TØI report 1859/2021

Kenneth Løvold Rødseth
Wiljar Hansen
Timo Kuosmanen
Finn Førsund

Institute of Transport Economics
Norwegian Centre for Transport Research

Benchmarking of outlier electricity grid companies

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Sammendrag:

I denne rapporten undersøker vi alternative metoder for sammenlignende effektivitetsanalyse av enheter som på bakgrunn av sin størrelse eller egenart, er unntatt fra utformingen av kostnadsnormen i den økonomiske reguleringen av norske strømnettselskaper. Formålet med rapporten er å danne et underlag i det videre arbeidet til NVE-RME med å utarbeide en inntektsrammeregulering som i større grad enn i dag bidrar til å fylle energilovens formålsbestemmelse. Dette gjøres gjennom en større grad av frikopling mellom egne kostnader og kostnadsnorm for selskapene som i dagens regulering er unntatt målestokk-konkurransen i utformingen av kostnadsnormen. I rapporten undersøker vi tre alternative metodiske retninger: a) tilpasninger til DEA metodikken, b) paneldata analyser og c) lokale front estimatorer. Basert på analysene i rapporten, foreslår vi å gå videre med nærmere studier av egnetheten til lokale front-estimatorer for inkludering av selskapene som i dag er utelatt fra målestokk-konkurransen i beregningen av kostnadsnormen.

Summary:

In this report we investigate alternative methods for benchmarking of Norwegian electricity grid companies that due to their uniqueness or size are omitted from the yardstick competition in the current income cap regulation. The objective of the report is to propose a regulatory framework that to a greater extent than the current regulation, ensures the decoupling between cost norm and actual costs for the outlier electricity grid companies, and by that, provide incentives for efficient utilization and development of the electricity network grid. We investigate three alternative methodological directions: a) adjustments to the DEA-methodology, b) panel data analysis and c) local frontier estimators. Based on our analysis, we recommend local front estimators as the most likely candidate for further study and implementation in the regulation.

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Transportøkonomisk Institutt
Gaustadalléen 21, 0349 Oslo
Telefon 22 57 38 00 - www.toi.no

Institute of Transport Economics
Gaustadalléen 21, N-0349 Oslo, Norway
Telephone +47 22 57 38 00 - www.toi.no

Preface

This report is the results of research commissioned by The Norwegian Energy Regulatory Authority (NVE-RME). The objective of the research has been to investigate alternative methods for benchmarking of Norwegian electricity grid companies that by their size or uniqueness currently are omitted from the Data Envelopment Analysis (DEA)-yardstick competition framework imposed on the industry. The aim of the research has been to propose a comprehensive model for income cap regulation for the companies that are currently not included in the comparative analysis for determining the cost norm of Norwegian electricity grid companies.

The alternative methods investigated are:

1. Adjustments to the DEA methodology
2. Panel data analysis
3. Local frontier estimators

The research team has consisted of Wiljar Hansen (project leader), Kenneth Løvold Rødseth, Timo Kuosmanen (Alto University, Finland), Finn Førsund and Rasmus Bøgh Holmen

Contact person at NVE-RME has been Roar Amundsveen, aided by Hilde Marit Kvile and Ole-Petter Kordahl. We are thankful for their excellent cooperation, productive project meetings and constructive feedback.

The internal quality assurance of this report as conducted by Chief Research Economist Askill Harkjerr Halse.

Oslo, December 2021

Institute of Transport Economics

Bjørne Grimsrud
Managing Director

Kjell Werner Johansen
Research Director

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I denne rapporten undersøker vi alternative metoder for sammenlignende effektivitetsanalyse av strømnettsel-skaper som på bakgrunn av sin størrelse eller egenart er unntatt fra utformingen av kostnadsnormen i den økonomiske reguleringen av norske strømnettselskaper. Ønsket har vært å utforme en helhetlig modell for inntektsregulering av de selskapene som per i dag enten er tilnærmet avkastningsregulert gjennom at deres kostnadsnorm settes lik kostnadsgrunnlaget eller har en kostnadsnorm som er fastsatt på grunnlag av et femårig flytende gjennomsnitt av selskapets egne kostnader og oppgaver. Formålet med rapporten er å danne et underlag i det videre arbeidet til Reguleringsmyndighet for energi (NVE-RME) med å utarbeide en inntektsrammeregulering som i større grad enn i dag bidrar til å fylle energilovens formålsbestemmelse. Dette gjøres gjennom en større grad av frikopling mellom egne kostnader og kostnadsnorm for selskapene som i dagens regulering er unntatt målestokk-konkurransen i utformingen av kostnadsnormen.

I rapporten undersøker vi tre alternative metodiske retninger for sammenlignende effektivitetsanalyser av de utelatte nettselskapene:

1. *Tilpasninger til DEA-metodikken*
2. *Paneldata analyser*
3. *Lokale front-estimatorer*

Basert på analysene i rapporten, foreslår vi å gå videre med nærmere studier av egnetheten til lokale front-estimatorer for inkludering av selskapene som i dag er utelatt fra målestokk-konkurransen i utformingen av kostnadsnormen til strømnettselskapene

Bakgrunn

Markedet for overføring av strøm er karakterisert som et naturlig monopol; det er høye kostnader forbundet med bygging av nett, samtidig som det ikke er samfunnsmessig rasjonelt å bygge flere parallelle og konkurrerende overføringsnett. Uregulert vil et naturlig monopol levere et for lavt kvantum til en for høy pris. Reguleringsmyndighet for Energi (NVE-RME) er reguleringsmyndighet for kraftmarkedet og nettmonopolet i Norge. Monopolreguleringen skal sikre en rasjonell drift, utnyttelse og utvikling av strømnettet. Det kreves konsesjon for å bygge, eie og drive nettanlegg, samt at nettselskapene er under-lagt direkte regulering i form av krav og plikter og insentivbasert regulering gjennom inntektsreguleringen.

Den insentivbaserte inntektsrammereguleringen skal gi nettselskapene insentiver til å oppfylle de krav og plikter som er gitt av den direkte reguleringen på en kostnadseffektiv måte. Dersom en monopolist automatisk får dekket alle sine kostnader, vil den ikke ha insentiver til å være kostnadseffektiv, men derimot ha insentiver til å overdrive sine faste kostnader gjennom investeringer utover det som er samfunnsøkonomisk optimalt.

Selskapenes inntektsramme fastsettes dels utfra selskapets faktiske kostnader og dels utfra en beregnet kostnadsnorm. Kostnadsnormen uttrykker det som er beregnet til å være det nødvendige kostnadsnivået for å drifte, utnytte og utvikle nettet gitt oppgaven til hvert enkelt selskap. I dagens system er disse to komponentene i inntektsrammen vektet med henholdsvis 40 prosent (faktiske kostnader) og 60 prosent (kostnadsnorm).

NVE-RME har benyttet sammenlignende effektivitetsanalyser i den økonomiske reguleringen av nettselskapene siden 1998. I all hovedsak, har *Data Envelopment Analysis* (DEA) vært det benyttede metodiske verktøyet i fastsettelsen av kostnadsnormen. I DEA blir selskapene evaluert mot individuelt konstruerte mønsterselskap som skal reflektere den lavest observerte ressursbruken for den oppgaven det evaluerte selskapet er satt til å utføre. Metoden omhyller datapunktene hvor det dannes en kostnadsfront bestående av referanseselskaper. Hvert selskap sin ressursbruk blir deretter evaluert opp imot denne kostandsfronten som er frikoplet fra selskapenes egne faktiske kostnader. Målt effektivitet er den relative avstanden mellom selskapets ressursbruk og fronten som reflekterer beste praksis (kostnadsnormen).

Dette er en velkjent metodikk for effektivitetsanalyse hvor et av dens fortrinn er at den er ikke-parametrisk, noe som betyr at analytikeren slipper å velge formen på funksjonen som skal tilpasses. Dermed unngår man valg av funksjoner som ikke passer data. En ulempe med metoden er at den er deterministisk, det vil si at den ikke skiller mellom effektivitet og stokastisk variasjon i dataene, men at alle avvik fra den estimerte fronten tolkes av modellen som ineffektivitet. Metoden blir dermed sårbar for målefeil i data og for spesielt innflytelsesrike datapunkter. Det er separate analyser for distribusjons- og regionalnettet, hvor oppgavene selskapene er satt til å utføre er modellert ulikt i de to nettnivåene. NVE-RME korrigerer deretter for rammebetingelser i en såkalt 2-stegs analyse hvor effekten av kontekstuelle faktorer (dvs. faktorer som påvirker effektivitet, men som ikke kan kontrolleres av nettselskapene) mht. effektivitetsscorene fra DEA-modellen analyseres ved hjelp av regresjonsanalyse.

Enkelte nettselskaper er utfra sin egenart eller størrelse unntatt fra den sammenlignende effektivitetsanalysen i utformingen av kostnadsnormen. For disse selskapene er det utarbeidet alternative metoder for beregning av kostnadsnorm og regulering. I dette prosjektet skal det utformes en helhetlig modell for inntektsregulering av de selskapene som per i dag enten er tilnærmet avkastningsregulert gjennom at deres kostnadsnorm settes lik kostnadsgrunnlaget eller har en kostnadsnorm som er fastsatt på grunnlag av et femårig flytende gjennomsnitt av selskapets egne kostnader og oppgaver.

Forslaget til inntektsregulering må være innenfor de rammene som dagens energilov og underliggende forskrifter fastsetter. Dette innebærer at de foreslåtte metodene for inntektsregulering må fastsette en inntektsramme for selskapene som over tid dekker kostnadene ved drift og avskrivning av nettet, samt gir en rimelig avkastning på investert kapital, gitt effektiv drift, utnyttelse og utvikling av nettet. Den insentivbaserte reguleringen skal med andre ord gi et inntektsgrunnlag for selskapene som, gitt effektiv drift, gjør selskapet i stand til å møte de krav og plikter som er gitt av den direkte reguleringen.

Formålet med arbeidet er å danne et underlag i det videre arbeidet til NVE-RME med å utarbeide en inntektsrammeregulering som i større grad enn i dag bidrar til å fylle energilovens formålsbestemmelse. § 1.2 (formål) i Lov om produksjon, omforming, overføring, omsetting, fordeling og bruk av energi m.m. (energiloven). Med dette menes at den foreslåtte metoden for inntekstregulering av selskaper som grunnet sin særskilte egenart eller størrelse i dag ikke er omfattet av målestokkonkurranse i utformingen av kostnadsnormen, skal ha en større grad av frikobling mellom egne kostnader og kostnadsnorm i det utformede forslaget enn hva tilfellet er i dagens regulering av disse nettselskapene.

Analyser og resultater

I rapporten undersøker vi tre alternative metodiske retninger for sammenlignende effektivitetsanalyser av nettselskapene som på bakgrunn av sin egenart eller størrelse er utelatt fra dagens analyserammeverk:

1. Tilpasninger til DEA metodikken
2. Paneldata analyse
3. Lokale front-estimatorer

Vi omtaler selskapene som på bakgrunn av sin størrelse eller egenart er unntatt analysene som *spesielle enheter*, mens de øvrige selskapene omtales som *konvensjonelle enheter*.

Tilpasninger til DEA-metodikken

NVE-RME antar konstant skalautbytte (CRS) i sine DEA-analyser benyttet til regulatoriske formål. For å forstå hvordan rangeringen av de spesielle enhetene avhenger av skalautformingen, vurderer vi både CRS og variabelt skalautbytte (VRS) i DEA modellen. Videre estimerer vi kostnadsnormen ved å a) slå sammen konvensjonelle og spesielle enheter i samme analyse og b) utelukkende basert på konvensjonelle enheter for å analysere effekten de spesielle enhetene har på kostnadsfronten.

Vi følger NVE-RME sin tilnærming til bruk av tverrsnittsdata i analysene, noe som innebærer at vi anvender et 5-års gjennomsnitt for å konstruere kostnadsnormen, mens siste års data brukes til å evaluere effektiviteten til selskapene. Som en sensitivitetstest vurderer vi hvordan bruk av 5-årsgjennomsnittet også for effektivitetsvurderingen påvirker resultatene.

Basert på analysene, konkluderer vi med at enkle justeringer av DEA-metodikken ikke er egnet til å inkludere de små og særegne nettselskapene i samme DEA-modell som de øvrige konvensjonelle selskapene. Egenarten til selskapene gjør at et flertall av dem blir svært ineffektive i analysene, samtidig som enkelte selskaper blir supereffektive og bidrar til å danne en kostnadsfront som ikke er oppnåelig for konvensjonelle enheter.

Paneldata analyse

Fordelene ved paneldata-analyse er velkjent. For det første, øker antall observasjoner tilgjengelig for effektivitetsevalueringen sammenlignet med DEA analysen på tverrsnittsdata. Dette er verdifullt for ikke-parametriske modeller som DEA som er sårbare for *dimensjonalitetens forbannelse*: Få observasjoner kan gjøre det vanskelig å skille mellom effektive og ineffektive enheter, særlig dersom det er mange variabler i modellen. For det andre gjør bruk av paneldata det mulig å ta hensyn til uobserverbar heterogenitet. Det vil si at det er mulig å redegjøre for forskjeller mellom DSOer[1] som er uobserverbare eller ikke en del av vurderingsgrunnlaget.

Vi baserer paneldataestimeringen på konvekse ikke-parametriske minst kvadrats metode (CNLS), jfr. Kuosmanen (2008), som et alternativ til DEA for å estimere referanse-fronten på en ikke-parametrisk måte. DEA framkommer som et spesialtilfelle av denne paneldatametodikken, se Kuosmanen og Johnson (2010) for detaljer. Men i motsetning til i DEA, kan vi nå ta hensyn til stokastisk variasjon i dataene.

[1] Forkortelse som blir benyttet om strømnettselskaper som opererer i distribusjons- eller regionalnettet: Distribution system operators (DSO)

Vi benytter observasjoner per DSO for hvert år mellom 2015 og 2019 i paneldata-CNLS-modellene. Vi estimerer paneldatamodellene for:

1. alle DSOer, det vil si både konvensjonelle og spesielle enheter
2. kun spesielle DSOer separat

Resultatene av analysene viser at noen spesielle enheter har stor innflytelse på fronten også når vi benytter paneldata-CNLS til å estimere kostnadsnormen. Som en konsekvens av dette blir et flertall av DSOene svært ineffektive både når spesielle og konvensjonelle enheter er inkludert i modellen og når spesialenheter vurderes separat. Vi konkluderer med at panel-CNLS ikke avhjelper problemene som ble identifisert når vi forsøkte å inkludere spesielle enheter i en samlet DEA analyse og dermed ikke er en egnet kandidat for videre analyser.

Lokale front-estimatorer

I de foregående evaluerte metodene, har vi konsentrert oss om modellalternativer som etablerer en felles referansenorm for alle enheter. Vi beveger oss nå vekk fra dette og ser nærmere på estimatorer som kun bruker sammenlignbare DSOer til å danne fronten i analysene. Med sammenlignbare DSOer mener vi her enten DSOer som er sammenliknbare når det gjelder oppgavevariable eller størrelse (målt i kostnadsnivåer). Det førstnevnte tilfellet krever Kernel- eller lokalt vektet regresjon, mens det siste tilfellet krever kvantilregresjon. Vi vurderer begge tilfellene ved bruk av tverrsnitts-CNLS med et ensidig restledd. Som under paneldata-analysene, så er CNLS i dette tilfellet i praksis en DEA-modell. Derfor refererer vi til estimatorene som henholdsvis lokalt vektet og kvantil-DEA.

Lokalt vektet DEA

Vi introduserer en helt ny estimator spesielt utviklet i dette prosjektet, inspirert av den betingede DEA-estimatoren til Daraio og Simar (2007). I modellen minimeres summen av kvadrerte residualer kun for enheter som har Kernel-vekter som er ulike fra null. Det vil si enheter som er sammenliknbare med hensyn til sine oppgaver. Utformingen av CNLS-modellen sikrer at det estimeres en lokalt vektet DEA modell-der det justerte feilleddet gir et estimat på effektivitet.

Grunnet konvergensproblemer i estimeringen for regionalnettet, er vi kun i stand til å presentere resultater for selskapene i distribusjonsnettet. Gitt forutsetningen i analysen anslår lokalt vektet DEA tydelig konvensjonelle enheter som mer effektive enn hva tilfelle var ved ordinær DEA. Tilnærmingen har imidlertid liten betydning for rangeringen av spesialenheter, som for de fleste tilfeller anses som svært ineffektive. Justeringer av parametere i modellen kan avhjelpe dette problemet, men kan også føre til et svært begrenset sett av DSOer som legges til grunn i estimeringen. Dette illustrerer hovedproblemet med denne typen estimator, hvor bare en begrenset mengde av datasettet benyttes til estimeringen av hver lokale front.

Kvantil-/ekspektil-DEA

Ved å benytte kvantil-/ekspektil-regresjon er vi i stand til å analysere forholdet mellom kostnader og kostnadsdrivere ved spesifikke kvantiler/ekspektiler av kostnadsfordelingen. Det vil si å identifisere lokale fronter som er betinget av kostnadsnivået til DSOene. I kvantil-/ekspektil-DEA benyttes hele utvalget til å konstruere lokale fronter. Dette gir statistiske fordeler i forhold til lokalt vektet DEA.

I motsetning til de øvrige metodiske tilnærmingene som er vurdert i denne rapporten, viser det seg at kvantil-/ekspektil-DEA gir rimelige anslag på effektiviteten til så vel spesielle som konvensjonelle enheter. Vi anser derfor denne metoden som en egnet kandidat for å håndtere utliggerproblemer knyttet til spesielle enheter som har blitt funnet både for vanlig DEA og for CNLS med paneldata.

Anbefaling

Kvantil-/ekspektil-DEA fremstår som en lovende metode for benchmarking av både spesielle og konvensjonelle enheter. Vi anbefaler å vurdere metoden for videre testing, med sikte på å ta tilnærmingen som en del av metodikken for benchmarking av norske DSOer. Dette kan skje enten ved å benytte metoden kun for spesialenheter, eller ved å foreta en fullverdig overgang fra konvensjonell til kvantil-/ekspektil-DEA for alle DSOer.

Kvantil-/ekspektil-DEA er langt mindre følsom for ekstremobservasjoner enn konvensjonell DEA. I tillegg muliggjør kvantil-/ekspektil-DEA separate effektivitetsvurderinger for klynger av DSOer gruppert i henhold til deres økonomiske størrelse.

Vi finner at det er tre hovedfordeler ved bruk av kvantil-/ekspektil-DEA til estimeringen av kostnadsfronten for norske nettselskaper:

1. Metoden er basert på de samme prinsippene som konvensjonell DEA. Ettersom de regulerte DSOene er godt kjent med DEA-metodikken, forventer vi at kostnadene ved å kommunisere den nye metodikken til brukerne vil være relativt lave.
2. Kvantil-/ekspektil-DEA muliggjør bruk av et samlet datasett som omfatter konvensjonelle og spesielle enheter. Dette øker utvalgsstørrelsen i forhold til det opprinnelige utvalget som ble brukt av NVE-RME for benchmarking, og forbedrer dermed effektivitetsestimatene ved å motvirke forventningsskjevhet i små utvalg.
3. Kvantil-/ekspektil-DEA utnytter effektivt informasjon både fra konvensjonelle og spesialenheter når de danner lokale fronter. Dette gir en fordel i forhold til å estimere fronter kun for spesialenheter separat, for eksempel ved bruk av CNLS på paneldata.

Selv om kvantil-DEA virker som den mest fruktbare veien videre i arbeidet med å inkludere selskapene som på bakgrunn av sin størrelse og egenart per i dag ikke er inkludert i den sammenlignende effektivitetsanalysen av nettselskapene i dagens reguleringsregime, så har denne metoden også noen ulemper sammenlignet med konvensjonell DEA. For det første er kvantil-DEA mer krevende å beregne enn standard DEA. For det andre må regulatoren velge hvilke kvantiler som skal benyttes i inntektsreguleringen, og DSOer må fordeles mellom valgte kvantiler. Dette innebærer en viss grad av subjektiv vurdering. Å definere kvantilgrenser og allokeringsregler for DSOer kan forårsake noen kontroverser blant de som blir vurdert. Slike kriterier må være klart definert og kommunisert, og utviklet på en måte som tar rettferdighetshensyn og samtidig unngår perverse insentiver.

1 Introduction

1.1 Introduction

The Norwegian Energy Regulatory Authority (NVE-RME) is the national regulatory authority for the power market and electricity grid system in Norway. Norwegian electricity grid companies are subjected to revenue cap regulation, where NVE-RME annually sets the limit for the network companies permitted income. The allowed revenue is supposed to cover operating costs and depreciation and, over time, give a reasonable return on investments given efficient operations, utilisation and development of the network. In the economic regulation the income cap is determined as a weighted average of the industry's cost norm and the actual costs of the individual companies. Efficient companies gain a higher return on their invested capital than less efficient companies.

A basic principle in the theory of economic regulation is the decoupling between the companies' actual costs and the cost norm. Norwegian electricity grid companies are subjected to benchmarking where Data Envelopment Analysis (DEA) is used to determine the cost norm and ensure the decoupling. However, some network companies are regulated separately on the basis of distinctive characteristics that makes comparison with other companies difficult, usually based on their uniqueness or size. This applies to both companies in the regional distribution network and in the local distribution networks. In this report we investigate alternative methods for benchmarking of such outlier electricity grid companies with the aim of proposing a comprehensive model for income cap regulation of companies that are currently not included in the comparative analysis for determining the cost norm of Norwegian electricity grid companies.

1.2 Background

The Norwegian electricity grid system consists of three levels: the transmission grid, the regional and local distribution grid. The three-level subdivision is based upon grid voltage. Statnett owns and operates the transmission grid and is the Norwegian TSO, while approximately 125 different distribution system operators (DSOs) operate the local (22kV-240V) and regional (132kV-33kV) distribution networks. All the DSOs are managed as private business entities irrespective of their private or public ownership.

The market for the transmission of electricity is characterized as a natural monopoly and hence has weak incentives for efficient production and strong incentives for monopoly pricing. Electricity transmission and distribution networks are capital intensive operations with economies of scale and it is not rational to build parallel and competing transmission networks.

Regulation theory states that "cost-of-service" pricing do not provide incentives for companies to minimize costs. Unregulated, a natural monopoly will deliver a too low quantity at too high a price. Firms in a monopoly setting will exploit their market power, resulting in a welfare loss. To achieve an efficient production and pricing, natural monopolies must be regulated. The Energy Act, in force from 1991, gives the Norwegian Water Resources and Energy Directorate delegated powers to regulate the transmission network companies. In 2019 the Norwegian Energy Regulatory Authority was established as an independent national regulator for the Norwegian electricity and downstream gas market.

The Norwegian electricity network companies are subject to direct and incentive-based regulation, which in total shall ensure socially efficient operation, utilization and development of the power grid. Benchmarking has been an important part of Norwegian regulation since the very beginning of the deregulated era. Revenue cap regulation of Norwegian network companies was introduced in 1997 using DEA as the prime benchmarking tool. The aim of revenue cap regulation is to provide the monopoly firm with incentives similar to those faced by firms in a competitive market. In regulatory theory, yardstick competition was introduced by Shleifer (1985), suggesting to compare the observed costs of a company with the observed costs of its competitors. However, it can be difficult to find competitors that are sufficiently similar and by that serve as an appropriate benchmark in the regulation. This is particular the case for companies that by their size or uniqueness make comparison with other companies difficult.

