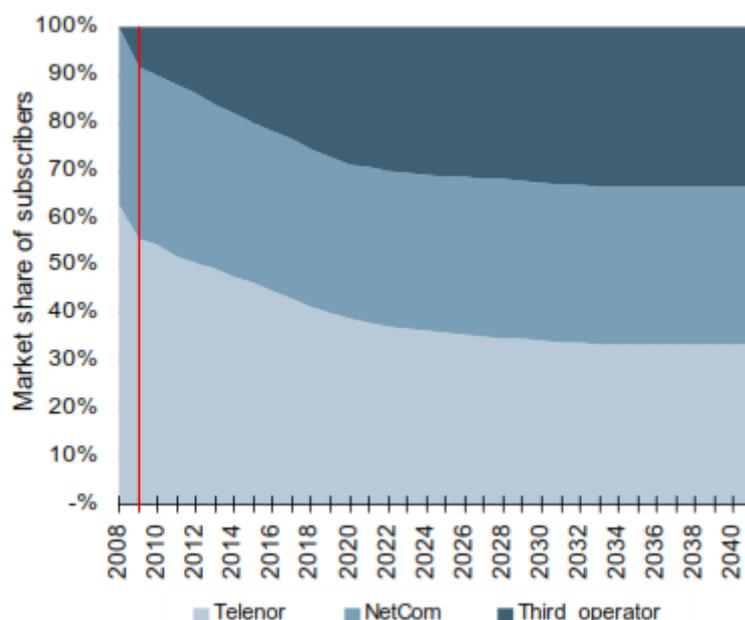
The reason why MVNOs and resellers are excluded from the analysis is that their influence on the Norwegian mobile market is not significant. According to NPT data for 2011 H1, there are only two independent MVNOs/resellers with a market share greater than 1%, namely Ventelo and Lycamobile, which have shares of 2.4% and 1.0% in the market for ordinary mobile telephony subscriptions. Chess has a market share of 8.4%, but is not independent: Chess, like NetCom, is wholly owned by TeliaSonera. Telenor and TeliaSonera’s sub-brands together have more than 75% of the market. Furthermore, even independent MVNOs are partially dependent on the terms offered by their host network, often resulting in a proposition targeted towards a market segment complementary to the host’s customer base. For example, Ventelo targets business customers while Lycamobile focuses on international calling.

We therefore conclude that the independent MVNOs in Norway do not have significant market influence, and should indeed be excluded from the analysis.

CSMG agrees with Tele2’s and Network Norway’s past reasoning that there are disadvantages to an operator which comes late to market. In this regard, Telenor and NetCom benefit from a first mover advantage versus Tele2. This is consistent with Analysys Mason’s forecast described in the model documentation for the NPT’s Mobile Cost Model, version 6<sup>6</sup>. The forecast assumed a third operator entering the market would “steadily achieve 33.3% of market share in the long term if it rolls out a full national network and does not need to rely on national roaming”. The extract below from the model documentation shows market shares gradually converging over time, as the impact of the first mover advantage of Telenor and NetCom erodes over time as subscribers switch between operators.

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<sup>6</sup> NPT’s mobile cost model version 6, Model documentation, Ref: 14336-493, Analysys Mason, 01/12/2009



**Figure: NPT's Mobile Cost Model Version 6: Market Share Evolution**

CSMG acknowledges that the cost-benefit model did not account for the first mover advantage of Telenor and NetCom and therefore implicitly assumed that subscribers would be able to seamlessly switch between operators. However, we can demonstrate that accounting for this in the analysis does not significantly affect the overall impact on social welfare.

In the original calculation, we derived marginal costs for the Factual case by assuming that Telenor, NetCom, Tele2 and Network Norway face the same marginal cost for traffic which travels through their own network. For the proportion of Tele2 and Network Norway’s traffic not carried over their own network, we assume a marginal cost equivalent to the wholesale access prices set by Telenor and NetCom. We estimate Telenor and NetCom’s wholesale access prices by applying a percentage mark-up on the marginal costs they face.

To test the materiality of Telenor’s claim, we have adapted the model to derive marginal costs from using the market shares of Telenor, NetCom and Tele2.<sup>7</sup> For the Factual case, we assume that market shares described for 2012 remain unchanged: Telenor (57%), NetCom (33.3%) and Tele2 (15.0%). Using these market shares, we calibrate the Cournot model to derive the marginal costs required for each operator to produce the Cournot equilibrium price and quantity equal to the forecasted market price and quantity.

For the Counterfactual case, in which Tele2 and Network Norway do not need to resort to national roaming, we assume market shares converge to equal shares of 33% in line with the NPT’s Mobile Cost Model, version 6. In the Cournot model this implies all three operators face the same marginal cost at this end point. We achieve this by setting marginal costs in 2031 for all operators equal to

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<sup>7</sup> We use the market shares given in the model documentation for the NPT’s Mobile Cost Model, version 6. In this model the market shares trend to equal share over time under the assumption that all three players have their own nationwide network.