The companies' allowed revenue is determined partly on the basis of the company's actual costs and partly on the basis of a calculated cost norm. In the current regulatory system, these two components of the revenue cap framework are weighted by 40 percent (actual costs) and 60 percent (cost norm), respectively. This implies that companies receive cost coverage for 40 percent of their actual costs. The weights put on the cost norm will increase to 70 percent from 2023, making cost efficiency even more attractive. By assigning greater weights to the cost norm in the regulation, the cost-reducing yardstick mechanisms are enhanced. The revenue cap is set annually where DEA is used as a comparative benchmarking tool in determining the cost norm with a two-year lag in the cost data. There are separate DEA models for local and regional distribution network companies. In order to take into account differences in geographically challenges between the companies, the DEA results are adjusted using a second stage regression analysis. The two-stage approach account for the heterogeneity in the network companies operating environment. The companies set their tariffs based on their allowed revenue. The weight put on the cost norm in the income cap regulation determines how unnecessarily high costs in the companies are to be distributed between the users of the transmission networks and the owners of the network companies.

The regulator calibrates the cost norm such that the total costs of the industry equal the sum of the cost norms. This implies that a network company with an average measured efficiency, will receive a pre-defined rate of return on their investments. The companies with a lower-than-average DEA result will receive a lower-than-average return, while a company with a higher-than-average DEA score will receive a higher-than-average rate of return. Currently the estimated NVE-RME decided rate of return is 5,13 % (October 2021).

1.3 Outlier companies

In total in our dataset, there are 105 DSOs that operate in the local distribution network and 75 DSOs that operate in the regional network.

Based on distinctive characteristics that makes comparison with other companies difficult, NVE-RME have developed alternative methods for calculating the cost norms for 36 network companies, 11 companies in local distribution and 25 companies in regional distribution. For all the other conventional DSOs, the DEA method is used for yardstick competition.

For the companies that by size or uniqueness cannot be compared with the conventional DSOs, NVE-RME have developed alternative ways of calculating cost norms. In the current regulation, the various options for calculation of cost norms for these special units are:

1. For DSO's that do not have a value for one or more of the output variables (they are the cost drivers: number of customers, length of high voltage network (lines and cables) and number of substations) in the ordinary DEA cost norm model, or that have large annual variations in data, the cost norm is set to be equal to the cost base.
2. For other special units that do not meet criteria 1, the current regulation sets the cost norm using a floating five-year average of the unit's own cost base. In the local grid, this model is used for companies with less than 500 customers. For regional network grid companies, this model is used for companies with less than 4000 in total output or for companies that do not have overhead lines in their grid.

Most of the outlier units are regulated according to alternative (2.).

For the DSOs that meet criteria 1, and hence are given a cost norm equal to their cost base, there is weak or no incentives for efficient utilization and development of the network. Slightly stronger but still weak incentives are given to the companies in category (2.), where the cost norm is based on a 5-year floating average of their own costs.

The aim of this report is to propose a regulatory framework that to a greater extent than the current regulation, ensures the decoupling between cost norm and actual costs for the outlier electricity grid companies, and by that, provide incentives for efficient utilization and development of the electricity network grid.

1.4 Limitations

In this report we have explored a set of methodological paths to include outlier electricity grid companies in the yardstick competition framework. The presented methodological directions do not fully cover all possible available solutions to the outlier problem, but rather point at interesting areas for further research.

It has not been within the scope of this project to look deeply into the provided data on the DSOs. The provided dataset is presented in appendix A and are identical to the data used in the income cap regulation by NVE-RME. However, we still cannot rule out any errors in the dataset or misunderstandings in the data collection from the DSOs.

1.5 Structure of the Report

This project investigates the possibilities of decoupling the cost norm from actual costs for Norwegian electricity grid companies that due to their size or uniqueness are excluded from the current regulatory benchmarking. This is done by investigating and comparing alternative methods for benchmarking where the outlier companies are included in the benchmarking exercise.

Chapter 2 of the report discuss theoretical underpinnings for DEA, panel data analysis and local frontier estimators. In chapter 3, we present the data and empirical implementation, while the results from our analysis are given in chapter 4. Here we show the analysis and results from four alternative benchmarking methods: DEA, panel data CNLS, locally weighted DEA and quantile DEA. In chapter 5, we give recommendations on how to include the outlier companies in the benchmarking and propose further research.

The frontier models presented in this report are estimated in GAMS[2] and results are post-processed in Stata[3].

The dataset, GAMS code, STATA post estimation code and results are presented in Appendix A-D. Appendix E gives a short introduction to CNLS as the prime benchmarking tool and area of further research.

[2] General Algebraic Modeling System (GAMS) is a high-level modeling system for mathematical optimization. http://www.gams.com

[3] Stata is a general purpose statistical software package developed by StataCorp. http://www.stata.com

2 Theoretical underpinnings

A key contribution of this project is to explore how cost norms and consequently efficiencies of DSOs that are not part of NVE-RME's yardstick model are affected by choice of methodology. Let us refer to DSOs included in NVE-RME's model as *conventional* units and DSOs not included in the model as *special* units. Applying this taxonomy, we can define our main cases considered for empirical analysis:

i. **Cross-sectional DEA** on a dataset pooling special and conventional units
ii. **Panel data analysis** with stochastic error component on a dataset pooling special and conventional units, in addition to separate panel data analysis for special units
iii. **Cross-sectional local frontier estimators** that estimate cost norms based on quantile/expectile and kernel regressions on a dataset pooling special and conventional units.

We briefly explain these concepts and their purpose for DSO benchmarking in the subsequent sections.

2.1 Data envelopment analysis (DEA)

The abbreviation DEA was coined by Charnes et al. (1978), but is based on earlier contributions by Farrell (1957). It is among the best known methods for efficiency analysis, and satisfies monotonicity (i.e., enables inefficient operations) and convexity axioms (i.e., it is possible to combine two feasible production plans). A key strength of the method is non-parametric estimation. However, DEA does not accommodate stochastic variation in the data; i.e., any deviation from the boundary of the datapoints used for estimation is considered inefficiency. This makes the method vulnerable to measurement error, and highly influential units or outliers can lead to unrealistic benchmarks for other decision making units. Because of this property, DEA becomes an inevitable reference scenario for comparison with other efficiency models that accommodate "less extreme" benchmarks, at least in theory.

Let $c \in \Re_+$ denote costs of DSO operations, and let $\mathbf{y} \in \Re_+^N$ denote a vector of cost drivers. Note that RME's benchmarking approach comprises separate models and variable selection for local and regional DSOs, respectively. Assume there are *I* DSOs in (one of) the dataset(s), and let $\boldsymbol{\lambda} \in \Re_+^K$ denote intensity variables which the DEA model uses for selecting the most productive DSOs in the data. The DEA cost model can then be stated.

$$c(\mathbf{y}_{i'}) = \min_{c,\boldsymbol{\lambda}} \left\{ c : \begin{array}{l} \sum_{i=1}^{I} \lambda_i y_{ni} \geq y_{ni'}, \forall n \\ \sum_{i=1}^{I} \lambda_i c_i \leq c \\ \sum_{i=1}^{I} \lambda_i = 1 \\ \boldsymbol{\lambda} \geq \mathbf{0} \end{array} \right\}, \quad (1)$$

The constraint that intensity variables sum to 1 imposes variable returns to scale (VRS). By omitting this constraint, the DEA model is estimated under constant returns to scale (CRS).

The NVE-RME is predominately using the CRS benchmark for regulatory purposes. In this project, we consider both VRS and CRS specifications to understand how the ranking of special units depend on the scale assumption. Moreover, we estimate the DEA benchmark both by a) pooling conventional and special units and b) restricting the sample to conventional units, to evaluate the impact of special units on the reference frontier.

Since (1) defines the minimal costs for a given output vector, an intuitive cost efficiency measure for the DEA model is:

$$CE = \frac{c}{c_{i'}} \quad (2)$$

In the normal case, CE ranges between 0 and 1, with 1 indicating efficient DSO operations.

When implementing the cross-sectional DEA models, we follow NVE-RME's approach. This means that a 5-year average (i.e., average of 2015-2019 data) is used for the purpose of constructing the reference frontier (cf. the left-hand sides of inequalities in (1)), while data from the final year (i.e., 2019) is used for efficiency analysis (cf. $y_{ni'}$ on the right-hand sides of inequalities in (1)). This can lead to efficiency scores that exceed 1. As a sensitivity test, we consider how applying the 5-year average also for efficiency measurement affects the DEA scores.

2.2 Panel data analysis

Pooling 5 years of data, as done in the case of cross-sectional DEA, can be seen as throwing away valuable information. A dataset that contains repeated information about a set of DSOs over multiple periods is known as a panel dataset. Virtues of panel data are well-known. First, by exploiting intertemporal data, the number of observations for benchmarking increases compared to the cross-sectional case. This is valuable for non-parametric models such as DEA that are vulnerable to the *curse of dimensionality*. This makes the models incapable of discriminating among efficient and inefficient units when units in the dataset are few and variables included in the production model are many. Second, using panel data enables considering unobservable unit-specific heterogeneity. That is, it is possible to account for differences among DSOs – for example stemming from local weather conditions or qualities of transmission systems – that are unobservable or merely not quantified as part of the assessment.

We based the panel data estimation on Convex Non-parametric Least Squares (CNLS; cf. Kuosmanen, 2008), which is an alternative to DEA for estimating the reference frontier in a nonparametric fashion. In fact, DEA can be obtained as a special case of CNLS; see Kuosmanen and Johnson (2010) for details. However, unlike DEA, we now accommodate random variation in the data.

Let t=1,..T denote the periods spanned by the panel dataset. We now define the cost model as

$$\ln c_{it} = \ln f(\mathbf{y}_{it}) + \varepsilon_{it}. \tag{3}$$

where *f*(.) is the cost benchmark and ε is a composite error. More precisely, we define ε=*u*+*v*, where *u* is cost efficiency and *v* comprises stochastic variation in the data. In this model, cost efficiency ranges between 0 and infinity, with 0 indicating best practices. To compare this with the efficiency scores of the DEA model, we use 1/exp(u) – that ranges between 0 and 1 – as the preferred cost efficiency measure.

Following Eskelinen and Kuosmanen (2013), we define the panel data CNLS estimator for the cost function as:

$$\begin{aligned}
&\min \sum_{t=1}^{T} \sum_{i=1}^{I} \varepsilon_{it}^2 \\
&\text{s.t.} \\
&\ln c_{it} = \ln \phi_{it} + \varepsilon_{it}, \forall it \\
&\phi_{it} = \boldsymbol{\beta}_{it}' \mathbf{y}_{it}, \forall it \\
&\phi_{it} \geq \boldsymbol{\beta}_{i't'}' \mathbf{y}_{it}, \forall it, i't' \\
&\boldsymbol{\beta}_{it} \geq 0, \forall it
\end{aligned} \tag{4}$$

In this model, the β-parameters determine the marginal costs of outputs (parallel to multiplier weights aka dual prices in DEA). These are constrained to be non-negative, which imposes monotonicity. As there are no intercept included, the model is estimated under CRS. The first set of inequalities in (4), known as Afriat inequalities, impose curvature properties (i.e., convexity) on the cost function.

Note that adding $\varepsilon_{it} \geq 0, \forall it$ to (4) will effectively make the CNLS model a DEA-model. In this case, ε will make up the efficiency term, and stochastic variation is assumed away (i.e., v=0 and u= ε).

The program in (4) is used to estimate the cost norm ϕ_{it}. We estimate panel data CNLS both on a sample pooling conventional and special units, and for special units separately.

In a second stage, the error term ε can be decomposed into efficiency and stochastic variation. The main approach considered in our application is the efficiency method for panel data proposed by Schmidt and Sickles (1984). It assumes that efficiencies are time-invariant (i.e., that the efficiency score per DMU is persistent and does not change over time). The point of departure is to compute the average performance of each DSO:

$$\bar{u}_i = \frac{1}{T}\sum_{t=1}^{T}\exp\left(-\varepsilon_{it}\right), \forall i \quad (5)$$

And to define the benchmark as:

$$u^* = \max\left\{\bar{u}_i\right\} \quad (6)$$

Consequently, efficiency of DMU *i* is defined:

$$u_i = \frac{\bar{u}_i}{u^*}, \forall i \quad (7)$$

A major advantage of Schmidt's and Sickles' (1984) approach is that it does not require any assumptions about the distribution of the efficiency term, *u*. However, by defining the most extreme DSO-specific effect as benchmark, the approach is (in a similar manner to DEA) vulnerable to extreme differences in unobservable heterogeneity among DSOs.

In short, Schmidt and Sickle assume differences in individual-specific heterogeneity identical to efficiency differences. However, individual-specific heterogeneity can also be affected by contextual factors influencing DSO operations. When this is the case, it is desirable to have an error term structure that distinguishes among DSO-heterogeneity and efficiency. We also consider this case as a robustness check. Building on Kumbhakar et al. (2014), we in this case decompose the composite error term ε into the following four components:

$$\varepsilon_{it} = \gamma_i + v_{it} + (\eta_i + u_{it}) \quad (8)$$

Now, the error term comprises

a) the DSO-specific effect γ_i
b) stochastic variation v_{it}
c) time-varying efficiency $(\eta_i + u_{it})$.

The algorithm used for efficiency measurement in this case is:

1. Estimate the cost function using CNLS
2. Use fixed (FE) or random (RE) effects estimator on $\ln c_{it} - \ln \hat{\phi}_{it} = \alpha + \tilde{\varepsilon}_{it}$ to obtain consistent estimate of fixed/random effects.
3. Predict persistent efficiencies:
    - Calculate persistent efficiency using the cross-sectional SFA model with half-normal efficiency term distribution and a constant term on the fixed or random effects from Step 2. Efficiencies are predicted following Battese and Coelli (1988).
4. Predict time-varying efficiencies:

- Calculate time-varying efficiency using the cross-sectional SFA model with half-normal efficiency term distribution and a constant term on the predicted residual error term from Step 2. Time-varying efficiencies are predicted following Battese and Coelli (1988).

2.3 Local frontier estimators

Thus far, we have discussed frontier methods that construct cost benchmarks based on the overall dataset used for estimation. In this section, we discuss estimators that fit local frontiers using data from *comparable* DSOs only. By comparable, we here either mean DSOs that are neighbors when considering Euclidean distances (i.e., the length of line segments) among their outputs, or of comparable size (measured in cost levels). The former case calls for *kernel regression*, while the latter case calls for *quantile regression*. We will consider both cases using cross-sectional CNLS with a one-sided error term. As previously explained, CNLS is in this case effectively a DEA model. Hence, we will refer to the estimators as locally weighted and quantile DEA, respectively, in the following.

2.3.1 Locally weighted DEA

In this section, we introduce a brand new CNLS estimator that was constructed specifically for this project. Bear in mind that it has not been feasible to undertake extensive testing of the estimator and its properties within the boundaries of this small project. The new estimator is inspired by the conditional DEA estimator by Daraio and Simar (2007).

In brief, locally weighted DEA is based on assigning weights, known as Kernel functions K(.), to DSOs. Formally, we estimate the DEA frontier iteratively per DSO. When DSO *j* is under consideration, we define weights for each output *m* and for all units *i* using the formula:

$$K_{mi}\left(y_{mj},h\right)=K\left(\frac{y_{mj}-y_{mi}}{h}\right),\forall i,m \qquad (9)$$

Hence, the more similar unit *i* is to *j* in terms of output m, the higher weight *i* gets in the estimation. Following Daraio and Simar (2007) we use the Epanechnikov kernel (i.e., $K(q) = (3/4)(1-q^2)$), which has a bounded support. This means that any unit *i* that differs substantially from unit *j* receives a weight of 0. Thereby, using the bounded Kernel allows us to fit the DEA model solely on the subset of the sample containing DSOs that are comparable in terms of outputs. This makes the estimator more robust to outliers compared to standard DEA, and at the same time enables benchmarks that are likely to be more realistic when units under consideration are heterogenous. A major drawback is that the method potentially discards much of the available data.

The parameter *h* is known as the bandwidth. Increasing the bandwidth implies increasing the number of units to be included in the subsets used for locally weighted DEA: When the bandwidth goes to infinity, all units included in the original sample will be used for DEA estimation. In other words, locally weighted DEA tends towards conventional DEA as the bandwidth increases.

Ideally, the bandwidth parameter should be optimized as part of the efficiency assessment. Because of time and resource constraints, this has not been possible as part of the current project. The bandwidth is consequently set arbitrarily to a value (1000) that ensures sufficiently large datasets for locally weighted DEA estimation.

The DSO-specific kernel weight is defined as the product of output-specific kernel weights:

$$K_i\left(\mathbf{y}_j, h\right) = \prod_{m=1}^{M} K_{mi}\left(y_{mj}, h\right), \forall i \tag{10}$$

Using these DSO-specific weights, the locally weighted DEA estimator for unit *i* is defined:

$$\begin{aligned}
&\min \sum_{i=1}^{I} K_i\left(\mathbf{y}_j, h\right)\varepsilon_i^2 \\
&\text{s.t.} \\
&\ln c_i = \ln \phi_i + \varepsilon_i, \forall i \\
&\phi_i = \boldsymbol{\beta}_i' \, \mathbf{y}_i, \forall i \\
&K_i\left(\mathbf{y}_j, h\right)\phi_i \geq K_i\left(\mathbf{y}_j, h\right)\boldsymbol{\beta}_{i'}'\mathbf{y}_i, \forall i, i' \\
&\boldsymbol{\beta}_i \geq 0, \forall i \\
&K_i\left(\mathbf{y}_j, h\right)\varepsilon_i \geq 0, \forall i
\end{aligned} \tag{11}$$

This model minimizes the sum of squared residuals only for units associated with non-zero Kernel weights. Note that Afriat inequalities (that impose curvature properties) are now only encompassing units with non-zero Kernel weights, and that error terms also are constrained to be non-negative for units with non-zero Kernel weights. The latter ensures that the CNLS problem estimates a locally weighted DEA model, where the adjusted error term 1/exp(ε) readily provides an estimate of the efficiency score.

2.3.2 Quantile/expectile DEA

Conventional Ordinary Least Squares fits the *mean* of the dependent variable (in this study, costs) conditional on independent variables. Using quantile regression, we are instead able to analyse the relationship among costs and outputs at specific *quantiles* of the cost distribution. That is, to identify local frontiers contingent on the level of costs of DSO operations.

As before, we have *I* DSOs in our sample, each reporting total costs of operations. For an intuitive explanation of the quantile/expectile approach, we can think of dividing the cost variable into specific intervals. For example, we can consider 5 quantiles: 0.2; 0.4; 0.6; 0.8; 1. The first case can be interpreted as fitting a frontier model to the DSOs with the bottom 20 percent costs. The second case as fitting the frontier to the units with bottom 40 percent costs, and so on. Finally, when the quantile is 1, all *I* units are included in the comparison, and the quantile DEA model collapses into the conventional DEA model.

Note, however, that the quantile DEA method is *not* based on applying standard DEA on subsets of DSOs, separated according to their cost distribution. Instead, all DSOs in the sample are used to construct local benchmarks. This gives statistical advantages over locally weighted DEA that only exploits subset of the data for estimation.

Quantile DEA was first proposed by Banker (1988) and Banker, Datar and Kemerer (1991). However, the optimal solution to the quantile DEA problem is not necessarily unique, and does not necessarily satisfy the non-crossing property[4] (see Wang, Wang, Dang and Ge, 2014). To address these two issues, Kuosmanen, Johnson and Saastamoinen (2015) and Kuosmanen and Zhou (2021) propose to estimate quantiles indirectly by first estimating expectiles, and then converting them to the corresponding quantiles.

The main distinction between the quantile and expectile approaches is that former uses a linear objective function while the latter is based on a quadratic objective function. A drawback of the expectile approach is that it does not give as simple interpretation of the results as in the quantile case. For example, Kuosmanen and Zhou (2021) prove that in the quantile case, the selected quantile determines the number of DSOs that are enveloped by the local quantile frontier. That is, when the quantile under consideration is 0.2, up to 20 percent of the DSOs in the sample will be enveloped by the corresponding local frontier. The expectile, on the other hand, defines the ratio of the sum of positive errors (i.e., the sum of efficiency scores in the DEA case) to the total sum of residuals (also including the sum of deviations for DSOs that are located "below" local cost frontiers; units that normally would be labelled "super-efficient" in productivity and efficiency analysis). However, the corresponding quantile can be inferred by considering the number of DSOs enveloped at a selected expectile.

As expectiles can improve statistical efficiency, we follow Kuosmanen, Johnson and Saastamoinen (2015) and Kuosmanen and Zhou (2021) to fit an expectile DEA cost function. Let ϱ denote the expectile under consideration (i.e., a number between 0 and 1). In addition, we introduce two error terms, a positive and a negative error. Formally, the model to be estimated (per selected expectile) is:

$$
\begin{aligned}
&\min \rho \sum_{i=1}^{I} \varepsilon_i^{-2} + (1-\rho) \sum_{i=1}^{I} \varepsilon_i^{+2} \\
&\text{s.t.} \\
&\ln c_i = \ln \phi_i + \varepsilon_i^{+} - \varepsilon_i^{-}, \forall i \\
&\phi_i = \boldsymbol{\beta}_i' \, \mathbf{y}_i, \forall i \\
&\phi_i \geq \boldsymbol{\beta}_{i'}' \mathbf{y}_i, \forall i, i' \\
&\boldsymbol{\beta}_i \geq 0, \varepsilon_i^{+} \geq 0, \varepsilon_i^{-} \geq 0, \forall i
\end{aligned} \tag{12}
$$

For the empirical analysis, we use 5 expectiles, i.e., rho = (0.2; 0.4; 0.6; 0.8; 1). Hence, the optimization problem in Eq. (12) is estimated 5 times per grid type.

Note that, at the optimum, $\varepsilon_i^{-} \times \varepsilon_i^{+} = 0$. This means that a DSO can only either a) be enveloped by the local expectile frontier (i.e., $\varepsilon_i^{+} > 0, \varepsilon_i^{-} = 0$) or b) be located "below" the local cost frontier (i.e., $\varepsilon_i^{+} = 0, \varepsilon_i^{-} > 0$).

$1/\exp\left(\varepsilon_i^{+}\right)$ is regarded the expectile DEA efficiency score. Indeed, when rho = 1, all DSOs are enveloped, and the efficiency score is identical to the efficiency obtained from the standard CRS DEA model in Eq. (1). However, when rho is smaller than 1 – meaning that

[4] Since quantile frontiers are estimated individually, frontiers constructed at different quantiles (e.g., 0.2 and 0.4) can cross each other.

only some of DSOs are enveloped by the local frontier – a choice must be made whether units that are located "below" the local cost frontier should be ignored or regarded efficient. By default, units with $\varepsilon_i^- > 0$ have $\varepsilon_i^+ = 0$, which means that 1/exp(0) = 1. In other words, all super-efficient units get an efficiency score of 1. We maintain this definition herein, but point out that it is also possible to disregard any super-efficient unit in the expositions. We note that this choice does not have any impact on the results and conclusions of this report.

3 Data and empirical implementation

The frontier models outlined in Section 2 are estimated in GAMS and results are post-processed in Stata. The models are fitted separately to samples containing local and regional grid operators, respectively. Data are obtained from NVE-RME, and is identical to their datasets used for benchmarking of DSOs. The dataset prepared for GAMS-estimation is included in Appendix A, the GAMS code is included in Appendix B, while the Stata code for post-estimation is included in Appendix C.

There are 36 small and special transmission units in total – 11 serving the local distribution networks and 25 serving the regional distribution networks.

In this section of the report, we will present scatterplots of the variable distribution for the local distribution grid companies and the regional distribution grid companies, along with summary statistics for the variables used in the benchmarking analysis. In the presented figures, annual company data for 5 years are bundled together. Special units are marked as red in the figures, while conventional units are marked as blue.

3.1 Local distribution network

For the local distribution network, we look at the cost drivers: value of high voltage lines, value of substations and number of customers on the vertical axis. There are 105 DSOs in the dataset that operate in the local distribution network. Out of these, 11 companies are characterized as special units due to their size or uniqueness. As the annual company data for 5 years are bundled together, there are in total 525 datapoints used for presenting the local distribution DSOs.

Figure 3.1 shows km of high voltage lines plotted against the total costs of the local distribution grid companies.

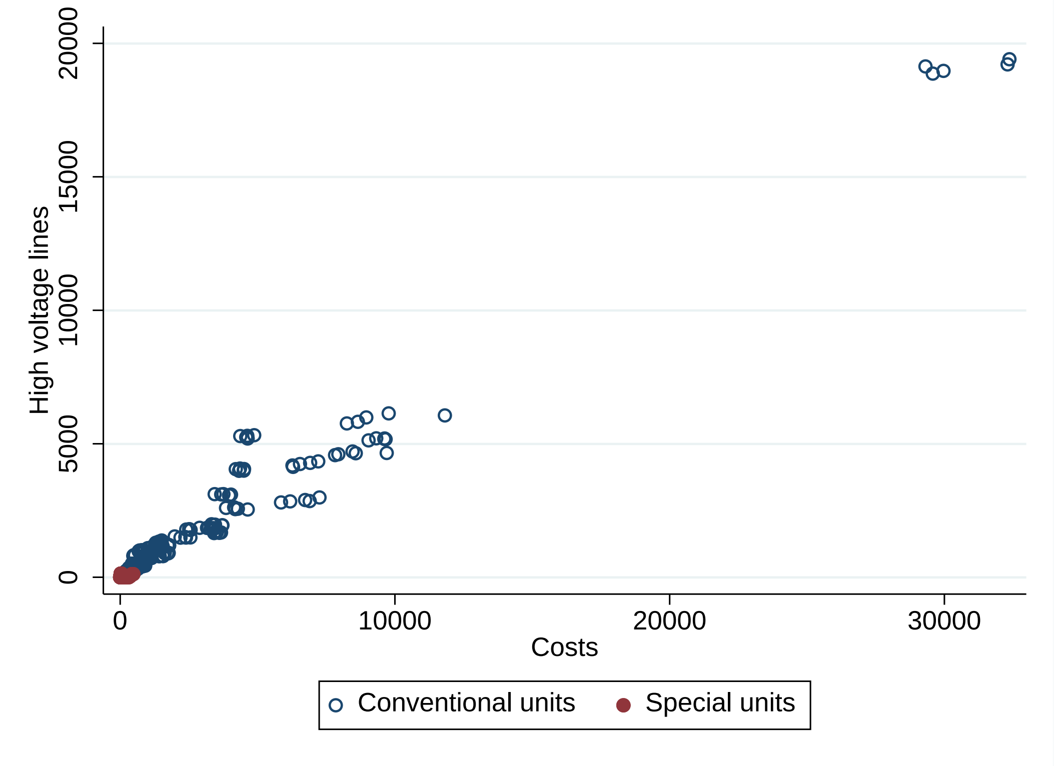


Figure 3.1: Comparison of the cost driver high voltage lines to the total reported costs of the local distribution grid companies. Data for 2015-2019.

Out of the 11 outlier grid companies that operate in the local distribution network, 10 companies have values for high voltage lines and all of these have low values close to the origin for all 5 years in our dataset. At the top right corner of the figure, we find a conventional unit with much higher costs and a much larger volume of high voltage lines than any other company in the dataset.

Figure 3.2 shows substations plotted against costs. We see the same overall picture in Figure 3.1 and Figure 3.2. The special units are small both in terms of kilometers of high voltage lines and number of substations.

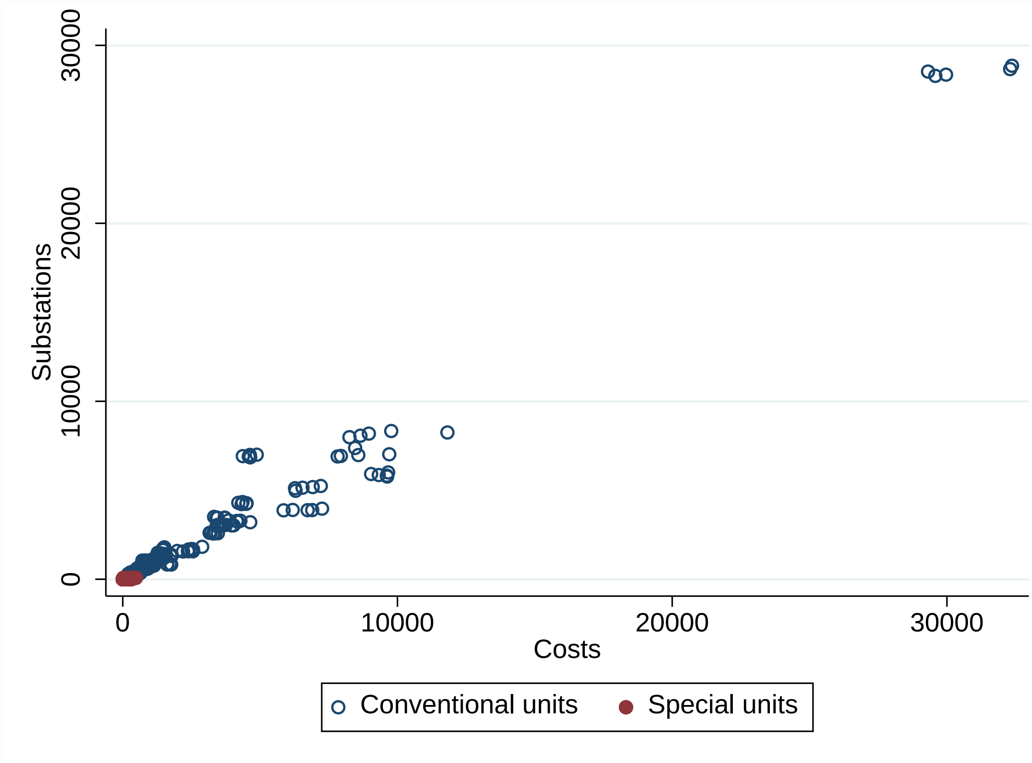


Figure 3.2: Substations plotted against total costs for the companies in the local distribution network. Data for 2015-2019.

7 of the 11 outlier companies in the local distribution network report postive values for substations in all five years of the data set, while 1 company have a value only for 2019 (Norske Skog Skogn AS). As for the high voltage, all the values for substation are close to the origin.

Figure 3.3 provides a picture of the number of customers plotted against the total costs. In this figure, the number of customers are divided by 100. Elvia is the largest local distribution network with close to 1.000.000 customers.

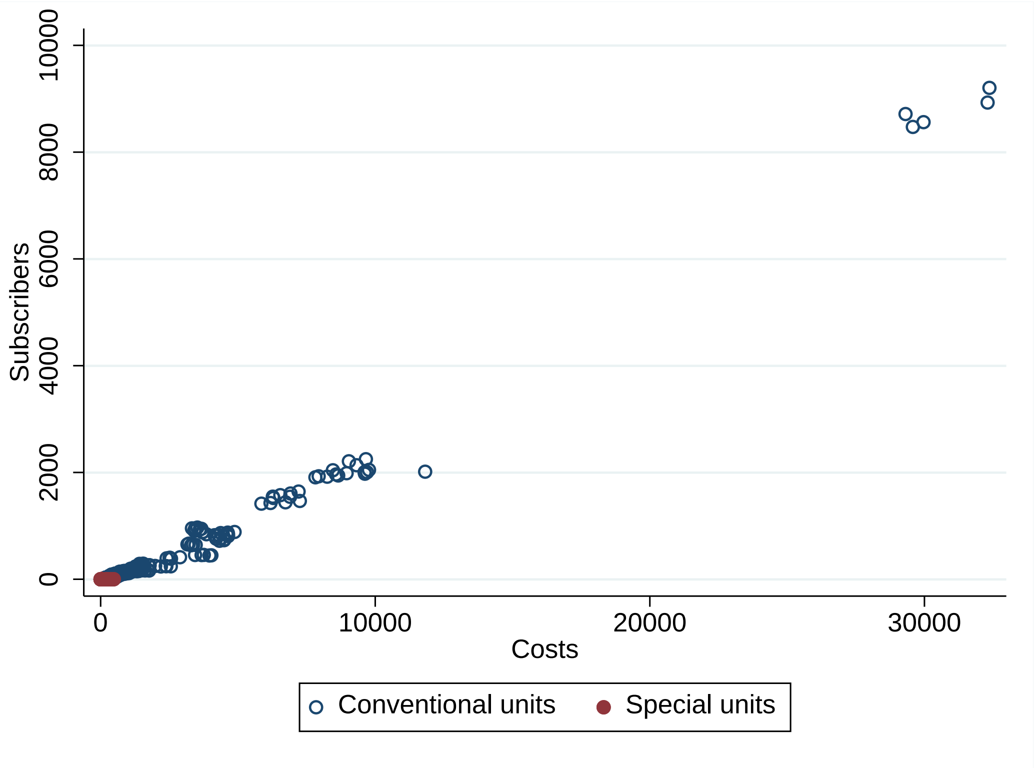


Figure 3.3: Number of subscribers (divided by 100) plotted against total costs for the local distribution network companies. Data for 2015-2019.

As for all the other plots, we see that the special units are small also when it comes to the number of subscribers.

The figures all show how small the special units are compared to the conventional units and thus appear as a tight group close to the origin in all figures. The figures also show that there is one conventional company in the sample that deviates from the rest of the sample by being much larger in all parameters for all five years in the dataset.

In Figure 3.4 we present a simple plot of the sum of all the cost drivers (high voltage lines, substations and subscribers) relative to the costs, plotted against the total costs of the companies. The unweighted sum of outputs divided by the costs, can be regarded as a simple measure of productivity.

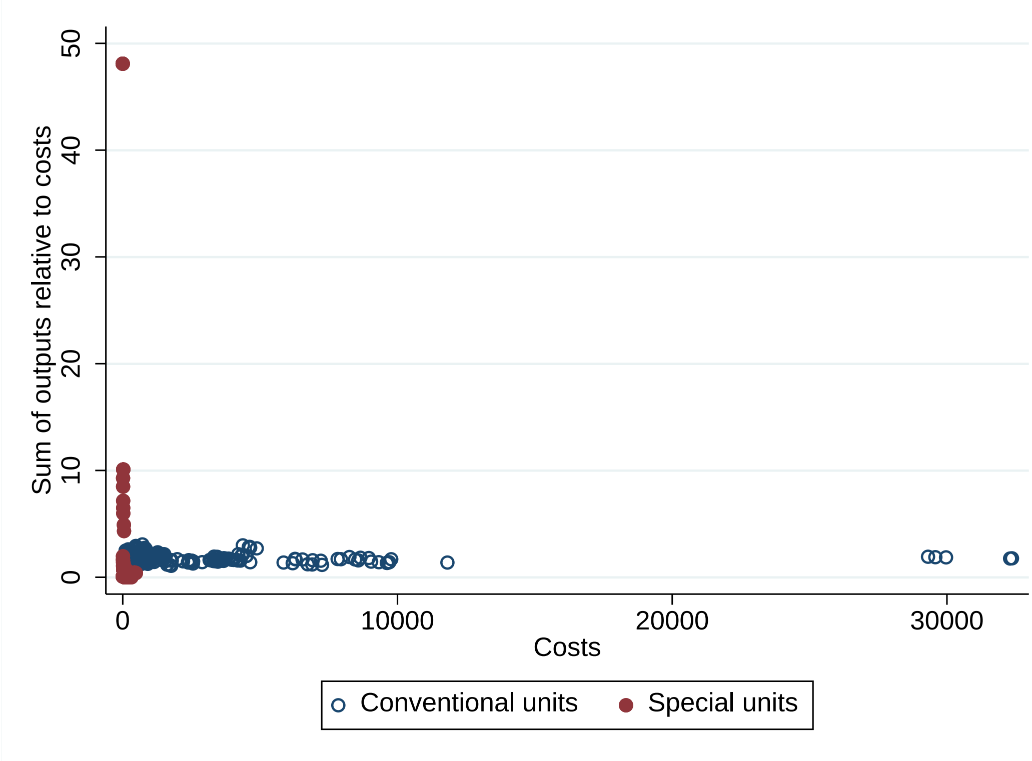


Figure 3.4: The unweighted sum of outputs relative to the costs plotted against total costs for the local distribution network companies. Data for 2015-2019.

Figure 3.4 shows that although all the special units are small in all cost drivers, they are not necessarily inefficient. We see that the pattern of the special units deviate substantially from conventional units in terms of the simple productivity measure. This suggests that special units can be highly influential in determining the cost norm in a comparative benchmarking exercise.

3.2 Regional distribution network

In total there are 75 companies that operate in the regional distribution network. Out of these companies, 25 units are characterized as special units due to their size or uniqueness. For the regional distribution network companies we look at the cost drivers overhead lines, sea cables, substations and underground cables plotted against the total costs of each company. As for the scatterplots for the local distribution network, the 5-year annual data is bundled together providing a dataset with 375 companies.

Figure 3.5 shows the value of overhead lines compared to the total costs of the companies.

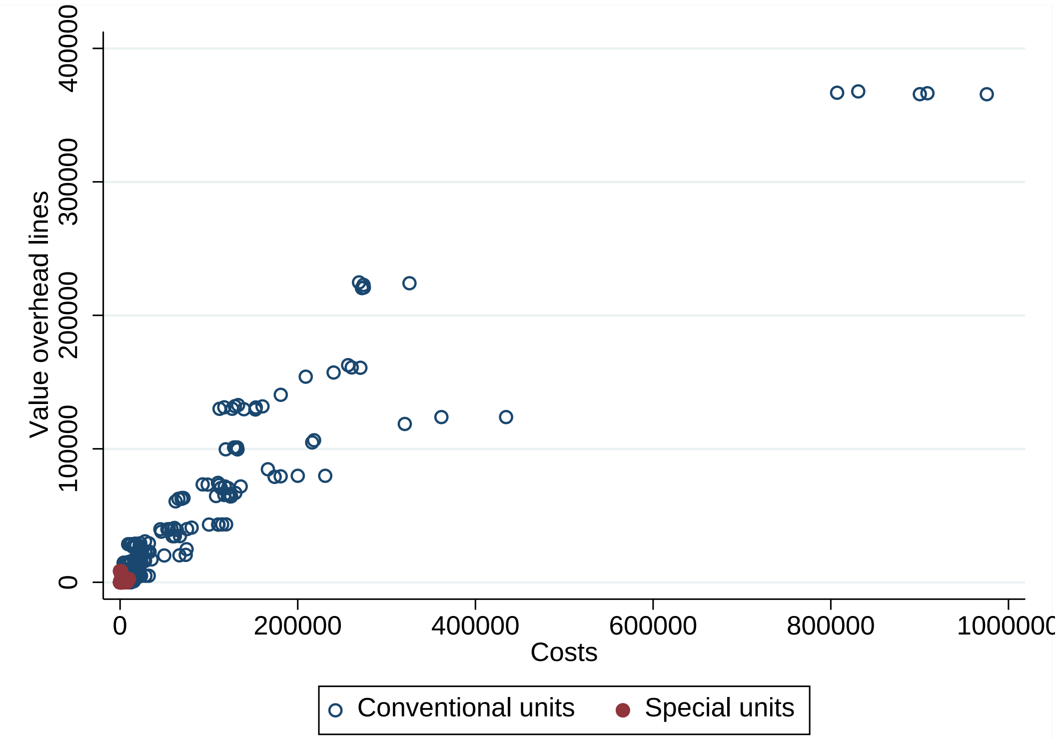


Figure 3.5: Overhead lines plotted against total costs for regional distribution network companies. Data 2015-2019.

We can see that the special units in the regional distribution network all have values close to the origin when we compare the cost driver overhead lines plotted against costs. On the other end of the size scale, we find a large company with high values for its datapoints for all five years.

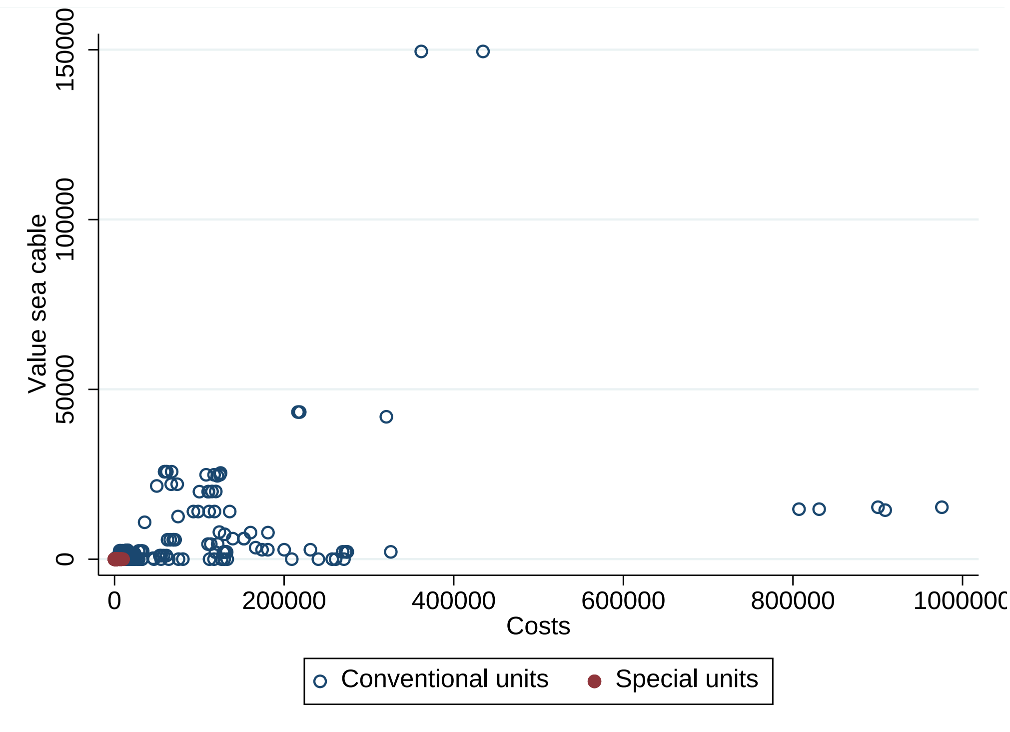


Figure 3.6: Sea cables plotted against total costs for regional distribution network companies. Data 2015-2019.

The same overall picture is apparent for the value of sea cables plotted against costs, where all special units have values close to the origin. However, as we can see in this plot, there is more variation among the conventional units for this cost driver compared to overhead lines.

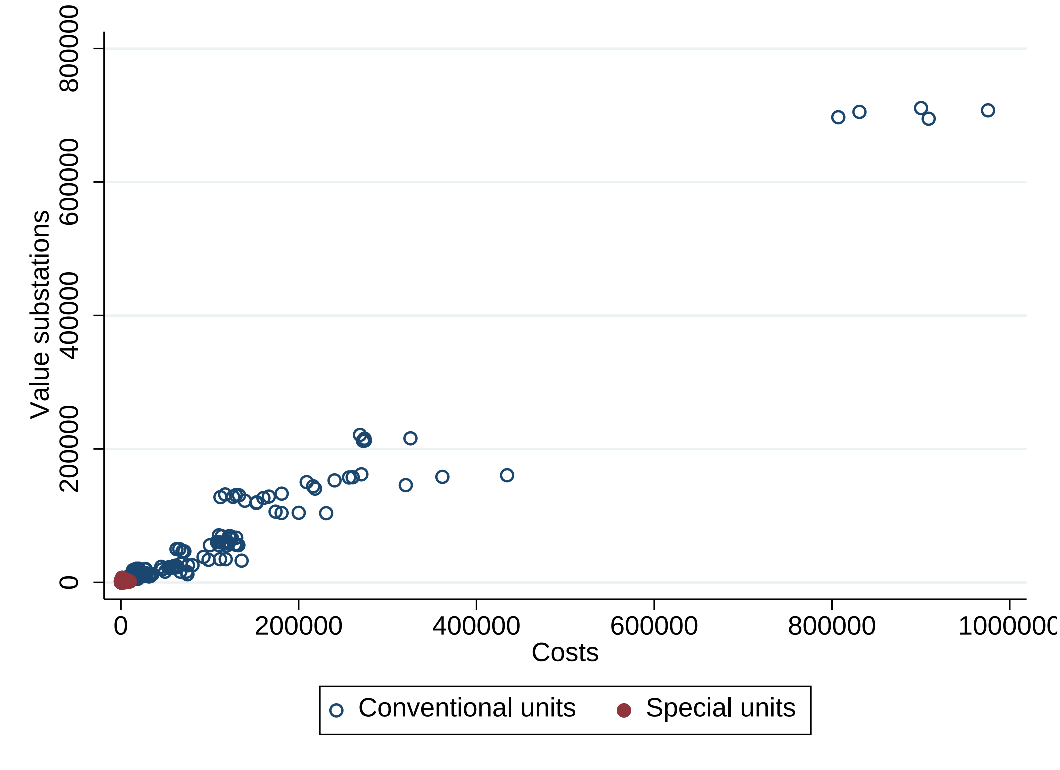


Figure 3.7: Substations plotted against total costs for regional distribution network companies. Data 2015-2019.

The same pattern is also found for substations. The special units all have small values, placing them bundled together and close to the origin.

Figure 3.8 shows the value of underground cables compared to total company-specific costs. The figure shows large variation among the conventional units and that all the special units are small in this cost driver as well.

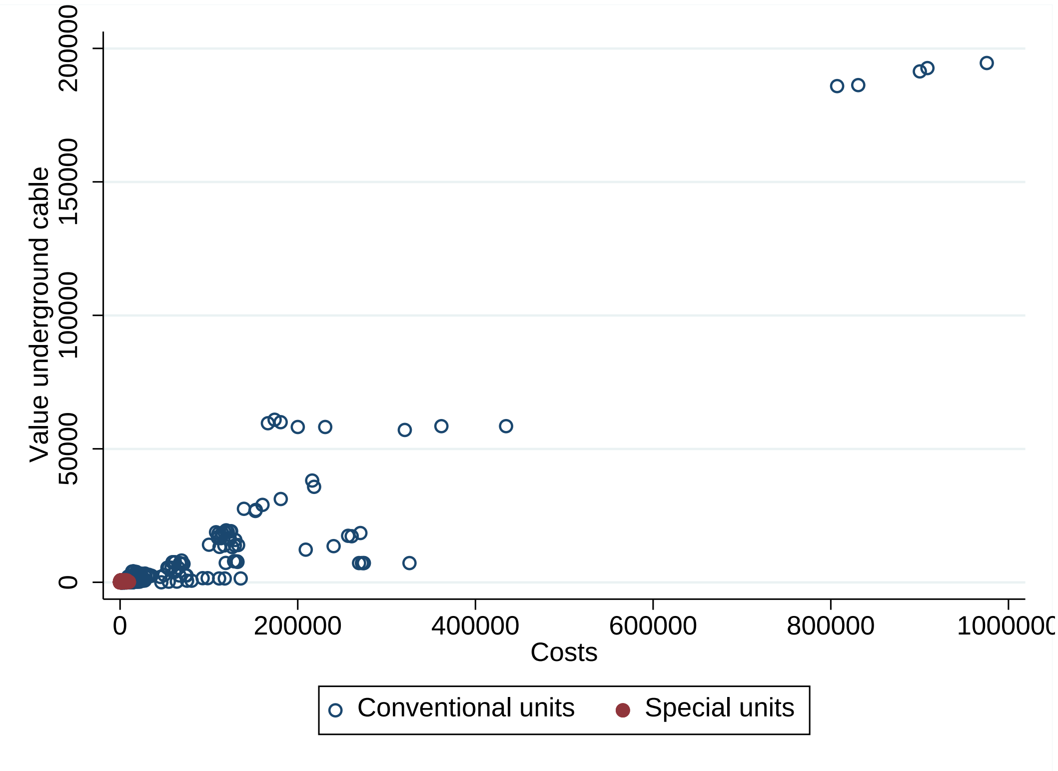


Figure 3.8: Underground cables plotted against total costs for regional distribution network companies. Data 2015-2019.