Telenor’s costs in this period in the Factual case. In terms of starting positions for marginal costs in 2012, we assume Telenor and NetCom face the same marginal costs as they faced in the Factual Case. For Tele2 and Network Norway, we assume they face the marginal cost of the Factual Case minus the national roaming mark-up of 200% applied to 30% of the network traffic.

The reduction in Tele2 and Network Norway’s marginal cost base due to their entry at the infrastructure level leads to a positive social welfare impact. In the first year, the average monthly revenue per subscriber declines by 6% and market quantity increases by 4%.

Over 20 years, there is a positive impact on consumer surplus of NOK 19.7B and a negative impact on producer surplus of NOK 1.6B. Overall, social welfare increases by a net present value of NOK 18.1B. This represents an increase over the result of NOK 15.3B in the original calculation.

In summary, we have evaluated the impact of accounting for market shares of Telenor and NetCom, and found that the revised calculation also shows a positive social welfare impact.

Furthermore, by assuming that market shares converge to equal shares of 33%, instead of starting immediately at 33% for all three operators, we are taking into account that seamless switching between operators does not occur and that subscribers take time to switch to the operator that suits their needs better.

### **3.3 Marginal Cost**

Both the marginal cost and national roaming mark-up assumptions are based on robust data, assumptions and methodology.

The marginal cost assumption is derived using the Cournot model with inputs for ARPU, subscriber volumes, price elasticity and the number of players in the market. This is described on p15 of the report and uses formulae in appendix B of the report.

The ARPU and subscriber volume assumptions are derived from the NPT’s market review and LRIC model v7.1 respectively. The price elasticity assumption is based on an extensive review of recent relevant studies, as described on p18 of the report. We assume three players in the market, counting Tele2 and Network Norway as one, and discounting small MVNOs and operator sub-brands that have insignificant market influence. Finally, the calculation to combine these assumptions uses the Cournot model, which is highly suitable for the analysis of market-level effects and socio-economic welfare as demonstrated on p14 of the report.

The national roaming mark-up assumption of 200% is based on an analysis of marginal and average costs based on the NPT’s LRIC model, which gives a mark-up from marginal cost to wholesale access price of between 130% and 330%. CSMG’s knowledge and experience of wholesale mobile contracts suggest that the mark-up may be even higher than this in practice.

Therefore, the marginal costs and national roaming mark-up results used in our analysis are supported by publically available data and methodologies. However, Telenor believes the resulting marginal cost is too high.

We therefore examine the effect of a low case 100% national roaming mark-up. This low case does show profitable MVNOs using Telenor’s calculation, and still gives a positive overall net benefit of NOK 3.0B. This challenge therefore does not provide any reason to alter the report’s conclusions.

### **3.4 Market Definition of Mobile Broadband**

Telenor comments that CSMG assumes that there are only two operators that offer mobile broadband ‘high usage’ plans in Norway, and that Tele2 and Network Norway would only be able to enter this market segment if they had a nationwide mobile network. Telenor added that other players in the market such as ICE had been ignored by CSMG.

In our report, we explained our rationale behind describing the market segment for mobile broadband ‘high usage’ plans in Norway as a duopoly, shared between Telenor and NetCom. We illustrated the difference between the largest packages of Tele2, OneCall, Telenor and NetCom:

*As of 21 February 2012, Tele2’s largest dedicated mobile broadband package at a retail price of NOK 239 has a 4GB limit and its speed is reduced to 64 kb/s when monthly consumption exceeds the limit. OneCall, a sub-brand of Network Norway, offers a 5GB plan (temporarily raised to 10GB during a marketing campaign) for a retail price significantly higher than that of Telenor and NetCom. In contrast, both Telenor and NetCom offer packages with far higher data limits. Telenor’s largest package has a 20GB limit, and NetCom has packages with 15GB and 30GB limits. We therefore define ‘high usage’ mobile broadband plans as those with a cap of at least 15GB.*

According to NPT data, Telenor and NetCom together have more than 75% of the dedicated mobile broadband market; in 2011 H1, Telenor’s market share was 54.7% and NetCom’s market share was 22.6%<sup>8</sup>. The remaining quarter of the market is served by other operators.

Telenor’s and NetCom’s market shares are even greater in the ‘high usage’ segment of the mobile broadband market. This can be deduced by looking at current packages offered by other mobile broadband operators. ICE which has its own nationwide network is currently the third largest mobile broadband provider with a 12.0% market share in 2011 H1. ICE’s largest dedicated mobile broadband package at a retail price of NOK 299 has a 6GB limit, which is significantly lower than the 15GB threshold we use to define ‘high usage’ mobile broadband plans.