Common for all plots for the regional distribution network companies is that special units are all bundled together close to the origin for all cost drivers and that there is a large conventional company that substantially deviate from the rest of the industry in size along all measured outputs.

Figure 3.9 provides a comparison of the unweighted sum of cost drivers relative to the costs plotted against the company specific total costs. As previously noted, this can be regarded as a simple measure of productivity.

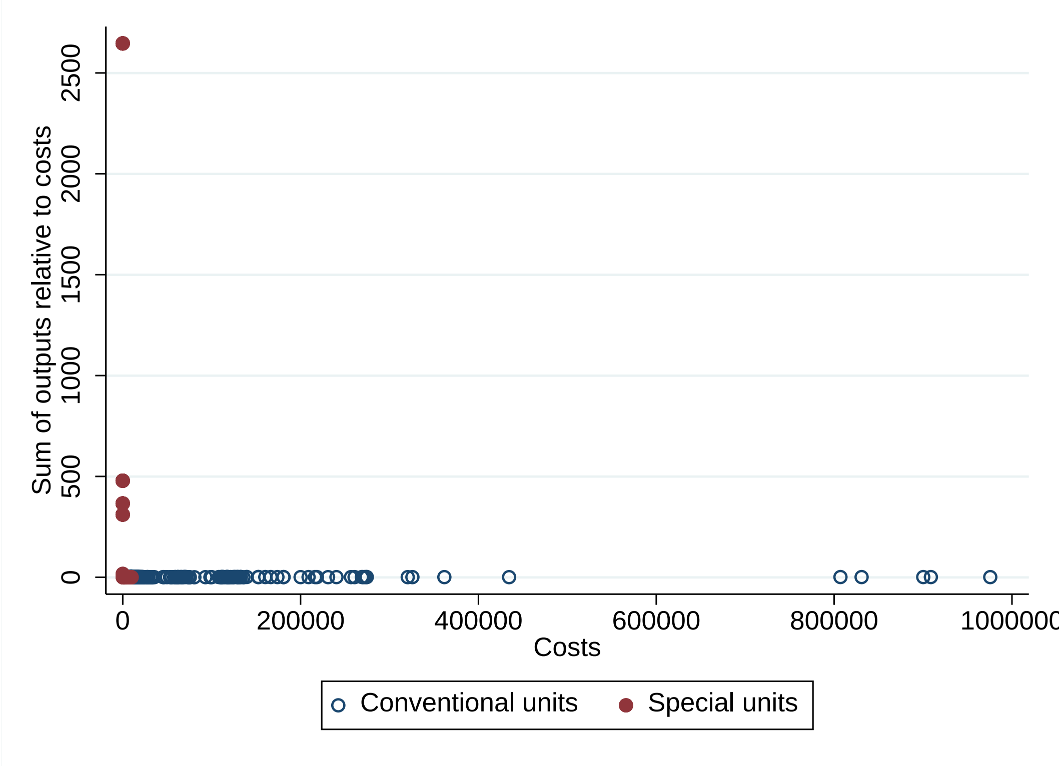


Figure 3.9: Sum of outputs relative to costs plotted against total costs for regional distribution network companies. Data 2015-2019.

As for the local distribution network companies, the datapoints plotted in Figure 3.9 provide an indication that special units have the potential to greatly influence the cost norm if they are included in the same DEA model as the conventional companies.

3.3 Summary statistics

The following two tables provide summary statistics for costs and cost drivers for the companies in the local and regional distribution network, respectively. We provide summary statistics for the conventional- and special units separately.

Table 3.1: Summary statistics of costs and cost drivers used in the NVE-RME benchmark model for conventional units (top) and special units (bottom) among local distribution network companies. Data 2015-2019.

Statistics	Group	Costs /100	Km Hight-V lines	Number of Sub-stations	Sub-scribers /100
Mean	Conv.	1606,8	1092,6	137,.7	326,8
Sd	Conv.	358,.5	2228,1	3233,8	976,7
Min	Conv.	96,9	58,0	0,0	10,4
Max	Conv.	32367,7	19406,0	28857,0	9204,2
Mean	Spec.	111,4	43,9	25,9	0,9
Sd	Spec.	137,5	46,3	28,9	1,3
Min	Spec.	0,0	0,0	0,0	0,0
Max	Spec.	479,1	137,0	75,0	4,3

First of all, the summary statistics for the local distribution network companies show that the special units are small in size compared to the conventional units, although there are conventional units that are smaller in each of the cost drivers separately than the largest special unit. The table also shows that there are missing values for all the cost drivers for at least one of the special units, indicated by the 0 minimum-value for these companies and meaning that for all cost drivers, there are special units that miss values. However, we also see that there is at least one conventional unit that miss values for substations.

Table 3.2: Summary statistics for costs and cost drivers in the NVE-RME benchmark model for conventional units (top) and special units (bottom) among regional distribution network companies. Data 2015-2019.

Statistics	Group	Costs	Weighted values of overhead lines	Weighted values of sea cables	Weighted values of sub-stations	Weighted values of undergr. cable
Mean	Conv.	70682,3	4184,2	4883,3	45255,6	9555,1
Sd	Conv.	138580,8	6604,3	15161,9	105391,8	28410,9
Min	Conv.	1175,0	67,0	0,0	1515,0	0,0
Max	Conv.	975594,0	367822,0	149494,0	710833,0	194550,0
Mean	Spec.	1569,9	589,8	0,0	1389,1	78,5
Sd	Spec.	2073,3	1728,6	0,0	1293,3	198,5
Min	Spec.	1,0	0,0	0,0	0,0	0,0
Max	Spec.	9970,0	8382,0	0,0	6895,0	711,0

For the regional distribution network, we also find that the special units on average are much smaller in all cost drivers than the conventional units. However, we see that there are companies among the special units that have values for one or more of the cost drivers that are larger than the smallest conventional unit. The summary statistics shows that there are missing values for all outputs among the special units and that all special units are missing sea cables.

4 Results

In this Section, we present the empirical results. Stata codes to reproduce figures and tables are available in Appendix C, while efficiency scores and cost norm estimates are available in Appendix D. Note that a few of the implemented models are not presented either because of selection for brevity or because GAMS fails to find an optimum. In the latter case, error code 999 is reported in the results file in Appendix D.

In cases when GAMS fails to find an optimum, this can usually be remedied for example by rescaling variables or imposing initial values for the optimization. Due to this project's resource constraints, we have been unable to explore such strategies in full. We do, however, believe that this has little or no impact on the main takeaways from the modeling exercise.

4.1 Data Envelopment Analysis

We first consider the results from the conventional DEA. Figure 4.1 presents histograms for DEA models based on variable returns to scale (VRS) and constant returns to scale (CRS), by DSO's classification (i.e., conventional and special units) and grid type (local and regional).

A histogram illustrates the distribution of DSOs' efficiencies by grouping them into separate bins, with each bin represented by a bar in the figures. The efficiency score is presented on the horizontal axis, while the number of DSOs belonging to each bin (i.e., number of DSOs with similar efficiency scores) is reported on the vertical axis. Thus, relatively low or missing bars mean that there are none or few units with the efficiency score in question, while a relatively high bar means that many DSOs exhibit efficiencies of this magnitude.

Note that each histogram is optimized by Stata with regards to layout. This means the definition of bins as well as axis scales can differ from panel to panel in the proceeding figures. We focus primarily on the overall distributions of efficiencies, and we consequently do not find it relevant to harmonize scales among panels.

We present efficiency distributions of conventional units using sand-colored bars and of special units using transparent bars. This does not imply that conventional and special units have been analyzed separately using DEA (or other methods), but the distinction is made to enable transparent visualization of whether efficiency scores of special units are fundamentally different from efficiency scores of conventional units.

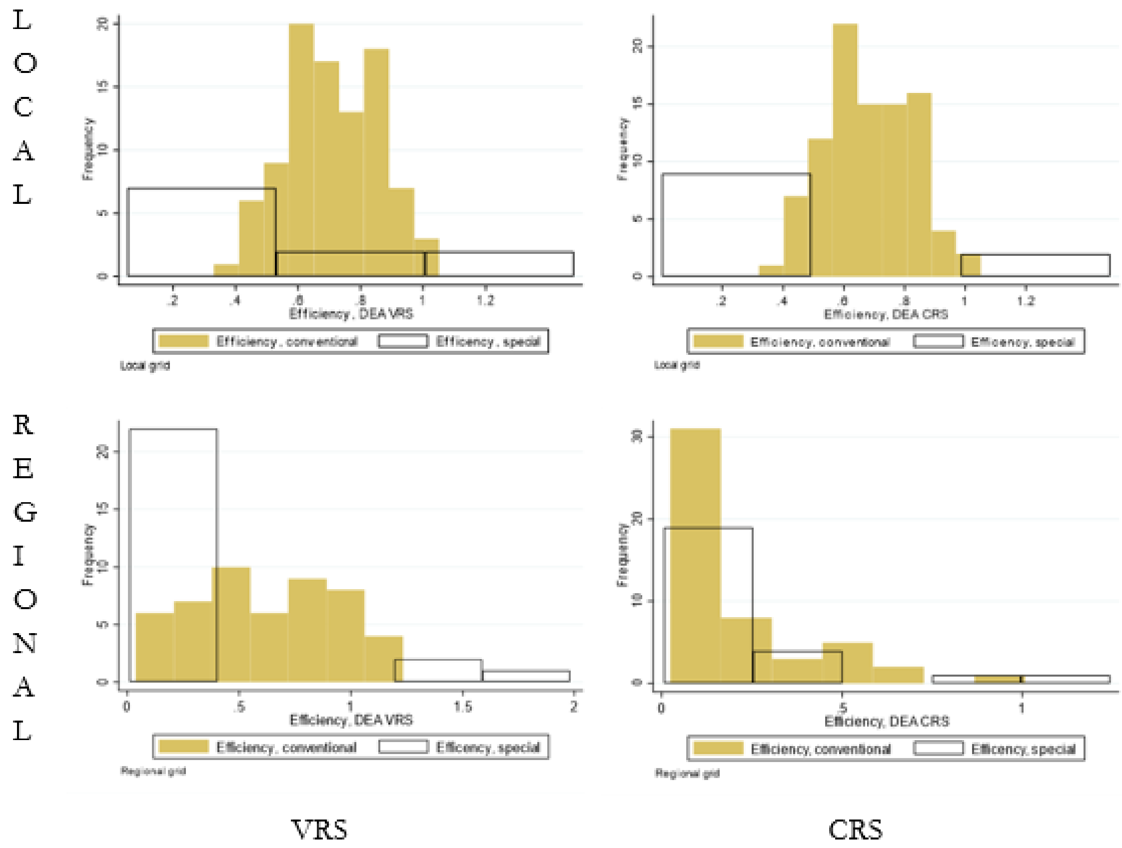


Figure 4.1: Efficiency score distributions for DEA VRS and CRS models, according to DSO classification (conventional/special) and distribution grid (local/regional).

First, note that some of the efficiency scores exceed 1. This is simply because 5-year (i.e., 2015-2019) averages are used to construct the reference frontier, while 2019-observations are used for benchmarking. Thus, there are no guarantees that efficiency ranges between 0 and 1.

Figure 4-1 reveals substantial difference in efficiency distributions between local and regional grids, respectively. Efficiency distribution for conventional local grid DSOs appears almost normally distributed around 0.7. For the regional grid, efficiencies of conventional units are almost uniformly distributed under VRS, while the distribution is positive skewed under CRS. Hence, scale inefficiencies (i.e., the ratio of efficiencies measured using CRS and VRS DEA, respectively) are far more pronounced for regional grid operators than local grid operators.

In general, Figure 4.1 identifies special DSOs as "outliers". That is, special DSOs are for the most either very efficient (and thus likely to influence the reference frontier) or inefficient. Because of positive skewed distribution resulting from severe scale inefficiency, special units turn out as comparable to conventional units under CRS in the case of the regional grid. This is not the case for local grid DSOs. With tight envelopment under the VRS benchmark, some of the special units turn out to be more similar to conventional units in terms of efficiency scores. However, a majority of special units are still very inefficient.

The NVE-RME confirms that CRS is the preferred benchmark for regulatory purposes. Figure 4.1 clearly identifies special units as outliers when applying standard CRS-DEA to local grid operators. In the case of the regional grid, special DSOs turn out to be more comparable to conventional DSOs. However, it is likely that at least one of the special units influence the benchmark for conventional units. We will therefore consider how the efficiency distribution for conventional units changes when special units are exempt from being a reference unit in the subsequent section.

4.1.1 Impact of special units on the benchmark

In this section, we compare efficiency distributions of conventional units estimated with and without imposing intensity variables of special units to be zero in Eq. (1); i.e., with and without including special units in the sample used for estimation. In the former case, special units have no influence on the benchmark for conventional units. In other words, special units are not allowed to define the benchmark for other units.

Figure 4.2 clearly shows that special units have an impact on the benchmark, thus affecting estimated efficiency of conventional units. In all cases considered, conventional units turn out to be more efficient when special units are not allowed to be a reference unit for conventional DSOs. This impact is especially pronounced for regional grid operators under CRS, where the right skewed distribution from Figure 4.1 is dramatically changed when special DSOs are removed from the reference set. In other words, at least one of the special units exhibit productivity that is not likely to be attainable for other units. Recall that all the special units are very small compared to conventional units. Thus, if one special unit reports some output together with negligible costs, this unit is likely to be very influential under the CRS benchmark. For local DSOs, the impact of removing special units from the benchmark is less pronounced. Hence, special DSOs are less influential in this case.

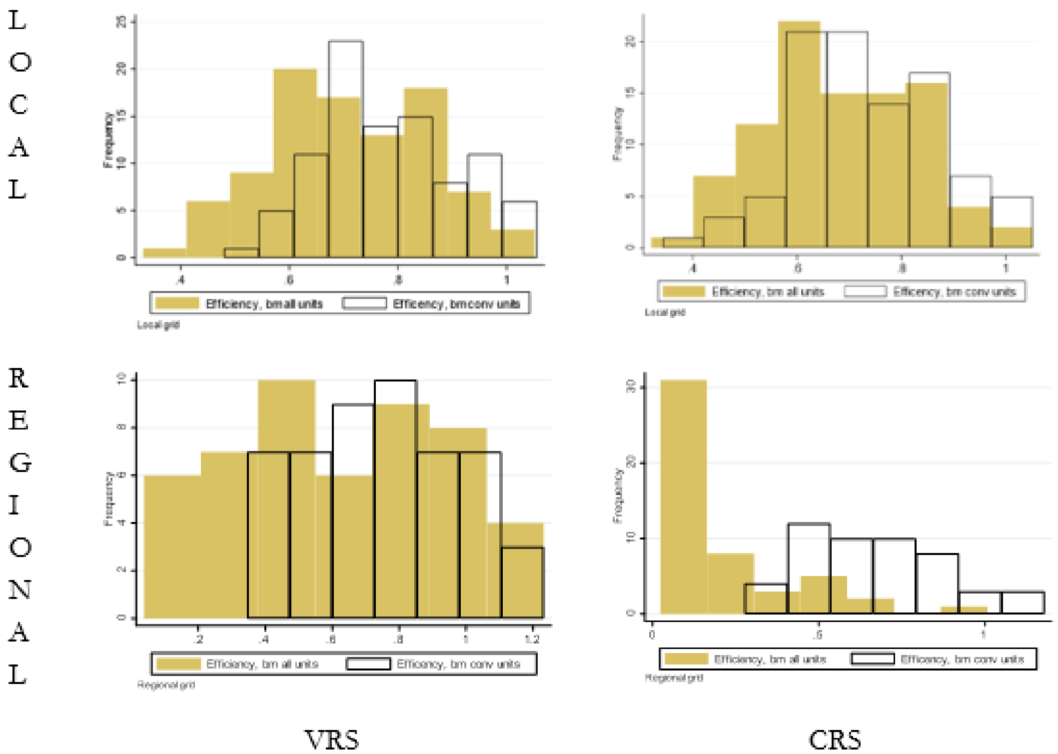


Figure 4.2: Comparing efficiencies of conventional units relative to benchmarks estimated based on all units (bm all) or conventional units only (bm conventional).

4.1.2 Sensitivity test

Finally, we consider how efficiencies are altered when using 5-year averages of data (i.e., averaging data from 2015 to 2019) both to construct the DEA reference frontier and to measure efficiency, compared to measuring efficiency based on 2019 data (but applying a reference frontier constructed based on 5-year averages; cf. Figure 4.1). Figure 4.3 presents this comparison for local and regional grid DSOs under CRS.

The NVE-RME has explained that some special units exhibit substantial intertemporal variation in costs and/or outputs. The purpose of this sensitivity test is consequently to consider if applying 5-year averages when measuring efficiency enables smoothing out such business cycles, and thereby to achieve a less extreme efficiency measurement compared to the standard NVE-RME case. Figure 4.3 shows that this is indeed the case for a few of the special units, but a majority of units remain either very efficient or inefficient regardless of variables used for efficiency measurement.

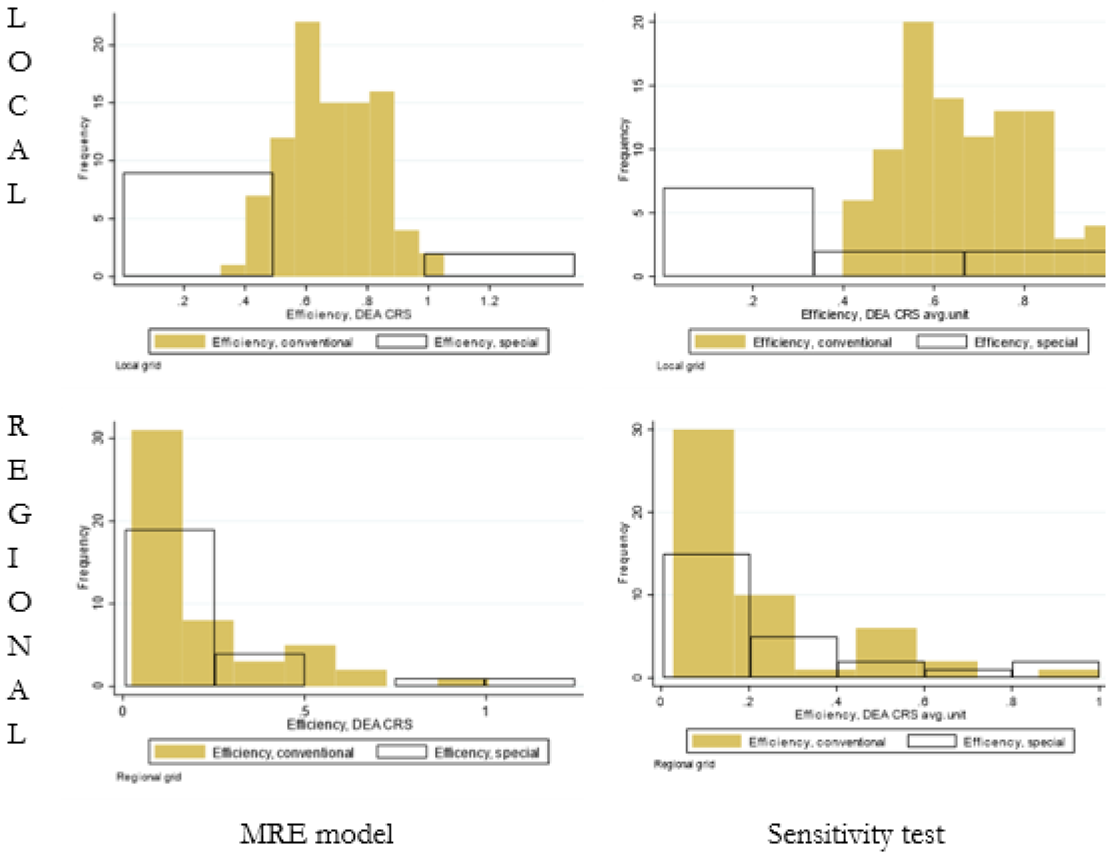


Figure 4.3: Comparing efficiency measurement based on 2019-data (MRE model) and 5-year averages (Sensitivity test) under CRS.

4.1.3 Conclusions derived from the DEA study

Based on Section 4.1 and its subsections, we conclude that minor adjustments to the DEA methodology are not capable to solve the "outlier issue" for special units. We consequently turn to other methods, to inspect how choice of methodology influence efficiencies of DSOs.

4.2 Panel data analysis

Panel data CNLS models are fitted using observations per DSO for every year between 2015 and 2019. All models assume a reference technology exhibiting monotonicity, convexity, and CRS. We estimate the panel data models

i. for all DSOs (i.e., both conventional and special units)
ii. for special DSOs separately.

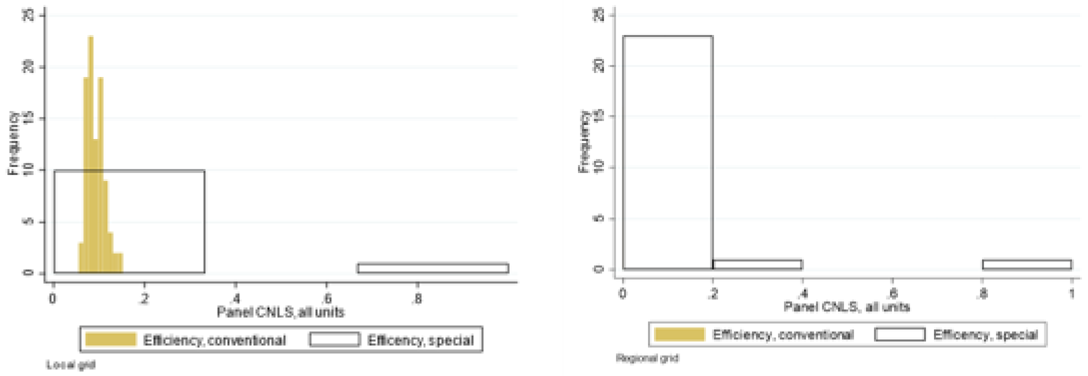
In case i., we compute and compare efficiencies both following Schmidt and Sickles (1984) – i.e., when treating DSO-specific effects as efficiency – with the approach of Kumbhakar et al. (2014) – assuming a 4-component error term structure. The latter is intended as a sensitivity test of the Schmidt and Sickles estimator, which is our preferred approach. The key distinction between these approaches is that Schmidt and Sickles assume that unit-specific heterogeneity captures efficiency differences, while Kumbhakar et al. assume unit-specific heterogeneity to be distinct from efficiency. We refer to Section 2.2 for technical details about the two distinct efficiency estimators.

While this report focuses on efficiency scores, it is also relevant to consider *cost norms* provided by CNLS as they readily provide an *average* cost norm for DSOs under consideration. This is fundamentally different from DEA, which provides an extreme cost norm by enveloping all DSOs (i.e., considering the lowest as supposed to average operating costs). Appendix E provides an overview of CNLS cost norms for Norwegian DSOs.

4.2.1 Panel data analysis of both conventional and special units

Figure 4.4 presents the distributions of the CNLS results for conventional/special units and local/regional grids, using the methodology by Schmidt and Sickles (1984). Both for regional and local grid DSOs, this approach labels most of the operators as very inefficient under CRS. As in the DEA-case, the reference unit is a special DSO, accounting for both local and regional grid DSOs.

Schmidt's and Sickle's approach assumes DSO-specific heterogeneity to exhibit (in)efficiency. Intuitively, the approach is comparable to estimating a dummy-variable for each DSO in the sample, and in turn to apply the best firm (i.e., with the lowest intercept of the cost frontier) as benchmark to which all other units are compared. As (random) DSO-effects vary substantially in the dataset, this leads to the result that most of the firms are labelled very inefficient. In fact, in the case of regional grid DSOs, most conventional units get an efficiency score close to 0. In this case, Stata does not display the associated histogram for conventional units (cf. the right panel of Figure 4.4).



Local grid DSOs

Regional grid DSOs

Figure 4.4: CNLS panel data efficiency estimates following the approach by Schmidt and Sickles (1984), according to DSO type (conventional/special) and grid (local/regional).

4.2.1.1 Sensitivity analysis

DSO-specific effects may indeed comprise both efficiency and impact of contextual variables. This is ignored by Schmidt's and Sickle's approach, but is accommodated by the 4-component model by Kumbhakar et al. (2014). Figure 4.5 presents efficiency scores for regional grid DSOs using their 4-component error term structure. While this approach makes the efficiency estimates more comparable to conventional DEA, it is clear that special DSOs are highly influential and thereby determines the reference frontier also when applying the 4-component approach.

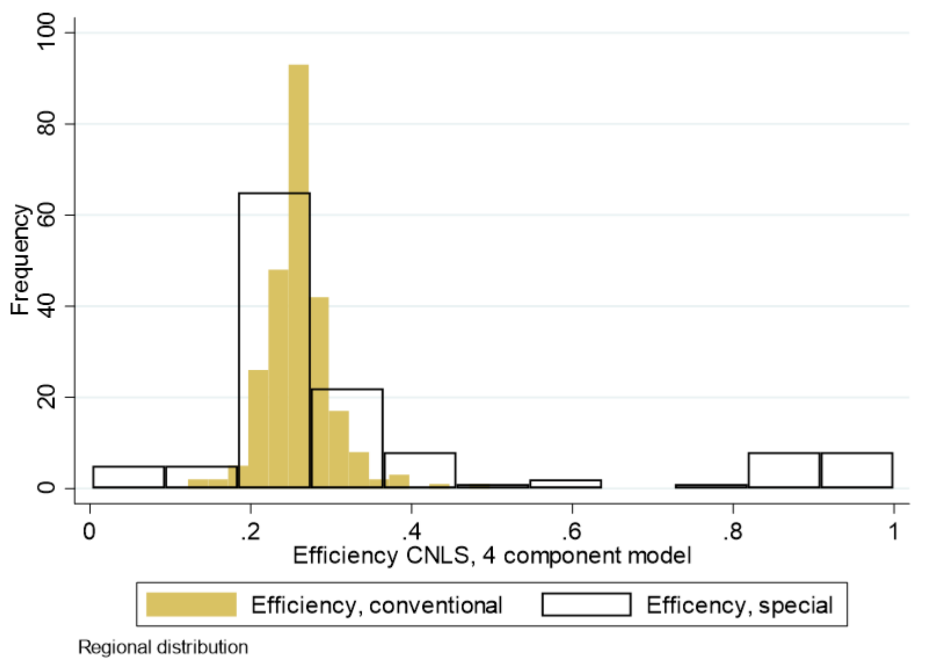


Figure 4.5: Distribution of CNLS panel estimates for regional grid DSOs from 4-component model, according to DSO type (conventional/special).

4.2.2 Panel data analysis for special units

This section presents efficiencies calculated using panel CNLS benchmark estimated under CRS, combined with the efficiency measure by Schmidt and Sickles (1984). The purpose of this exercise is to evaluate the possibility to use panel data methods to benchmark special units only. Because there are only a few special DSOs per grid type, applying NVE-RME's standard DEA approach only to special units is likely to lead to problems with the curse of dimensionality, making the model incapable to discriminate among efficient and inefficient units. Using panel data – that increases the sample size relative to cross-sectional models – can enable the NVE-RME to apply frontier methods to specialized units only.

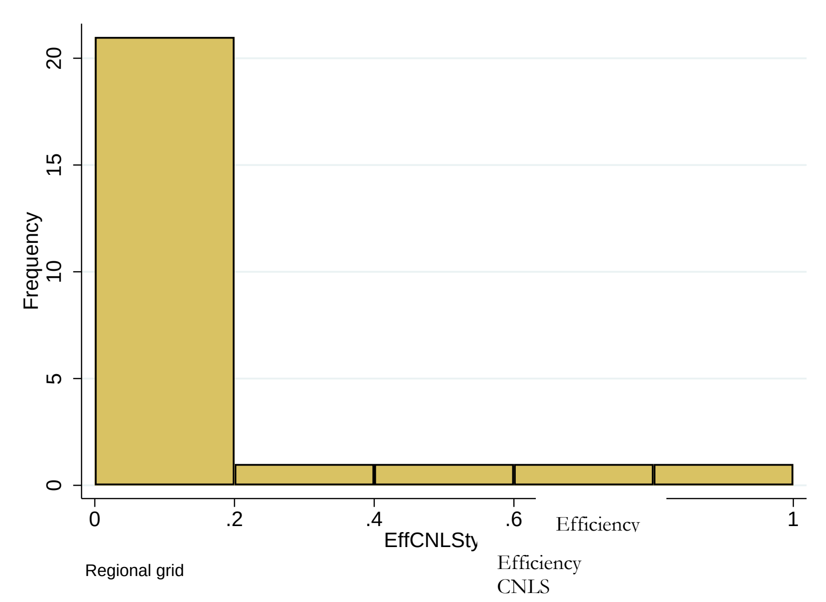


Figure 4.6: Panel data CNLS for special units only, by grid.

Figure 4.6 presents distributions of efficiencies for the local and regional grids, respectively. Both cases are evaluated under CRS. As seen previously, this leads to one or few highly influential units determining the frontier, and a majority of DSOs being very inefficient relative to this benchmark. Although special units are now evaluated separately from conventional units, Schmidt's and Sickles' (1984) approach could be seen as leading to too extreme benchmarks for a majority of units under consideration.

4.2.3 Conclusions derived from the panel data study

Our results show that some special units are highly influential also in the panel data CNLS case. As a consequence, a majority of DSOs become very inefficient both when special and conventional units are included in the model and when special units are considered only. As such, panel CNLS is not found to remedy outlier problems associated with DEA on a sample pooling special and conventional units.

4.3 Local frontier estimators

Having considered "global frontiers" based on DEA and CNLS, we now turn to local frontier estimators. The purpose of this exercise is to consider if applying benchmarks made up of comparable units – either in terms of economic size (quantile DEA) or output (locally weighted DEA) – can provide more appropriate benchmarks for special units that remedies the outlier problem previously illustrated.

4.3.1 Locally weighted DEA

Due to convergence problems, we only present the results of locally weighted DEA for local grid DSOs. Recall from Section 2.3.1 that we do not consider optimizing of bandwidth for the locally weighted DEA estimator within the scope of the current project, but use an arbitrary and identical bandwidth for all DSOs. Optimizing of bandwidth is recommended for further work.

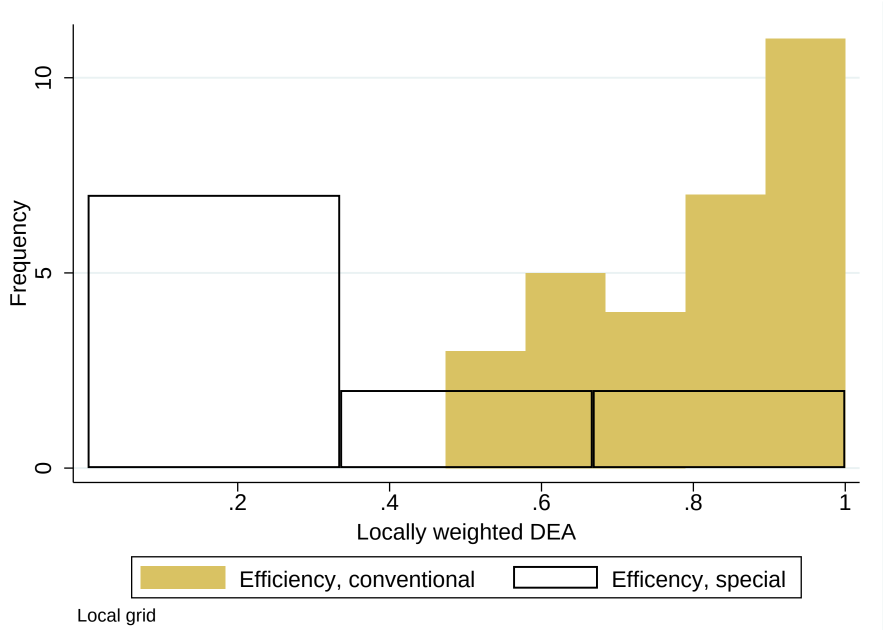


Figure 4.7: Distribution of locally weighted CRS-DEA efficiency estimates for local grid DSOs, according to DSO type (conventional/special).

Figure 4.7 presents the distribution of efficiencies obtained from locally weighted DEA under CRS and a selected bandwidth of 1000. This can readily be compared to Figure 4.3 that presents efficiencies for the conventional DEA model.

At the selected bandwidth, locally weighted DEA clearly considers conventional units more efficient than conventional DEA. However, the approach matters little for the ranking of special units, which for the most are considered very inefficient. Restricting the bandwidth could remedy this problem, but can also lead to a very limited set of peers to form the benchmarks. Indeed, use of only a limited amount of the overall data for fitting local frontiers is one of the main disadvantages of the locally weighted DEA approach.

4.3.2 Expectile DEA

Expectile DEA entails a computational demanding optimization that currently only converges for regional grid operators. Providing appropriate initial values is likely to solve this computational problem, but the scope of the current project has prevented further investigation into the matter.

We estimate the CRS-DEA benchmark at selected expectiles (i.e., rho = 0.2; 0.4; 0.6; 0.8; 1). When the expectile is set equal to 1, the model collapses into the conventional DEA model. We consequently focus on the other expectiles when reporting the results.

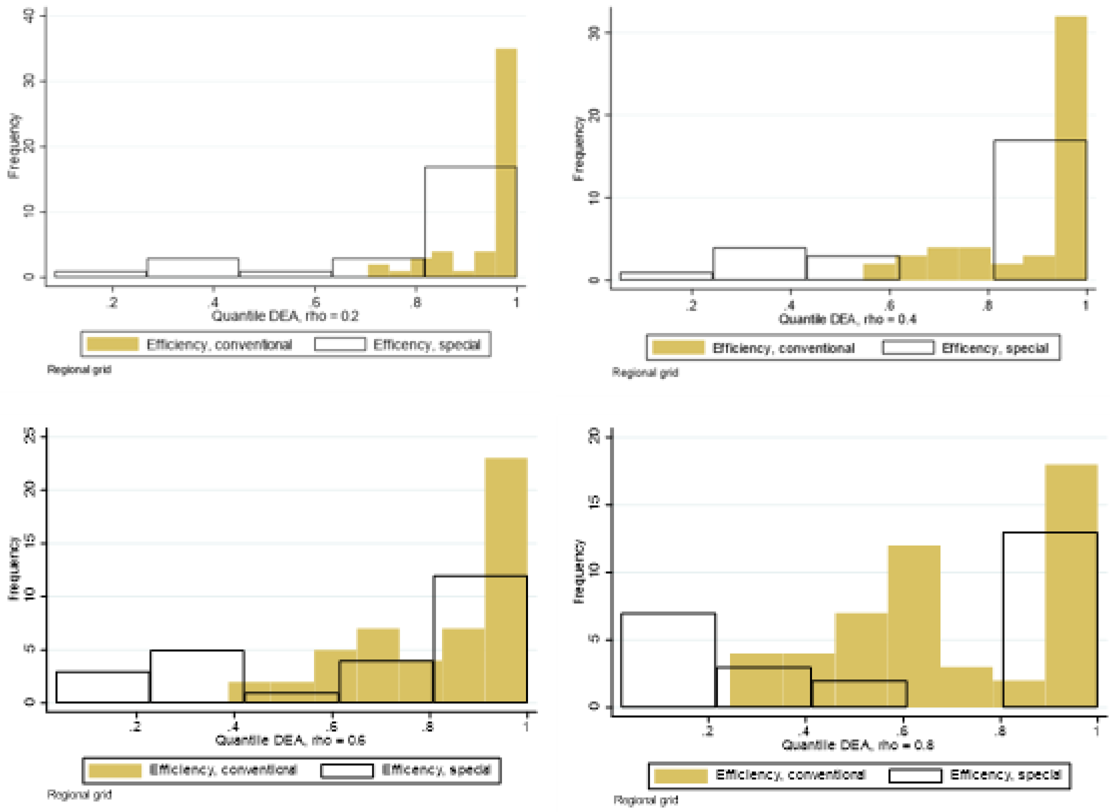


Figure 4.8: Distribution of quantile CRS-DEA efficiency estimates for regional grid DSOs, according to expectile (rho) and DSO type (conventional/special).

Figure 4.8 presents efficiencies at different expectile benchmarks. As rho increases, a larger share of the units in the sample are enveloped by the quantile/expectile frontier. Consequently, the average efficiency of the sample decreases: Recall that units that are not enveloped at a given expectile always receives an efficiency score equal to 1 because they are "super-efficient". When rho = 1, all units are enveloped, and the expectile DEA is identical to standard DEA. The local frontier efficiency estimates can consequently be compared with Figure 4-3 that presents efficiencies for the conventional DEA model (i.e., when rho=1).

The expectile benchmarks appear more realistic for special units than the conventional DEA benchmark. In fact, when rho = 0.2 (i.e., for the benchmark tailored to the bottom 20 percent of reported costs) a majority of special DSOs are regarded very efficient. Recall from section 3 that special units are among the smallest DSOs in our sample. Hence, the 0.2 expectile frontier can be suitable for these units. Even in this case, a few of the special DSOs are still found to be very inefficient.

It is noteworthy that Figure 4-8 presents dramatically different efficiency distributions than Figure 4.3, i.e., conventional DEA. In the case of conventional DEA, the efficiency distribution becomes positive skewed, with a majority of both conventional and special DSOs being very inefficient. This illustrates the vulnerability of conventional DEA to outliers and extreme units, a characteristics that is mitigated by the expectile DEA estimator.

4.3.3 Conclusions derived from the local frontier estimator study

In contrast to other methods under consideration in this study, quantile/expectile DEA is found to provide reasonable efficiency estimates for special and conventional units alike. We consequently consider this method a suitable candidate for managing outlier problems associated with special units that have been demonstrated both for DEA and panel CNLS.

5 Conclusion and Discussion

Section 4 outlines the empirical results from applying different frontier models to NVE-RME's datasets used for benchmarking of DSOs in 2019. 4 frontier methods are considered: Conventional DEA, Panel CNLS, Locally Weighted DEA, and Quantile DEA.

Special units are currently exempted from benchmarking, partly due to being associated with outlier problems. A key objective of our study is to consider a wide range of methods to evaluate if any of them are capable to remedy the outlier problem. Stated differently, we aim to find a method that provides reasonable efficiency estimates both for conventional and special units when special units are part of the efficiency assessment.

Results reveal that both conventional DEA and panel CNLS – referred to as "global" frontier estimators – are sensitive to extreme units, both in the local and regional distribution grids. Special units are found to impact on the reference frontier, possibly resulting in benchmarks that are unrealistic for other DSOs. Using "local" frontier estimators, the impact of special units on the benchmark is remedied. However, in our implementation of locally weighted DEA, a majority of DSOs turn out to be very inefficient as in DEA/CNLS. Using quantile regression on the other hand results in efficiencies that are likely to be in the admissible range for most of the special DSOs.

5.1 Conclusion

Quantile DEA appears as a promising method for benchmarking of special and conventional units alike. We recommend considering the method for further testing, with the aim to adopt the approach as part of the methodology for benchmarking of Norwegian DSOs. This can take place either by utilizing the method only for special units, or to undertake a full-fledged transition from conventional to quantile DEA for all DSOs.

Quantile DEA is clearly less sensitive to extreme units than conventional DEA. Moreover, quantile DEA enables separate benchmarks for clusters of DSOs, grouped according to their economic sizes. Indeed, Section 3 illustrates that Norwegian DSOs are very heterogenous, which can make quantile DEA appropriate for DSO benchmarking.

We find there are three main advantages associated with the use of quantile DEA:

1) Quantile DEA is based on the same principles as conventional DEA. As DSOs are well acquainted with the DEA methodology, we expect the costs of communicating the new methodology to users will be low.
2) Quantile DEA enables using a pooled dataset comprising conventional and special units. This increases the sample size relative to the original sample used by NVE-RME for benchmarking, thereby improving efficiency estimates by counteracting small-sample bias.
3) Quantile DEA effectively exploits information both from conventional and special units when forming local benchmarks. This gives an advantages over estimating frontiers separately for special units only, e.g., using panel CNLS.

5.2 Discussion/Perspective

While quantile/expectile DEA seems a fruitful avenue for further research and benchmarking practice, it also has some drawbacks compared to standard DEA.

First, the quantile or quantiles to be analyzed must be selected by the practitioner, and DSOs must be allocated among quantile frontiers. This implies for example selecting a common quantile for special units (that are all small in size), or distributing both special and conventional units among a set of selected quantile frontiers in the case when all units are subject to quantile benchmarking. Currently, NVE-RME applies a quantile frontier approach with rho=1 (i.e., conventional DEA) only to conventional units. As shown in this report, this quantile frontier is very sensitive to outliers, and using other quantiles can thus enable more realistic benchmarks when DSOs are heterogenous.

Selection of quantiles involves some level of subjective assessment. There are some studies that have looked into identifying the optimal quantile (e.g., Jradi et al., 2019), but we do not consider this approach relevant for incentive regulation. A preliminary advise can be to aim for the median cost norm (i.e., rho = 0.5). However, if performance differences are too large, the use of multiple quantiles could be used temporarily. In general, we advise more research on how the approach actually should be implemented for yardstick competition.

Defining quantile frontiers and allocation rules for DSOs may cause some controversy among operators. Such criteria must be clearly defined and communicated, and developed in a way that takes equity considerations and at the same time avoids perverse incentives.

Second, quantile DEA is computationally more demanding than standard DEA. As a consequence, we were unable to produce quantile DEA estimates for local grid DSOs. In our experience, this problem can be solved by testing initial values and/or rescaling of variables. Other solutions include choosing other solvers and/or software. Currently, a new package for quantile DEA and CNLS is becoming available for Python, which could make the use of these methods more accessible to practitioners.

5.3 Source of Error

Special units in NVE-RME's terminology do indeed turn out to be outliers in most of the methodological frameworks considered in this project. While our mandate has been to consider the impact of choice of methodology, another fruitful avenue is also to understand what causes special observations to differ from conventional observations, and to which degree such differences can be attributed to measurement errors.

NVE-RME explains that some of the discrepancies can be attributed to special units having distribution system operations only as a minor task within their overall operations. In the case of economies of scope, there can be cost indivisibilities among operations, hence making it challenging for special units to separate costs attributed to grid operations. As such, different practices for cost reporting may arise across firms, thereby leading to measurement errors in data. There could also be important cost drivers or outputs lacking from the benchmarking model, which inevitably leads to downward bias in productivity and efficiency estimates. Further investigation into these matters can lead to better reporting of variables for benchmarking and/or better formulation of benchmarking models that prevent special units from remaining special in the future.

Other sources of error relate to lack of reported efficiency scores in some cases (cf. Appendix D, when error code 999 emerges) when results are unavailable. This happens when GAMS fails to converge to an optimum, and is only a problem for the CNLS estimator that is based on non-linear programming.

It is possible to solve such issues using a wide range of techniques, for example by

i. Changing the scaling of variables
ii. Changing initial values (i.e., the starting point of the optimization algorithm)
iii. Using other solvers

Because we have considered a wide range of models simultaneously, and due to resource constraints, we have been unable to customize the optimization for each model to be estimated to solely ensure successful outcomes. While this clearly is a shortcoming, we do not anticipate it to influence the main conclusions of our work.

6 References

Banker, R. (1988), Stochastic data envelopment analysis. Working Paper, Carnegie Mellon University

Banker, R., Datar, S.M. & Kemerer, C.F. (1991) A Model to Evaluate Variables Impacting the Productivity of Software Maintenance Projects. Management Science, 37, 1-18.

Battese, G.E. & Coelli, T.J. (1988) Prediction of firm-level technical efficiencies with a generalized frontier production function and panel data. Journal of Econometrics, 38, 387-399.

Charnes, A., W. W. Cooper & Rhodes,E. (1978) Measuring the efficiency of decision making units. European Journal of Operational Research, 2, 429–444.

Daraio, C. & Simar, L. (2007) Conditional nonparametric frontier models for convex and nonconvex technologies: a unifying approach. Journal of Productivity Analysis, 28, 13-32.

Eskelinen,J., & Kuosmanen, T. (2013) Intertemporal efficiency analysis of sales teams of a bank: Stochastic semi-nonparametric approach, Journal of Banking & Finance, 37, 5163-5175.

Farrell, M. J. (1957) The measurement of productive efficiency of production." Journal of the Royal Statistical Society, Series A, 120(III), 253–281.

Jradi, S., Parameter, C.F. & Ruggiero, J. (2019) Quantile estimation of the stochastic frontier model. European Journal of Operational Research, 182, 15-18.

Kumbhakar, S.C., Lien, G., & Hardaker, J.B. (2014) Technical efficiency in competing panel data models: A study of Norwegian grain farming. Journal of Productivity Analysis, 41, 321–37.

Kuosmanen, T. (2008) Representation theorem for Convex Nonparametric Least Squares. Econometrics Journal, 11, 308-325.

Kuosmanen, T. & Johnson, A. (2010) Data Envelopment Analysis as nonparametric least squares regression. Operations Research, 58, 149-160.

Kuosmanen, T., Johnson, A. & Saastamoinen, A. (2015) Stochastic nonparametric approach to efficiency analysis: A unified framework. In: Zhu J. (eds) Data Envelopment Analysis. International Series in Operations Research & Management Science, vol 221. Springer, Boston, MA.

Kuosmanen, T. & Zhou, X. (2021) Shadow prices and marginal abatement costs: Convex quantile regression approach. European Journal of Operational Research, 289, 666-675.

Schmidt, P, & Sickles, R. (1984) Production frontiers and panel data. Journal of Business & Economic Statistics, 2, 367-374.