Further evidence can be found on [www.telepriser.no](http://www.telepriser.no), a price comparison service offered by the NPT. Reviewing the latest prices for mobile broadband one can see that the only operators that offer plans with 15GB or more are Telenor, NetCom and NextGenTel. The lowest price of a 15GB or higher plan is NOK 399, hence the ARPU assumption used in the report. As was the case when the report was written, Telenor’s largest package has a 20GB limit, and NetCom has packages with 15GB and 30GB limits. NextGenTel offers ‘high usage’ packages with the same usage caps as NetCom at the same prices, which is unsurprising given that both NextGenTel and NetCom are owned by TeliaSonera.

Tele2 continues to have no presence in the ‘high usage’ segment. Its largest dedicated mobile broadband package has only a 4GB limit.

In summary, Telenor and NetCom are dominant in the market for mobile broadband. In the ‘high usage’ segment of this market there are no other players.

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<sup>8</sup> The Norwegian Electronic Communications Services Market 2011 H1, NPT, 14 November 2011

### 3.5 Commercial Profitability

Telenor argues that Tele2’s cost savings will have a present value of NOK 7.5 B, implying that the network expansion would be commercially profitable even without asymmetric mobile termination rates.

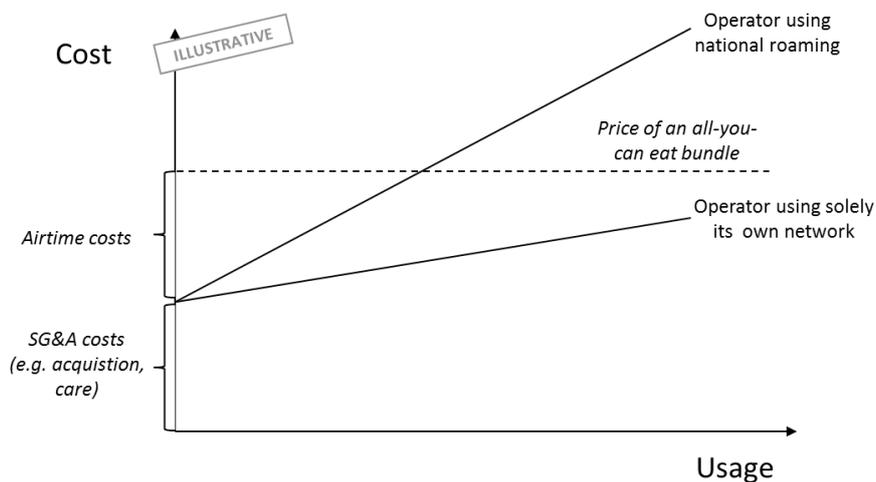
The Cournot model is not appropriate for assessing the case of a particular investment. Any assessment of the profitability of expanding Tele2’s network would need to take into account the commercial risks that Tele2 would face. Moreover, it should consider the likely impact and persistence of Telenor’s and NetCom’s first mover advantages.

### 3.6 Developments in the Retail Market

Section 4.3 (a) of Telenor’s letter discusses developments in the retail market, and specifically Tele2’s ability to match the prices of Telenor’s ‘all-you-can-eat’ packages.

The marginal cost faced by an operator producing minutes on its own network is substantially lower than the wholesale access rates available in the market. This means that, for an operator such as Tele2 and Network Norway that relies on national roaming for a portion of its traffic, a customer that consumes a large amount of traffic via national roaming will cost significantly more than it would for an operator that did not use national roaming.

Therefore, in the case of ‘all-you-can-eat’ package, a sufficiently high usage customer would still be profitable for an operator using solely its own network, while being unprofitable for an operator forced to use national roaming. This is shown in the illustrative figure below.



**Figure: Illustrative analysis of ‘all-you-can-eat’ package profitability**

## 4 CONCLUSION

Telenor’s findings do not reveal any errors in the report’s original calculations.

Telenor suggested there was an error in the calculation regarding Tele2 and Network Norway’s lower cost base due to network infrastructure. We found that there is no error in the calculation, and that Telenor’s conclusion appeared to be due to a misinterpretation of the description in the report. We describe above the correct method for calculating the social welfare impact in this case.

Telenor also believed there to be errors in the calculation used to generate the ARPU and subscriber forecasts for ‘high usage’ mobile broadband, based on an attempt to recreate the forecast from the formulas and figures presented in the report. We found that Telenor’s attempt to recreate the forecast was unsuccessful, and show that the original calculations are correct, contrary to Telenor’s claim.

For a number of assumptions challenged by Telenor, we disagree with Telenor’s analysis and find no reason to change the original assumptions. Specifically, this includes: the decision not to include MVNOs in the model; the market definition of ‘high usage’ mobile broadband; and ARPU assumptions for ‘high usage’ mobile broadband.

For other assumptions, we tested alternatives and found the revised calculation still shows a positive net benefit. This includes: market share assumptions; the movement of customers between operators; and the marginal cost assumption.

In summary, we find no reason within Telenor’s letter to alter the conclusion of the original report. The expansion of the third network to nationwide coverage will deliver a socio-economic benefit to Norway.