Wang, Y., Wang, S. Dang, C. & Ge, W. (2014) Nonparametric quantile frontier estimation under shape restrictions. European Journal of Operational Research, 232, 671-678.

Appendix A: Dataset

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
ld	i1	2015	Conv	830,929545	ALTA KRAFTLAG SA	7	0	0	0	0	802	883	122,93
ld	i1	2016	Conv	941,405953	ALTA KRAFTLAG SA	7	0	0	0	0	817	906	125,64
ld	i1	2017	Conv	897,37158	ALTA KRAFTLAG SA	7	0	0	0	0	825	947	127,28
ld	i1	2018	Conv	961,050699	ALTA KRAFTLAG SA	7	0	0	0	0	823	927	129,33
ld	i1	2019	Conv	966,492382	ALTA KRAFTLAG SA	7	0	0	0	0	833	937	132,2
ld	i2	2015	Conv	281,225463	ANDØY ENERGI NETT AS	9	0	0	0	0	282	220	36,28
ld	i2	2016	Conv	278,543077	ANDØY ENERGI NETT AS	9	0	0	0	0	290	222	36,49
ld	i2	2017	Conv	297,672152	ANDØY ENERGI NETT AS	9	0	0	0	0	293	222	36,87
ld	i2	2018	Conv	303,334152	ANDØY ENERGI NETT AS	9	0	0	0	0	294	222	36,7
ld	i2	2019	Conv	327,034447	ANDØY ENERGI NETT AS	9	0	0	0	0	315	226	36,72
ld	i3	2015	Conv	344,286795	AUSTEVOLL KRAFTLAG SA	16	0	0	0	0	143	170	41,33
ld	i3	2016	Conv	341,857097	AUSTEVOLL KRAFTLAG SA	16	0	0	0	0	143	170	42,32
ld	i3	2017	Conv	377,82708	AUSTEVOLL KRAFTLAG SA	16	0	0	0	0	145	170	43,15
ld	i3	2018	Conv	337,004666	AUSTEVOLL KRAFTLAG SA	16	0	0	0	0	160	179	44,31
ld	i3	2019	Conv	396,812531	AUSTEVOLL KRAFTLAG SA	16	0	0	0	0	155	183	44,71
ld	i4	2015	Conv	109,495519	BINDAL KRAFTLAG SA	22	0	0	0	0	142	109	11,97
ld	i4	2016	Conv	105,588897	BINDAL KRAFTLAG SA	22	0	0	0	0	142	110	11,98
ld	i4	2017	Conv	118,122566	BINDAL KRAFTLAG SA	22	0	0	0	0	142	111	11,94
ld	i4	2018	Conv	114,655073	BINDAL KRAFTLAG SA	22	0	0	0	0	142	112	12,04
ld	i4	2019	Conv	107,25415	BINDAL KRAFTLAG SA	22	0	0	0	0	143	114	12,02
ld	i5	2015	Conv	3419,60037	NORGESNETT AS	32	0	0	0	0	1662	3009	910,29
ld	i5	2016	Conv	3608,99215	NORGESNETT AS	32	0	0	0	0	1670	3050	933,33
ld	i5	2017	Conv	3670,6285	NORGESNETT AS	32	0	0	0	0	1684	3047	948,24
ld	i5	2018	Conv	3443,60699	NORGESNETT AS	32	0	0	0	0	1693	3050	956,72
ld	i5	2019	Conv	3523,95741	NORGESNETT AS	32	0	0	0	0	1705	3078	971,63
ld	i6	2015	Conv	262,85117	DRANGEDAL EVERK KF	35	0	0	0	0	268	278	35,58
ld	i6	2016	Conv	272,824908	DRANGEDAL EVERK KF	35	0	0	0	0	269	280	35,92
ld	i6	2017	Conv	262,078538	DRANGEDAL EVERK KF	35	0	0	0	0	271	282	36,52
ld	i6	2018	Conv	302,521825	DRANGEDAL EVERK KF	35	0	0	0	0	271	282	37,07
ld	i6	2019	Conv	292,34013	DRANGEDAL EVERK KF	35	0	0	0	0	275	285	37,49
ld	i7	2015	Conv	715,579212	AS EIDEFOSS	37	0	0	0	0	1011	1060	140,79
ld	i7	2016	Conv	814,664135	AS EIDEFOSS	37	0	0	0	0	1014	1062	141,05
ld	i7	2017	Conv	815,91824	AS EIDEFOSS	37	0	0	0	0	1019	1053	142,95
ld	i7	2018	Conv	843,590909	AS EIDEFOSS	37	0	0	0	0	1023	1058	144,56
ld	i7	2019	Conv	801,825809	AS EIDEFOSS	37	0	0	0	0	1014	1059	145,24
ld	i8	2015	Conv	555,633346	ISE NETT AS	42	0	0	0	0	387	348	78,47
ld	i8	2016	Conv	610,266787	ISE NETT AS	42	0	0	0	0	389	352	79,32
ld	i8	2017	Conv	594,304518	ISE NETT AS	42	0	0	0	0	392	351	79,94
ld	i8	2018	Conv	564,106356	ISE NETT AS	42	0	0	0	0	393	354	80,63
ld	i8	2019	Conv	604,043825	ISE NETT AS	42	0	0	0	0	403	357	81,45
ld	i9	2015	Conv	529,362948	FINNÅS KRAFTLAG SA	43	0	0	0	0	246	306	79,82
ld	i9	2016	Conv	547,340163	FINNÅS KRAFTLAG SA	43	0	0	0	0	251	308	81,33
ld	i9	2017	Conv	494,003045	FINNÅS KRAFTLAG SA	43	0	0	0	0	261	318	82,85
ld	i9	2018	Conv	502,852662	FINNÅS KRAFTLAG SA	43	0	0	0	0	265	318	84,47
ld	i9	2019	Conv	527,243927	FINNÅS KRAFTLAG SA	43	0	0	0	0	269	320	85,54
ld	i10	2015	Conv	165,35586	FJELBERG KRAFTLAG SA	46	0	0	0	0	76	103	20,04
ld	i10	2016	Conv	172,159252	FJELBERG KRAFTLAG SA	46	0	0	0	0	73	103	20,27
ld	i10	2017	Conv	168,244512	FJELBERG KRAFTLAG SA	46	0	0	0	0	68	103	20,36

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
ld	i10	2018	Conv	196,936335	FJELBERG KRAFTLAG SA	46	0	0	0	0	67	101	20,71
ld	i10	2019	Conv	194,102871	FJELBERG KRAFTLAG SA	46	0	0	0	0	69	102	21
ld	i11	2015	Conv	338,217281	FUSA KRAFTLAG SA	55	0	0	0	0	187	234	30,87
ld	i11	2016	Conv	334,036328	FUSA KRAFTLAG SA	55	0	0	0	0	184	233	31,27
ld	i11	2017	Conv	301,551377	FUSA KRAFTLAG SA	55	0	0	0	0	184	233	31,48
ld	i11	2018	Conv	295,434106	FUSA KRAFTLAG SA	55	0	0	0	0	185	235	31,83
ld	i11	2019	Conv	283,371786	FUSA KRAFTLAG SA	55	0	0	0	0	185	236	32,26
ld	i12	2015	Conv	1307,67179	SUNNFJORD ENERGI AS	56	0	0	0	0	1075	1093	153,51
ld	i12	2016	Conv	1377,29233	SUNNFJORD ENERGI AS	56	0	0	0	0	1079	1102	156,41
ld	i12	2017	Conv	1416,74517	SUNNFJORD ENERGI AS	56	0	0	0	0	1078	1103	162,68
ld	i12	2018	Conv	1318,34008	SUNNFJORD ENERGI AS	56	0	0	0	0	1092	1115	164,77
ld	i12	2019	Conv	1372,5739	SUNNFJORD ENERGI AS	56	0	0	0	0	1080	1126	165,85
ld	i13	2015	Conv	441,801536	TROLLFJORD NETT AS	63	0	0	0	0	319	321	53,98
ld	i13	2016	Conv	539,979957	TROLLFJORD NETT AS	63	0	0	0	0	324	324	54,24
ld	i13	2017	Conv	500,676987	TROLLFJORD NETT AS	63	0	0	0	0	324	322	54,65
ld	i13	2018	Conv	508,528412	TROLLFJORD NETT AS	63	0	0	0	0	324	325	54,96
ld	i13	2019	Conv	550,847615	TROLLFJORD NETT AS	63	0	0	0	0	339	330	55,46
ld	i14	2015	Conv	658,5318	HAMMERFEST ENERGI NETT AS	65	0	0	0	0	510	454	77,5
ld	i14	2016	Conv	649,782516	HAMMERFEST ENERGI NETT AS	65	0	0	0	0	520	453	77,5
ld	i14	2017	Conv	656,654301	HAMMERFEST ENERGI NETT AS	65	0	0	0	0	517	451	78,24
ld	i14	2018	Conv	568,487512	HAMMERFEST ENERGI NETT AS	65	0	0	0	0	519	460	79,12
ld	i14	2019	Conv	631,68434	HAMMERFEST ENERGI NETT AS	65	0	0	0	0	521	466	79,97
ld	i15	2015	Conv	3964,17142	HELGELAND KRAFT NETT AS	71	0	0	0	0	3075	3033	447,76
ld	i15	2016	Conv	4034,38815	HELGELAND KRAFT NETT AS	71	0	0	0	0	3102	3038	451,62
ld	i15	2017	Conv	3676,97158	HELGELAND KRAFT NETT AS	71	0	0	0	0	3109	3051	455,7
ld	i15	2018	Conv	3440,12727	HELGELAND KRAFT NETT AS	71	0	0	0	0	3119	3050	457,26
ld	i15	2019	Conv	3757,90299	HELGELAND KRAFT NETT AS	71	0	0	0	0	3120	3062	458,99
ld	i16	2015	Conv	358,175201	HURUM NETT AS	82	0	0	0	0	163	296	70,64
ld	i16	2016	Conv	407,449622	HURUM NETT AS	82	0	0	0	0	164	297	71,2
ld	i16	2017	Conv	368,881105	HURUM NETT AS	82	0	0	0	0	170	299	71,69
ld	i16	2018	Conv	398,729289	HURUM NETT AS	82	0	0	0	0	170	299	73,11
ld	i16	2019	Conv	382,752949	HURUM NETT AS	82	0	0	0	0	177	300	73,72
ld	i17	2015	Conv	301,722782	HØLAND OG SETSKOG ELVERK SA	84	0	0	0	0	245	317	60,75
ld	i17	2016	Conv	326,290813	HØLAND OG SETSKOG ELVERK SA	84	0	0	0	0	247	320	61,5
ld	i17	2017	Conv	360,55771	HØLAND OG SETSKOG ELVERK SA	84	0	0	0	0	255	324	63,56
ld	i17	2018	Conv	348,470343	HØLAND OG SETSKOG ELVERK SA	84	0	0	0	0	256	323	64,73
ld	i17	2019	Conv	359,836641	HØLAND OG SETSKOG ELVERK SA	84	0	0	0	0	257	323	65,97
ld	i18	2015	Conv	1518,71932	ISTAD NETT AS	86	0	0	0	0	1115	1393	262,62
ld	i18	2016	Conv	1535,50289	ISTAD NETT AS	86	0	0	0	0	1119	1410	265,85
ld	i18	2017	Conv	1496,82028	ISTAD NETT AS	86	0	0	0	0	1121	1410	273,34
ld	i18	2018	Conv	1414,95332	ISTAD NETT AS	86	0	0	0	0	1141	1417	290,91
ld	i18	2019	Conv	1549,52601	ISTAD NETT AS	86	0	0	0	0	1158	1424	294,66
ld	i19	2015	Conv	394,677423	JÆREN EVERK KOMMUNALT FORETAK I HÅ	88	0	0	0	0	292	390	85,81
ld	i19	2016	Conv	452,561624	JÆREN EVERK KOMMUNALT FORETAK I HÅ	88	0	0	0	0	295	396	87,46
ld	i19	2017	Conv	451,247594	JÆREN EVERK KOMMUNALT FORETAK I HÅ	88	0	0	0	0	292	401	88,54
ld	i19	2018	Conv	448,010115	JÆREN EVERK KOMMUNALT FORETAK I HÅ	88	0	0	0	0	301	403	89,14
ld	i19	2019	Conv	422,843383	JÆREN EVERK KOMMUNALT FORETAK I HÅ	88	0	0	0	0	300	417	90,08
ld	i20	2015	Conv	409,281552	KLEPP ENERGI AS	91	0	0	0	0	210	305	82,52
ld	i20	2016	Conv	434,373621	KLEPP ENERGI AS	91	0	0	0	0	216	307	84,58
ld	i20	2017	Conv	395,778931	KLEPP ENERGI AS	91	0	0	0	0	220	310	86,25

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
ld	i20	2018	Conv	411,773959	KLEPP ENERGI AS	91	0	0	0	0	223	311	88,06
ld	i20	2019	Conv	394,107711	KLEPP ENERGI AS	91	0	0	0	0	221	314	89,83
ld	i21	2015	Conv	631,881844	KRAGERØ ENERGI AS	93	0	0	0	0	324	377	95,68
ld	i21	2016	Conv	645,759571	KRAGERØ ENERGI AS	93	0	0	0	0	324	378	96,34
ld	i21	2017	Conv	622,888615	KRAGERØ ENERGI AS	93	0	0	0	0	325	378	97,24
ld	i21	2018	Conv	656,358961	KRAGERØ ENERGI AS	93	0	0	0	0	341	380	97,32
ld	i21	2019	Conv	592,053911	KRAGERØ ENERGI AS	93	0	0	0	0	331	374	97,92
ld	i22	2015	Conv	167,176566	KRØDSHERAD EVERK KF	95	0	0	0	0	144	183	29,7
ld	i22	2016	Conv	196,796487	KRØDSHERAD EVERK KF	95	0	0	0	0	149	188	30,03
ld	i22	2017	Conv	174,916402	KRØDSHERAD EVERK KF	95	0	0	0	0	151	188	30,52
ld	i22	2018	Conv	167,805563	KRØDSHERAD EVERK KF	95	0	0	0	0	151	193	30,91
ld	i22	2019	Conv	173,178599	KRØDSHERAD EVERK KF	95	0	0	0	0	152	195	31,64
ld	i23	2015	Conv	546,975845	KVAM KRAFTVERK AS	96	0	0	0	0	238	364	71,52
ld	i23	2016	Conv	496,041609	KVAM KRAFTVERK AS	96	0	0	0	0	248	371	71,94
ld	i23	2017	Conv	487,722983	KVAM KRAFTVERK AS	96	0	0	0	0	250	381	73,04
ld	i23	2018	Conv	475,88798	KVAM KRAFTVERK AS	96	0	0	0	0	250	383	73,17
ld	i23	2019	Conv	515,102835	KVAM KRAFTVERK AS	96	0	0	0	0	253	386	73,94
ld	i24	2015	Conv	563,062594	KVINNHERAD ENERGI AS	97	0	0	0	0	335	409	71,76
ld	i24	2016	Conv	555,446457	KVINNHERAD ENERGI AS	97	0	0	0	0	333	409	72,48
ld	i24	2017	Conv	557,3673	KVINNHERAD ENERGI AS	97	0	0	0	0	334	410	73,26
ld	i24	2018	Conv	484,515748	KVINNHERAD ENERGI AS	97	0	0	0	0	337	412	73,86
ld	i24	2019	Conv	475,947276	KVINNHERAD ENERGI AS	97	0	0	0	0	361	418	74,43
ld	i25	2015	Conv	539,026286	LUOSTEJOK KRAFTLAG SA	103	0	0	0	0	501	353	38,64
ld	i25	2016	Conv	500,733044	LUOSTEJOK KRAFTLAG SA	103	0	0	0	0	508	355	38,87
ld	i25	2017	Conv	488,32365	LUOSTEJOK KRAFTLAG SA	103	0	0	0	0	508	356	39,2
ld	i25	2018	Conv	447,728663	LUOSTEJOK KRAFTLAG SA	103	0	0	0	0	509	357	39,47
ld	i25	2019	Conv	429,279877	LUOSTEJOK KRAFTLAG SA	103	0	0	0	0	514	360	39,74
ld	i26	2015	Conv	285,464296	LUSTER ENERGIVERK AS	104	0	0	0	0	254	252	37,41
ld	i26	2016	Conv	267,367785	LUSTER ENERGIVERK AS	104	0	0	0	0	258	255	37,67
ld	i26	2017	Conv	288,525485	LUSTER ENERGIVERK AS	104	0	0	0	0	257	256	37,96
ld	i26	2018	Conv	253,629679	LUSTER ENERGIVERK AS	104	0	0	0	0	258	257	38,2
ld	i26	2019	Conv	308,587071	LUSTER ENERGIVERK AS	104	0	0	0	0	251	262	38,16
ld	i27	2015	Conv	196,422446	LÆRDAL ENERGI AS	106	0	0	0	0	147	131	18,88
ld	i27	2016	Conv	217,677081	LÆRDAL ENERGI AS	106	0	0	0	0	156	135	18,99
ld	i27	2017	Conv	198,448405	LÆRDAL ENERGI AS	106	0	0	0	0	156	135	19,2
ld	i27	2018	Conv	182,062389	LÆRDAL ENERGI AS	106	0	0	0	0	154	137	19,37
ld	i27	2019	Conv	178,27957	LÆRDAL ENERGI AS	106	0	0	0	0	154	138	19,78
ld	i28	2015	Conv	435,959347	MELØY ENERGI NETT AS	116	0	0	0	0	312	314	48,76
ld	i28	2016	Conv	416,670585	MELØY ENERGI NETT AS	116	0	0	0	0	311	313	48,68
ld	i28	2017	Conv	418,000872	MELØY ENERGI NETT AS	116	0	0	0	0	311	313	48,61
ld	i28	2018	Conv	382,638668	MELØY ENERGI NETT AS	116	0	0	0	0	311	320	48,63
ld	i28	2019	Conv	428,475558	MELØY ENERGI NETT AS	116	0	0	0	0	312	320	48,41
ld	i29	2015	Conv	538,740485	NORD-SALTEN KRAFT NETT AS	132	0	0	0	0	831	528	66,33
ld	i29	2016	Conv	477,271965	NORD-SALTEN KRAFT NETT AS	132	0	0	0	0	808	530	66,69
ld	i29	2017	Conv	490,306983	NORD-SALTEN KRAFT NETT AS	132	0	0	0	0	824	533	67,07
ld	i29	2018	Conv	515,859213	NORD-SALTEN KRAFT NETT AS	132	0	0	0	0	817	543	67,34
ld	i29	2019	Conv	507,784467	NORD-SALTEN KRAFT NETT AS	132	0	0	0	0	834	559	67,83
ld	i30	2015	Conv	746,746484	YMBER NETT AS	133	0	0	0	0	974	674	87,84
ld	i30	2016	Conv	708,754624	YMBER NETT AS	133	0	0	0	0	982	679	88,36
ld	i30	2017	Conv	688,903767	YMBER NETT AS	133	0	0	0	0	995	689	88,86
ld	i30	2018	Conv	682,492001	YMBER NETT AS	133	0	0	0	0	970	694	90,19
ld	i30	2019	Conv	674,691371	YMBER NETT AS	133	0	0	0	0	981	701	90,73
ld	i31	2015	Conv	885,735293	NORD-ØSTERDAL KRAFTLAG SA	135	0	0	0	0	1000	944	107,44
ld	i31	2016	Conv	900,163656	NORD-ØSTERDAL KRAFTLAG SA	135	0	0	0	0	1002	955	108,62

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
ld	i31	2017	Conv	854,593009	NORD-ØSTERDAL KRAFTLAG SA	135	0	0	0	0	1006	962	109,84
ld	i31	2018	Conv	846,109007	NORD-ØSTERDAL KRAFTLAG SA	135	0	0	0	0	1011	972	110,85
ld	i31	2019	Conv	805,804769	NORD-ØSTERDAL KRAFTLAG SA	135	0	0	0	0	1020	972	111,94
ld	i32	2015	Conv	242,740484	NORDKYN KRAFTLAG SA	138	0	0	0	0	229	134	18,52
ld	i32	2016	Conv	224,961211	NORDKYN KRAFTLAG SA	138	0	0	0	0	229	134	18,59
ld	i32	2017	Conv	212,080297	NORDKYN KRAFTLAG SA	138	0	0	0	0	229	134	18,77
ld	i32	2018	Conv	222,200669	NORDKYN KRAFTLAG SA	138	0	0	0	0	229	135	19,04
ld	i32	2019	Conv	217,549662	NORDKYN KRAFTLAG SA	138	0	0	0	0	248	143	19,06
ld	i33	2015	Conv	421,513606	ODDA ENERGI NETT AS	146	0	0	0	0	250	229	61,03
ld	i33	2016	Conv	439,82514	ODDA ENERGI NETT AS	146	0	0	0	0	249	231	61,8
ld	i33	2017	Conv	435,617693	ODDA ENERGI NETT AS	146	0	0	0	0	250	235	62,59
ld	i33	2018	Conv	434,052545	ODDA ENERGI NETT AS	146	0	0	0	0	250	239	63,18
ld	i33	2019	Conv	436,38598	ODDA ENERGI NETT AS	146	0	0	0	0	250	239	63,88
ld	i34	2015	Conv	384,432701	TENSIO OEV AS	149	0	0	0	0	305	431	69,01
ld	i34	2016	Conv	390,382092	TENSIO OEV AS	149	0	0	0	0	309	433	70,45
ld	i34	2017	Conv	397,359343	TENSIO OEV AS	149	0	0	0	0	310	439	72,25
ld	i34	2018	Conv	403,940439	TENSIO OEV AS	149	0	0	0	0	313	448	74,56
ld	i34	2019	Conv	404,00538	TENSIO OEV AS	149	0	0	0	0	318	457	77,15
ld	i35	2015	Conv	278,040551	RAKKESTAD ENERGI AS	157	0	0	0	0	278	371	43,65
ld	i35	2016	Conv	309,754841	RAKKESTAD ENERGI AS	157	0	0	0	0	278	379	43,87
ld	i35	2017	Conv	284,935186	RAKKESTAD ENERGI AS	157	0	0	0	0	280	388	44,14
ld	i35	2018	Conv	296,867469	RAKKESTAD ENERGI AS	157	0	0	0	0	281	391	45,07
ld	i35	2019	Conv	297,240594	RAKKESTAD ENERGI AS	157	0	0	0	0	283	393	45,58
ld	i36	2015	Conv	338,217213	RAULAND KRAFTFORSYNINGSLAG SA	161	0	0	0	0	316	222	41,07
ld	i36	2016	Conv	303,324469	RAULAND KRAFTFORSYNINGSLAG SA	161	0	0	0	0	313	225	42,27
ld	i36	2017	Conv	307,054464	RAULAND KRAFTFORSYNINGSLAG SA	161	0	0	0	0	313	224	43,67
ld	i36	2018	Conv	315,254969	RAULAND KRAFTFORSYNINGSLAG SA	161	0	0	0	0	312	228	45,07
ld	i36	2019	Conv	296,138148	RAULAND KRAFTFORSYNINGSLAG SA	161	0	0	0	0	296	229	46,26
ld	i37	2015	Conv	464,625184	RAUMA ENERGI AS	162	0	0	0	0	322	364	51,38
ld	i37	2016	Conv	484,347256	RAUMA ENERGI AS	162	0	0	0	0	322	370	51,42
ld	i37	2017	Conv	466,344768	RAUMA ENERGI AS	162	0	0	0	0	324	373	51,78
ld	i37	2018	Conv	420,934443	RAUMA ENERGI AS	162	0	0	0	0	350	379	51,72
ld	i37	2019	Conv	453,276091	RAUMA ENERGI AS	162	0	0	0	0	350	386	52,53
ld	i38	2015	Conv	578,622992	REPVÅG KRAFTLAG SA	164	0	0	0	0	507	284	43,95
ld	i38	2016	Conv	540,150154	REPVÅG KRAFTLAG SA	164	0	0	0	0	503	284	44,27
ld	i38	2017	Conv	521,519511	REPVÅG KRAFTLAG SA	164	0	0	0	0	479	284	44,6
ld	i38	2018	Conv	500,000433	REPVÅG KRAFTLAG SA	164	0	0	0	0	485	308	44,88
ld	i38	2019	Conv	505,601245	REPVÅG KRAFTLAG SA	164	0	0	0	0	512	310	45
ld	i39	2015	Conv	150,550017	ROLLAG ELEKTRISITETSVERK AS	168	0	0	0	0	116	149	20,37
ld	i39	2016	Conv	158,792628	ROLLAG ELEKTRISITETSVERK AS	168	0	0	0	0	122	151	21,19
ld	i39	2017	Conv	155,139453	ROLLAG ELEKTRISITETSVERK AS	168	0	0	0	0	125	155	22,36
ld	i39	2018	Conv	167,172868	ROLLAG ELEKTRISITETSVERK AS	168	0	0	0	0	127	159	23,38
ld	i39	2019	Conv	182,14045	ROLLAG ELEKTRISITETSVERK AS	168	0	0	0	0	130	166	24,33
ld	i40	2015	Conv	354,694245	RØROS E-VERK NETT AS	173	0	0	0	0	350	342	61,16
ld	i40	2016	Conv	341,8196	RØROS E-VERK NETT AS	173	0	0	0	0	351	345	62,33
ld	i40	2017	Conv	389,662616	RØROS E-VERK NETT AS	173	0	0	0	0	353	353	63,36
ld	i40	2018	Conv	340,455776	RØROS E-VERK NETT AS	173	0	0	0	0	356	362	64,94
ld	i40	2019	Conv	318,239986	RØROS E-VERK NETT AS	173	0	0	0	0	359	364	64,72
ld	i41	2015	Conv	118,168051	SANDØY NETT AS	181	0	0	0	0	58	61	10,43

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
ld	i41	2016	Conv	96,8506361	SANDØY NETT AS	181	0	0	0	0	58	61	10,61
ld	i41	2017	Conv	110,210303	SANDØY NETT AS	181	0	0	0	0	63	66	10,87
ld	i41	2018	Conv	134,170313	SANDØY NETT AS	181	0	0	0	0	59	64	10,9
ld	i41	2019	Conv	154,43882	SANDØY NETT AS	181	0	0	0	0	59	64	10,88
ld	i42	2015	Conv	219,877368	SKJÅK ENERGI AS	194	0	0	0	0	179	200	20,44
ld	i42	2016	Conv	215,225148	SKJÅK ENERGI AS	194	0	0	0	0	178	201	20,54
ld	i42	2017	Conv	209,869481	SKJÅK ENERGI AS	194	0	0	0	0	180	205	20,63
ld	i42	2018	Conv	191,225453	SKJÅK ENERGI AS	194	0	0	0	0	182	206	21,05
ld	i42	2019	Conv	176,197412	SKJÅK ENERGI AS	194	0	0	0	0	182	206	21,01
ld	i43	2015	Conv	665,210074	SOGNEKRAFT AS	197	0	0	0	0	495	566	89,12
ld	i43	2016	Conv	645,844986	SOGNEKRAFT AS	197	0	0	0	0	511	570	90,91
ld	i43	2017	Conv	535,514562	SOGNEKRAFT AS	197	0	0	0	0	510	576	92,12
ld	i43	2018	Conv	594,498543	SOGNEKRAFT AS	197	0	0	0	0	519	582	93,4
ld	i43	2019	Conv	666,052772	SOGNEKRAFT AS	197	0	0	0	0	536	589	94,86
ld	i44	2015	Conv	308,213686	STRANDA ENERGI AS	204	0	0	0	0	190	219	33,3
ld	i44	2016	Conv	332,966073	STRANDA ENERGI AS	204	0	0	0	0	194	228	33,96
ld	i44	2017	Conv	322,977727	STRANDA ENERGI AS	204	0	0	0	0	194	226	35,57
ld	i44	2018	Conv	325,22265	STRANDA ENERGI AS	204	0	0	0	0	193	230	36,16
ld	i44	2019	Conv	348,976746	STRANDA ENERGI AS	204	0	0	0	0	197	241	36,45
ld	i45	2015	Conv	372,641431	STRYN ENERGI AS	205	0	0	0	0	268	348	45,87
ld	i45	2016	Conv	423,061259	STRYN ENERGI AS	205	0	0	0	0	274	354	46,81
ld	i45	2017	Conv	408,3137	STRYN ENERGI AS	205	0	0	0	0	277	361	47,69
ld	i45	2018	Conv	393,805195	STRYN ENERGI AS	205	0	0	0	0	280	365	48,63
ld	i45	2019	Conv	409,597399	STRYN ENERGI AS	205	0	0	0	0	282	366	49,43
ld	i46	2015	Conv	289,619908	SYKKYLVEN ENERGI AS	213	0	0	0	0	186	223	45,5
ld	i46	2016	Conv	316,445185	SYKKYLVEN ENERGI AS	213	0	0	0	0	189	225	45,71
ld	i46	2017	Conv	308,722886	SYKKYLVEN ENERGI AS	213	0	0	0	0	189	224	46,46
ld	i46	2018	Conv	309,577616	SYKKYLVEN ENERGI AS	213	0	0	0	0	190	222	47,14
ld	i46	2019	Conv	296,461707	SYKKYLVEN ENERGI AS	213	0	0	0	0	190	225	47,41
ld	i47	2015	Conv	325,047273	SØR AURDAL ENERGI AS	214	0	0	0	0	226	291	28,83
ld	i47	2016	Conv	321,906132	SØR AURDAL ENERGI AS	214	0	0	0	0	226	291	29,19
ld	i47	2017	Conv	322,569203	SØR AURDAL ENERGI AS	214	0	0	0	0	227	291	29,58
ld	i47	2018	Conv	343,077707	SØR AURDAL ENERGI AS	214	0	0	0	0	257	298	30,12
ld	i47	2019	Conv	338,180009	SØR AURDAL ENERGI AS	214	0	0	0	0	261	308	30,84
ld	i48	2015	Conv	6293,22743	TENSIO TS AS	215	0	0	0	0	4139	4976	1523,34
ld	i48	2016	Conv	6271,50088	TENSIO TS AS	215	0	0	0	0	4191	5120	1548,98
ld	i48	2017	Conv	6545,03674	TENSIO TS AS	215	0	0	0	0	4245	5148	1577,31
ld	i48	2018	Conv	6915,23125	TENSIO TS AS	215	0	0	0	0	4289	5185	1607,92
ld	i48	2019	Conv	7209,48837	TENSIO TS AS	215	0	0	0	0	4344	5246	1644,62
ld	i49	2015	Conv	611,866673	TINN ENERGI AS	223	0	0	0	0	390	418	73,9
ld	i49	2016	Conv	587,42397	TINN ENERGI AS	223	0	0	0	0	392	422	74,8
ld	i49	2017	Conv	595,909112	TINN ENERGI AS	223	0	0	0	0	394	422	75,53
ld	i49	2018	Conv	602,124579	TINN ENERGI AS	223	0	0	0	0	383	401	76,34
ld	i49	2019	Conv	530,416156	TINN ENERGI AS	223	0	0	0	0	389	408	77,59
ld	i50	2015	Conv	4327,92697	TROMS KRAFT NETT AS	227	0	0	0	0	3991	4229	722,07
ld	i50	2016	Conv	4496,92172	TROMS KRAFT NETT AS	227	0	0	0	0	3997	4243	733,15
ld	i50	2017	Conv	4509,02681	TROMS KRAFT NETT AS	227	0	0	0	0	4058	4276	746,75
ld	i50	2018	Conv	4207,24629	TROMS KRAFT NETT AS	227	0	0	0	0	4054	4300	761,58
ld	i50	2019	Conv	4361,25351	TROMS KRAFT NETT AS	227	0	0	0	0	4076	4341	767,82
ld	i51	2015	Conv	207,050214	TRØGSTAD ELVERK AS (Inaktiv i brreg)	231	0	0	0	0	190	303	32,31
ld	i51	2016	Conv	200,784396	TRØGSTAD ELVERK AS (Inaktiv i brreg)	231	0	0	0	0	190	304	32,52
ld	i51	2017	Conv	208,180693	TRØGSTAD ELVERK AS (Inaktiv i brreg)	231	0	0	0	0	191	306	32,71
ld	i51	2018	Conv	222,377649	TRØGSTAD ELVERK AS (Inaktiv i brreg)	231	0	0	0	0	195	308	33,4

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
ld	i51	2019	Conv	230,532902	TRØGSTAD ELVERK AS (Inaktiv i brreg)	231	0	0	0	0	195	310	33,88
ld	i52	2015	Conv	631,780062	HARDANGER ENERGI NETT AS	238	0	0	0	0	454	446	66,26
ld	i52	2016	Conv	562,360141	HARDANGER ENERGI NETT AS	238	0	0	0	0	456	452	66,93
ld	i52	2017	Conv	501,12962	HARDANGER ENERGI NETT AS	238	0	0	0	0	461	459	67,36
ld	i52	2018	Conv	559,93607	HARDANGER ENERGI NETT AS	238	0	0	0	0	470	462	68,08
ld	i52	2019	Conv	504,241727	HARDANGER ENERGI NETT AS	238	0	0	0	0	482	460	69,02
ld	i53	2015	Conv	167,344437	UVDAL KRAFTFORSYNING SA	242	0	0	0	0	110	130	20,4
ld	i53	2016	Conv	169,845078	UVDAL KRAFTFORSYNING SA	242	0	0	0	0	111	131	20,64
ld	i53	2017	Conv	185,605128	UVDAL KRAFTFORSYNING SA	242	0	0	0	0	113	132	21,08
ld	i53	2018	Conv	180,902428	UVDAL KRAFTFORSYNING SA	242	0	0	0	0	114	134	21,49
ld	i53	2019	Conv	164,017573	UVDAL KRAFTFORSYNING SA	242	0	0	0	0	115	134	21,99
ld	i54	2015	Conv	221,312954	VANG ENERGIVERK KF	248	0	0	0	0	174	207	22,71
ld	i54	2016	Conv	223,386525	VANG ENERGIVERK KF	248	0	0	0	0	185	218	23,21
ld	i54	2017	Conv	249,690694	VANG ENERGIVERK KF	248	0	0	0	0	185	225	23,69
ld	i54	2018	Conv	213,846362	VANG ENERGIVERK KF	248	0	0	0	0	185	223	24,01
ld	i54	2019	Conv	203,534433	VANG ENERGIVERK KF	248	0	0	0	0	189	227	24,36
ld	i55	2015	Conv	1295,18096	VARANGER KRAFTNETT AS	249	0	0	0	0	1295	1162	166,11
ld	i55	2016	Conv	1435,39969	VARANGER KRAFTNETT AS	249	0	0	0	0	1312	1171	167,49
ld	i55	2017	Conv	1410,82117	VARANGER KRAFTNETT AS	249	0	0	0	0	1339	1183	168,75
ld	i55	2018	Conv	1461,27868	VARANGER KRAFTNETT AS	249	0	0	0	0	1340	1203	170,56
ld	i55	2019	Conv	1513,93581	VARANGER KRAFTNETT AS	249	0	0	0	0	1380	1215	170,91
ld	i56	2015	Conv	1050,80033	VEST-TELEMARK KRAFTLAG AS	251	0	0	0	0	1095	920	137,41
ld	i56	2016	Conv	1004,79494	VEST-TELEMARK KRAFTLAG AS	251	0	0	0	0	1089	930	138,07
ld	i56	2017	Conv	1005,55621	VEST-TELEMARK KRAFTLAG AS	251	0	0	0	0	1091	931	141,78
ld	i56	2018	Conv	1097,49524	VEST-TELEMARK KRAFTLAG AS	251	0	0	0	0	1102	943	142,92
ld	i56	2019	Conv	1106,7596	VEST-TELEMARK KRAFTLAG AS	251	0	0	0	0	1116	954	144,74
ld	i57	2015	Conv	1053,00772	DALANE NETT AS	257	0	0	0	0	713	775	142,53
ld	i57	2016	Conv	1144,08664	DALANE NETT AS	257	0	0	0	0	725	775	147,05
ld	i57	2017	Conv	1059,9373	DALANE NETT AS	257	0	0	0	0	736	786	146,76
ld	i57	2018	Conv	1035,13863	DALANE NETT AS	257	0	0	0	0	740	823	148,36
ld	i57	2019	Conv	921,479508	DALANE NETT AS	257	0	0	0	0	762	834	149,42
ld	i58	2015	Conv	504,892494	ØVRE EIKER NETT AS	264	0	0	0	0	323	520	95,21
ld	i58	2016	Conv	519,583443	ØVRE EIKER NETT AS	264	0	0	0	0	325	526	97,38
ld	i58	2017	Conv	489,810484	ØVRE EIKER NETT AS	264	0	0	0	0	330	526	99,67
ld	i58	2018	Conv	507,222727	ØVRE EIKER NETT AS	264	0	0	0	0	331	526	101,93
ld	i58	2019	Conv	532,416439	ØVRE EIKER NETT AS	264	0	0	0	0	346	528	103,82
ld	i59	2015	Conv	260,391685	ÅRDAL ENERGI NETT AS	267	0	0	0	0	148	135	35,71
ld	i59	2016	Conv	259,409008	ÅRDAL ENERGI NETT AS	267	0	0	0	0	140	134	35,74
ld	i59	2017	Conv	278,219359	ÅRDAL ENERGI NETT AS	267	0	0	0	0	144	135	35,84
ld	i59	2018	Conv	269,05587	ÅRDAL ENERGI NETT AS	267	0	0	0	0	145	135	35,71
ld	i59	2019	Conv	302,461826	ÅRDAL ENERGI NETT AS	267	0	0	0	0	147	136	35,64
ld	i60	2015	Conv	2196,17975	SFE NETT AS	269	0	0	0	0	1486	1563	240,73
ld	i60	2016	Conv	2556,11281	SFE NETT AS	269	0	0	0	0	1495	1576	243,36
ld	i60	2017	Conv	2394,52938	SFE NETT AS	269	0	0	0	0	1490	1579	246,4
ld	i60	2018	Conv	2372,22443	SFE NETT AS	269	0	0	0	0	1509	1588	248,28
ld	i60	2019	Conv	1986,25316	SFE NETT AS	269	0	0	0	0	1532	1594	250,66
ld	i61	2015	Conv	639,743826	SVORKA ENERGI AS	274	0	0	0	0	516	547	65,95
ld	i61	2016	Conv	657,627664	SVORKA ENERGI AS	274	0	0	0	0	515	532	66,71
ld	i61	2017	Conv	599,204867	SVORKA ENERGI AS	274	0	0	0	0	518	537	67,88
ld	i61	2018	Conv	565,581911	SVORKA ENERGI AS	274	0	0	0	0	524	543	68,42
ld	i61	2019	Conv	602,048585	SVORKA ENERGI AS	274	0	0	0	0	525	545	68,99
ld	i62	2015	Conv	1466,36158	HALLINGDAL KRAFTNETT AS	275	0	0	0	0	1154	1651	232,98
ld	i62	2016	Conv	1468,17708	HALLINGDAL KRAFTNETT AS	275	0	0	0	0	1167	1667	238,58
ld	i62	2017	Conv	1466,03755	HALLINGDAL KRAFTNETT AS	275	0	0	0	0	1193	1719	244,32
ld	i62	2018	Conv	1495,08917	HALLINGDAL KRAFTNETT AS	275	0	0	0	0	1201	1767	250,68
ld	i62	2019	Conv	1514,03971	HALLINGDAL KRAFTNETT AS	275	0	0	0	0	1210	1799	258,03

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
ld	i63	2015	Conv	1110,17892	GUDBRANDSDAL ENERGI NETT AS	295	0	0	0	0	879	1091	187,37
ld	i63	2016	Conv	1086,42118	GUDBRANDSDAL ENERGI NETT AS	295	0	0	0	0	910	1114	192,64
ld	i63	2017	Conv	1086,72225	GUDBRANDSDAL ENERGI NETT AS	295	0	0	0	0	926	1126	197,8
ld	i63	2018	Conv	1146,34211	GUDBRANDSDAL ENERGI NETT AS	295	0	0	0	0	933	1152	204,09
ld	i63	2019	Conv	1196,0712	GUDBRANDSDAL ENERGI NETT AS	295	0	0	0	0	950	1168	209,25
ld	i64	2015	Conv	870,52887	VALDRES ENERGIVERK AS	306	0	0	0	0	694	975	139,95
ld	i64	2016	Conv	859,985551	VALDRES ENERGIVERK AS	306	0	0	0	0	707	982	142,83
ld	i64	2017	Conv	912,45713	VALDRES ENERGIVERK AS	306	0	0	0	0	733	1002	146,8
ld	i64	2018	Conv	920,002351	VALDRES ENERGIVERK AS	306	0	0	0	0	744	1014	149,79
ld	i64	2019	Conv	892,111715	VALDRES ENERGIVERK AS	306	0	0	0	0	759	1034	153,45
ld	i65	2015	Conv	1773,77787	NEAS AS	311	0	0	0	0	1187	1325	259,59
ld	i65	2016	Conv	1784,21977	NEAS AS	311	0	0	0	0	1195	1333	260,91
ld	i65	2017	Conv	1735,41042	NEAS AS	311	0	0	0	0	1199	1339	261,87
ld	i65	2018	Conv	1761,59836	NEAS AS	311	0	0	0	0	1204	1351	262,1
ld	i65	2019	Conv	1777,0961	NEAS AS	311	0	0	0	0	1212	1368	264,34
ld	i66	2015	Conv	282,643982	HEMSEDAL ENERGI AS	343	0	0	0	0	223	333	38,52
ld	i66	2016	Conv	296,227919	HEMSEDAL ENERGI AS	343	0	0	0	0	227	335	39,61
ld	i66	2017	Conv	288,493303	HEMSEDAL ENERGI AS	343	0	0	0	0	232	338	40,35
ld	i66	2018	Conv	279,923046	HEMSEDAL ENERGI AS	343	0	0	0	0	238	342	41,24
ld	i66	2019	Conv	289,391185	HEMSEDAL ENERGI AS	343	0	0	0	0	240	348	42,89
ld	i67	2015	Conv	643,856372	EVERKET AS	349	0	0	0	0	351	417	74,94
ld	i67	2016	Conv	658,900768	EVERKET AS	349	0	0	0	0	351	414	75,1
ld	i67	2017	Conv	658,074103	EVERKET AS	349	0	0	0	0	350	417	75,63
ld	i67	2018	Conv	599,138566	EVERKET AS	349	0	0	0	0	350	421	75,83
ld	i67	2019	Conv	664,37059	EVERKET AS	349	0	0	0	0	353	416	76,12
ld	i68	2015	Conv	1766,17437	LOFOTKRAFT AS	354	0	0	0	0	914	830	164,95
ld	i68	2016	Conv	1617,65008	LOFOTKRAFT AS	354	0	0	0	0	936	833	165,74
ld	i68	2017	Conv	1742,42127	LOFOTKRAFT AS	354	0	0	0	0	897	852	168,33
ld	i68	2018	Conv	1620,18024	LOFOTKRAFT AS	354	0	0	0	0	905	852	169,99
ld	i68	2019	Conv	1720,89714	LOFOTKRAFT AS	354	0	0	0	0	910	865	172,49
ld	i69	2015	Conv	207,360452	NORE ENERGI AS	373	0	0	0	0	172	188	20,74
ld	i69	2016	Conv	199,610943	NORE ENERGI AS	373	0	0	0	0	172	185	20,82
ld	i69	2017	Conv	209,156112	NORE ENERGI AS	373	0	0	0	0	178	189	21,06
ld	i69	2018	Conv	213,662498	NORE ENERGI AS	373	0	0	0	0	182	192	21,41
ld	i69	2019	Conv	222,053044	NORE ENERGI AS	373	0	0	0	0	185	197	21,81
ld	i70	2015	Conv	209,495856	AURLAND ENERGIVERK AS	418	0	0	0	0	157	146	13,56
ld	i70	2016	Conv	209,802628	AURLAND ENERGIVERK AS	418	0	0	0	0	147	148	13,78
ld	i70	2017	Conv	202,17759	AURLAND ENERGIVERK AS	418	0	0	0	0	149	149	14,18
ld	i70	2018	Conv	216,89589	AURLAND ENERGIVERK AS	418	0	0	0	0	145	150	14,46
ld	i70	2019	Conv	191,129453	AURLAND ENERGIVERK AS	418	0	0	0	0	145	152	14,5
ld	i71	2015	Conv	1450,48876	HÅLOGALAND KRAFT NETT AS	433	0	0	0	0	1236	1267	255,48
ld	i71	2016	Conv	1441,20873	HÅLOGALAND KRAFT NETT AS	433	0	0	0	0	1236	1274	257,55
ld	i71	2017	Conv	1518,35743	HÅLOGALAND KRAFT NETT AS	433	0	0	0	0	1238	1268	260,29
ld	i71	2018	Conv	1510,29892	HÅLOGALAND KRAFT NETT AS	433	0	0	0	0	1236	1281	262,33
ld	i71	2019	Conv	1439,28363	HÅLOGALAND KRAFT NETT AS	433	0	0	0	0	1236	1297	264,49
ld	i72	2015	Conv	3296,58501	MØRENETT AS	460	0	0	0	0	1820	2572	637,55
ld	i72	2016	Conv	3462,66132	MØRENETT AS	460	0	0	0	0	1839	2590	643,86
ld	i72	2017	Conv	3368,7677	MØRENETT AS	460	0	0	0	0	1843	2598	650,5
ld	i72	2018	Conv	3162,20462	MØRENETT AS	460	0	0	0	0	1850	2609	654,17
ld	i72	2019	Conv	3210,15711	MØRENETT AS	460	0	0	0	0	1855	2623	667,85
ld	i73	2015	Conv	1030,49635	VESTERÅLSKRAFT NETT AS	464	0	0	0	0	677	710	115,96
ld	i73	2016	Conv	973,196999	VESTERÅLSKRAFT NETT AS	464	0	0	0	0	683	715	116,76
ld	i73	2017	Conv	960,194022	VESTERÅLSKRAFT NETT AS	464	0	0	0	0	684	717	117,52

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
ld	i73	2018	Conv	900,548244	VESTERÅLSKRAFT NETT AS	464	0	0	0	0	693	720	118,71
ld	i73	2019	Conv	968,934109	VESTERÅLSKRAFT NETT AS	464	0	0	0	0	692	725	119,25
ld	i74	2015	Conv	4642,06523	HAUGALAND KRAFT NETT AS	503	0	0	0	0	2540	3207	808,39
ld	i74	2016	Conv	4189,60532	HAUGALAND KRAFT NETT AS	503	0	0	0	0	2555	3231	817,58
ld	i74	2017	Conv	4148,06923	HAUGALAND KRAFT NETT AS	503	0	0	0	0	2621	3277	826,1
ld	i74	2018	Conv	4283,61189	HAUGALAND KRAFT NETT AS	503	0	0	0	0	2568	3290	833,75
ld	i74	2019	Conv	3852,95793	HAUGALAND KRAFT NETT AS	503	0	0	0	0	2600	3308	843,8
ld	i75	2015	Conv	5854,64691	LYSE ELNETT AS	511	0	0	0	0	2804	3877	1417,13
ld	i75	2016	Conv	6187,20226	LYSE ELNETT AS	511	0	0	0	0	2844	3897	1428,95
ld	i75	2017	Conv	6731,19086	LYSE ELNETT AS	511	0	0	0	0	2896	3885	1442,15
ld	i75	2018	Conv	7255,45799	LYSE ELNETT AS	511	0	0	0	0	2992	3970	1467,33
ld	i75	2019	Conv	6898,18516	LYSE ELNETT AS	511	0	0	0	0	2856	3889	1545,56
ld	i76	2015	Conv	873,579141	VOKKS NETT AS	542	0	0	0	0	757	908	131,64
ld	i76	2016	Conv	936,039481	VOKKS NETT AS	542	0	0	0	0	757	910	132,82
ld	i76	2017	Conv	908,84504	VOKKS NETT AS	542	0	0	0	0	764	915	134,08
ld	i76	2018	Conv	1105,14126	VOKKS NETT AS	542	0	0	0	0	771	925	135,3
ld	i76	2019	Conv	954,220071	VOKKS NETT AS	542	0	0	0	0	767	930	136,15
ld	i77	2015	Conv	9625,39587	BKK NETT AS	566	0	0	0	0	5200	5775	1977,53
ld	i77	2016	Conv	9613,2286	BKK NETT AS	566	0	0	0	0	5187	5823	2007,64
ld	i77	2017	Conv	9320,61293	BKK NETT AS	566	0	0	0	0	5206	5858	2136,9
ld	i77	2018	Conv	9041,31938	BKK NETT AS	566	0	0	0	0	5130	5918	2210,99
ld	i77	2019	Conv	9661,3983	BKK NETT AS	566	0	0	0	0	5171	6006	2249,4
ld	i78	2015	Conv	267,545794	FLESBERG ELEKTRISITETSVERK AS	578	0	0	0	0	220	201	39,03
ld	i78	2016	Conv	300,64656	FLESBERG ELEKTRISITETSVERK AS	578	0	0	0	0	222	206	39,84
ld	i78	2017	Conv	288,932876	FLESBERG ELEKTRISITETSVERK AS	578	0	0	0	0	225	212	40,95
ld	i78	2018	Conv	286,129922	FLESBERG ELEKTRISITETSVERK AS	578	0	0	0	0	228	215	41,84
ld	i78	2019	Conv	326,777065	FLESBERG ELEKTRISITETSVERK AS	578	0	0	0	0	232	230	42,5
ld	i79	2015	Conv	758,858091	MIDTKRAFT NETT AS	591	0	0	0	0	579	793	134,53
ld	i79	2016	Conv	788,100486	MIDTKRAFT NETT AS	591	0	0	0	0	589	780	135,85
ld	i79	2017	Conv	835,341016	MIDTKRAFT NETT AS	591	0	0	0	0	585	788	137,99
ld	i79	2018	Conv	861,667803	MIDTKRAFT NETT AS	591	0	0	0	0	589	794	140,3
ld	i79	2019	Conv	899,853753	MIDTKRAFT NETT AS	591	0	0	0	0	588	803	142,36
ld	i80	2015	Conv	228,306267	NESSET KRAFT AS	593	0	0	0	0	166	0	23,28
ld	i80	2016	Conv	228,844554	NESSET KRAFT AS	593	0	0	0	0	166	183	23,23
ld	i80	2017	Conv	243,965429	NESSET KRAFT AS	593	0	0	0	0	166	183	23,33
ld	i80	2018	Conv	233,557801	NESSET KRAFT AS	593	0	0	0	0	164	184	23,78
ld	i80	2019	Conv	212,209211	NESSET KRAFT AS	593	0	0	0	0	165	186	23,83
ld	i81	2015	Conv	406,001864	SUNNDAL ENERGI KF	599	0	0	0	0	253	283	48,04
ld	i81	2016	Conv	380,215815	SUNNDAL ENERGI KF	599	0	0	0	0	257	282	48,4
ld	i81	2017	Conv	404,026518	SUNNDAL ENERGI KF	599	0	0	0	0	251	281	48,73
ld	i81	2018	Conv	383,862836	SUNNDAL ENERGI KF	599	0	0	0	0	252	281	49
ld	i81	2019	Conv	395,630286	SUNNDAL ENERGI KF	599	0	0	0	0	252	281	49,28
ld	i82	2015	Conv	7822,69876	SKAGERAK NETT AS	611	0	0	0	0	4577	6903	1910,55
ld	i82	2016	Conv	7940,3308	SKAGERAK NETT AS	611	0	0	0	0	4609	6932	1929,54
ld	i82	2017	Conv	8575,25881	SKAGERAK NETT AS	611	0	0	0	0	4647	6980	1964,24
ld	i82	2018	Conv	9701,24264	SKAGERAK NETT AS	611	0	0	0	0	4657	7025	2005,23
ld	i82	2019	Conv	8458,92487	SKAGERAK NETT AS	611	0	0	0	0	4713	7379	2042,2
ld	i83	2015	Conv	682,775396	NORDVEST NETT AS	613	0	0	0	0	575	849	140,23
ld	i83	2016	Conv	740,630549	NORDVEST NETT AS	613	0	0	0	0	580	861	142,55
ld	i83	2017	Conv	718,601407	NORDVEST NETT AS	613	0	0	0	0	586	877	143,75
ld	i83	2018	Conv	807,164223	NORDVEST NETT AS	613	0	0	0	0	596	881	145,62
ld	i83	2019	Conv	821,706792	NORDVEST NETT AS	613	0	0	0	0	598	899	147,26
ld	i84	2015	Conv	3710,87119	GLITRE ENERGI NETT AS	615	0	0	0	0	1944	3467	879,47

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
ld	i84	2016	Conv	3722,31653	GLITRE ENERGI NETT AS	615	0	0	0	0	1951	3446	887,56
ld	i84	2017	Conv	3409,85297	GLITRE ENERGI NETT AS	615	0	0	0	0	1958	3453	910,8
ld	i84	2018	Conv	3452,21779	GLITRE ENERGI NETT AS	615	0	0	0	0	1973	3458	942,05
ld	i84	2019	Conv	3326,35798	GLITRE ENERGI NETT AS	615	0	0	0	0	1986	3506	954,43
ld	i85	2015	Conv	8251,28352	AGDER ENERGI NETT AS	624	0	0	0	0	5764	7987	1921,48
ld	i85	2016	Conv	8651,61832	AGDER ENERGI NETT AS	624	0	0	0	0	5824	8068	1944,26
ld	i85	2017	Conv	8958,35819	AGDER ENERGI NETT AS	624	0	0	0	0	5988	8186	1987,2
ld	i85	2018	Conv	11819,1065	AGDER ENERGI NETT AS	624	0	0	0	0	6064	8249	2015,53
ld	i85	2019	Conv	9773,81749	AGDER ENERGI NETT AS	624	0	0	0	0	6140	8334	2049,14
ld	i86	2015	Conv	801,233636	VOSS ENERGI NETT AS	625	0	0	0	0	404	573	105,74
ld	i86	2016	Conv	819,55945	VOSS ENERGI NETT AS	625	0	0	0	0	428	572	107,72
ld	i86	2017	Conv	866,290938	VOSS ENERGI NETT AS	625	0	0	0	0	431	589	110,16
ld	i86	2018	Conv	869,853936	VOSS ENERGI NETT AS	625	0	0	0	0	434	593	112,28
ld	i86	2019	Conv	912,398456	VOSS ENERGI NETT AS	625	0	0	0	0	435	594	119,3
ld	i87	2015	Conv	916,692686	NORDKRAFT NETT AS	637	0	0	0	0	641	678	153,13
ld	i87	2016	Conv	863,540224	NORDKRAFT NETT AS	637	0	0	0	0	644	692	153,67
ld	i87	2017	Conv	913,766661	NORDKRAFT NETT AS	637	0	0	0	0	649	700	154,44
ld	i87	2018	Conv	833,370927	NORDKRAFT NETT AS	637	0	0	0	0	653	721	154,88
ld	i87	2019	Conv	871,604395	NORDKRAFT NETT AS	637	0	0	0	0	647	743	155,35
ld	i88	2015	Conv	527,336733	MIDT-TELEMARK ENERGI AS	659	0	0	0	0	448	614	106,31
ld	i88	2016	Conv	588,129528	MIDT-TELEMARK ENERGI AS	659	0	0	0	0	449	616	107,2
ld	i88	2017	Conv	585,009312	MIDT-TELEMARK ENERGI AS	659	0	0	0	0	451	621	107,9
ld	i88	2018	Conv	579,413747	MIDT-TELEMARK ENERGI AS	659	0	0	0	0	459	630	108,95
ld	i88	2019	Conv	587,278213	MIDT-TELEMARK ENERGI AS	659	0	0	0	0	465	634	110,09
ld	i89	2015	Conv	734,127338	STANGE ENERGI NETT AS	669	0	0	0	0	455	721	108,96
ld	i89	2016	Conv	758,838357	STANGE ENERGI NETT AS	669	0	0	0	0	461	725	110,61
ld	i89	2017	Conv	700,575361	STANGE ENERGI NETT AS	669	0	0	0	0	465	729	112,7
ld	i89	2018	Conv	727,126093	STANGE ENERGI NETT AS	669	0	0	0	0	464	736	115,27
ld	i89	2019	Conv	747,64249	STANGE ENERGI NETT AS	669	0	0	0	0	474	746	116,03
ld	i90	2015	Conv	29578,8151	ELVIA AS	675	0	0	0	0	18867	28286	8472,66
ld	i90	2016	Conv	29967,7966	ELVIA AS	675	0	0	0	0	18970	28354	8562,1
ld	i90	2017	Conv	29312,5737	ELVIA AS	675	0	0	0	0	19137	28529	8714,6
ld	i90	2018	Conv	32300,6216	ELVIA AS	675	0	0	0	0	19213	28668	8929,31
ld	i90	2019	Conv	32367,74	ELVIA AS	675	0	0	0	0	19406	28857	9204,2
ld	i91	2015	Conv	1408,40086	RINGERIKSKRAFT NETT AS	693	0	0	0	0	789	1320	210,9
ld	i91	2016	Conv	1439,34438	RINGERIKSKRAFT NETT AS	693	0	0	0	0	794	1329	214,59
ld	i91	2017	Conv	1430,01456	RINGERIKSKRAFT NETT AS	693	0	0	0	0	793	1336	217,89
ld	i91	2018	Conv	1562,02948	RINGERIKSKRAFT NETT AS	693	0	0	0	0	793	1365	220,27
ld	i91	2019	Conv	1552,65822	RINGERIKSKRAFT NETT AS	693	0	0	0	0	800	1372	222,26
ld	i92	2015	Conv	4640,17476	TENSIO TN AS	699	0	0	0	0	5199	6853	849,28
ld	i92	2016	Conv	4588,1261	TENSIO TN AS	699	0	0	0	0	5247	6902	857,84
ld	i92	2017	Conv	4371,08513	TENSIO TN AS	699	0	0	0	0	5290	6919	865,63
ld	i92	2018	Conv	4627,29341	TENSIO TN AS	699	0	0	0	0	5299	6988	873,77
ld	i92	2019	Conv	4877,70468	TENSIO TN AS	699	0	0	0	0	5322	6998	885,94
ld	i93	2015	Conv	2563,16932	NORDLANDSNETT AS	726	0	0	0	0	1773	1664	385,81
ld	i93	2016	Conv	2404,3747	NORDLANDSNETT AS	726	0	0	0	0	1788	1679	392,04
ld	i93	2017	Conv	2511,17162	NORDLANDSNETT AS	726	0	0	0	0	1801	1684	397,56
ld	i93	2018	Conv	2519,50076	NORDLANDSNETT AS	726	0	0	0	0	1798	1703	403,27
ld	i93	2019	Conv	2891,62479	NORDLANDSNETT AS	726	0	0	0	0	1853	1825	412,53
ld	i94	2015	Conv	1425,40331	NETTSELSKAPET AS	903	0	0	0	0	1197	1439	227,8
ld	i94	2016	Conv	1406,20516	NETTSELSKAPET AS	903	0	0	0	0	1209	1437	231,56
ld	i94	2017	Conv	1397,41751	NETTSELSKAPET AS	903	0	0	0	0	1218	1445	235,24
ld	i94	2018	Conv	1327,66891	NETTSELSKAPET AS	903	0	0	0	0	1252	1471	238,37
ld	i94	2019	Conv	1272,47043	NETTSELSKAPET AS	903	0	0	0	0	1247	1488	239,78
ld	i95	2015	Spec	41,7911807	MODALEN KRAFTLAG SA	121	0	0	0	0	33	4	4,26
ld	i95	2016	Spec	31,8342589	MODALEN KRAFTLAG SA	121	0	0	0	0	33	4	4,2

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
ld	i95	2017	Spec	34,566625	MODALEN KRAFTLAG SA	121	0	0	0	0	33	4	4,29
ld	i95	2018	Spec	38,4067524	MODALEN KRAFTLAG SA	121	0	0	0	0	33	4	4,29
ld	i95	2019	Spec	40,9652472	MODALEN KRAFTLAG SA	121	0	0	0	0	33	4	4,32
ld	i96	2015	Spec	19,6709448	HYDRO ENERGI AS	167	0	0	0	0	15	0	0
ld	i96	2016	Spec	14,7122308	HYDRO ENERGI AS	167	0	0	0	0	15	0	0
ld	i96	2017	Spec	20,7674392	HYDRO ENERGI AS	167	0	0	0	0	15	0	0
ld	i96	2018	Spec	21,6882877	HYDRO ENERGI AS	167	0	0	0	0	15	0	0
ld	i96	2019	Spec	23,2739704	HYDRO ENERGI AS	167	0	0	0	0	15	0	0,01
ld	i97	2015	Spec	42,0393565	SIRA KVINA KRAFTSELSKAP	187	0	0	0	0	136	70	0,31
ld	i97	2016	Spec	47,9251645	SIRA KVINA KRAFTSELSKAP	187	0	0	0	0	137	70	0,31
ld	i97	2017	Spec	20,533445	SIRA KVINA KRAFTSELSKAP	187	0	0	0	0	137	70	0,31
ld	i97	2018	Spec	20,533445	SIRA KVINA KRAFTSELSKAP	187	0	0	0	0	137	70	0,31
ld	i97	2019	Spec	20,533445	SIRA KVINA KRAFTSELSKAP	187	0	0	0	0	137	70	0,31
ld	i98	2015	Spec	10,7686109	TINFOS AS	222	0	0	0	0	9	8	0,64
ld	i98	2016	Spec	8,96946968	TINFOS AS	222	0	0	0	0	9	8	0,61
ld	i98	2017	Spec	10,021882	TINFOS AS	222	0	0	0	0	9	7	0,69
ld	i98	2018	Spec	11,8739103	TINFOS AS	222	0	0	0	0	9	7	0,69
ld	i98	2019	Spec	15,0155108	TINFOS AS	222	0	0	0	0	9	7	0,72
ld	i99	2015	Spec	200,476284	HYDRO ALUMINIUM AS	294	0	0	0	0	1	0	0,16
ld	i99	2016	Spec	229,27658	HYDRO ALUMINIUM AS	294	0	0	0	0	1	0	0,16
ld	i99	2017	Spec	194,043535	HYDRO ALUMINIUM AS	294	0	0	0	0	1	0	0,17
ld	i99	2018	Spec	315,950723	HYDRO ALUMINIUM AS	294	0	0	0	0	1	0	0,17
ld	i99	2019	Spec	197,828916	HYDRO ALUMINIUM AS	294	0	0	0	0	1	0	0,16
ld	i100	2015	Spec	19,461567	LYSE PRODUKSJON AS	512	0	0	0	0	84	31	1,36
ld	i100	2016	Spec	17,9201248	LYSE PRODUKSJON AS	512	0	0	0	0	84	31	1,38
ld	i100	2017	Spec	13,7169982	LYSE PRODUKSJON AS	512	0	0	0	0	84	31	1,49
ld	i100	2018	Spec	15,9274427	LYSE PRODUKSJON AS	512	0	0	0	0	83	31	0
ld	i100	2019	Spec	12,2760827	LYSE PRODUKSJON AS	512	0	0	0	0	83	31	0
ld	i101	2015	Spec	163,921033	YARA NORGE AS	686	0	0	0	0	47	42	0,39
ld	i101	2016	Spec	154,976093	YARA NORGE AS	686	0	0	0	0	47	46	0,4
ld	i101	2017	Spec	139,374349	YARA NORGE AS	686	0	0	0	0	47	46	0,4
ld	i101	2018	Spec	143,221741	YARA NORGE AS	686	0	0	0	0	47	46	0,15
ld	i101	2019	Spec	132,841966	YARA NORGE AS	686	0	0	0	0	47	47	0,22
ld	i102	2015	Spec	368,103501	MIP INDUSTRINETT AS	743	0	0	0	0	38	41	2,61
ld	i102	2016	Spec	184,368917	MIP INDUSTRINETT AS	743	0	0	0	0	38	41	2,6
ld	i102	2017	Spec	201,316395	MIP INDUSTRINETT AS	743	0	0	0	0	38	43	2,57
ld	i102	2018	Spec	207,483513	MIP INDUSTRINETT AS	743	0	0	0	0	41	69	2,57
ld	i102	2019	Spec	266,392618	MIP INDUSTRINETT AS	743	0	0	0	0	42	70	2,73
ld	i103	2015	Spec	424,565386	HERØYA NETT AS	852	0	0	0	0	115	73	0,3
ld	i103	2016	Spec	428,868261	HERØYA NETT AS	852	0	0	0	0	115	73	0,31
ld	i103	2017	Spec	429,502095	HERØYA NETT AS	852	0	0	0	0	115	72	0,31
ld	i103	2018	Spec	437,998895	HERØYA NETT AS	852	0	0	0	0	117	75	0,3
ld	i103	2019	Spec	479,079497	HERØYA NETT AS	852	0	0	0	0	117	75	0,32
ld	i104	2015	Spec	0,31594118	SØR-NORGE ALUMINIUM AS	873	0	0	0	0	0	0	0,02
ld	i104	2016	Spec	0,31594118	SØR-NORGE ALUMINIUM AS	873	0	0	0	0	0	0	0,02
ld	i104	2017	Spec	74,5892892	SØR-NORGE ALUMINIUM AS	873	0	0	0	0	0	0	0,02
ld	i104	2018	Spec	56,2901161	SØR-NORGE ALUMINIUM AS	873	0	0	0	0	0	0	0,02
ld	i104	2019	Spec	67,6111178	SØR-NORGE ALUMINIUM AS	873	0	0	0	0	0	0	0,02
ld	i105	2015	Spec	0,042	NORSKE SKOG SKOGN AS	902	0	0	0	0	2	0	0,02
ld	i105	2016	Spec	0,042	NORSKE SKOG SKOGN AS	902	0	0	0	0	2	0	0,02
ld	i105	2017	Spec	0,042	NORSKE SKOG SKOGN AS	902	0	0	0	0	2	0	0,02
ld	i105	2018	Spec	24,273636	NORSKE SKOG SKOGN AS	902	0	0	0	0	2	0	0,02
ld	i105	2019	Spec	28,5965712	NORSKE SKOG SKOGN AS	902	0	0	0	0	2	2	0,02
rd	i106	2015	Conv	4227,05106	ALTA KRAFTLAG SA	7	7988,13	0	5366,64	62,08	0	0	0
rd	i106	2016	Conv	4387,78472	ALTA KRAFTLAG SA	7	7988,13	0	5366,64	62,08	0	0	0
rd	i106	2017	Conv	10926,0677	ALTA KRAFTLAG SA	7	8489,55	0	8560,65	62,08	0	0	0

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
rd	i106	2018	Conv	12418,6342	ALTA KRAFTLAG SA	7	8489,55	0	8560,65	62,08	0	0	0
rd	i106	2019	Conv	10750,2976	ALTA KRAFTLAG SA	7	8489,55	0	8560,65	62,08	0	0	0
rd	i107	2015	Conv	12591,254	ANDØY ENERGI NETT AS	9	15294,27	316,08	4761,96	856,91	0	0	0
rd	i107	2016	Conv	10031,9763	ANDØY ENERGI NETT AS	9	15294,27	316,08	4761,96	856,91	0	0	0
rd	i107	2017	Conv	9774,10945	ANDØY ENERGI NETT AS	9	15294,27	316,08	4761,96	856,91	0	0	0
rd	i107	2018	Conv	9706,83519	ANDØY ENERGI NETT AS	9	15294,27	316,08	4761,96	856,91	0	0	0
rd	i107	2019	Conv	11151,8585	ANDØY ENERGI NETT AS	9	15294,27	316,08	4783,39	856,91	0	0	0
rd	i108	2015	Conv	12203,7294	NORGESNETT AS	32	67,28	0	5582,71	71,11	0	0	0
rd	i108	2016	Conv	10842,3743	NORGESNETT AS	32	67,28	0	5582,71	71,11	0	0	0
rd	i108	2017	Conv	10072,1408	NORGESNETT AS	32	67,28	0	5610,57	71,11	0	0	0
rd	i108	2018	Conv	9908,4844	NORGESNETT AS	32	67,28	0	5610,57	71,11	0	0	0
rd	i108	2019	Conv	9735,22447	NORGESNETT AS	32	67,28	0	5610,57	71,11	0	0	0
rd	i109	2015	Conv	21975,0898	AS EIDEFOSS	37	27373,28	0	11693,78	279,31	0	0	0
rd	i109	2016	Conv	18039,0441	AS EIDEFOSS	37	27373,28	0	11693,78	279,31	0	0	0
rd	i109	2017	Conv	22721,5437	AS EIDEFOSS	37	29313,62	0	13113,06	2853,21	0	0	0
rd	i109	2018	Conv	32453,2002	AS EIDEFOSS	37	29313,62	0	13113,06	2853,21	0	0	0
rd	i109	2019	Conv	28099,1674	AS EIDEFOSS	37	30760,42	0	13947,66	3322,66	0	0	0
rd	i110	2015	Conv	28119,337	SUNNFJORD ENERGI AS	56	16082,63	0	10333,64	1062,92	0	0	0
rd	i110	2016	Conv	23747,4361	SUNNFJORD ENERGI AS	56	16082,63	0	10553,55	1062,92	0	0	0
rd	i110	2017	Conv	27156,9943	SUNNFJORD ENERGI AS	56	16082,63	0	10638,87	1062,92	0	0	0
rd	i110	2018	Conv	20563,5825	SUNNFJORD ENERGI AS	56	16082,63	0	10450,84	1062,92	0	0	0
rd	i110	2019	Conv	19356,1464	SUNNFJORD ENERGI AS	56	16082,63	0	10450,84	1062,92	0	0	0
rd	i111	2015	Conv	9285,24941	TROLLFJORD NETT AS	63	2223,41	2474,09	2977,33	155,72	0	0	0
rd	i111	2016	Conv	6013,76786	TROLLFJORD NETT AS	63	2223,41	2474,09	3014,68	155,72	0	0	0
rd	i111	2017	Conv	6934,19547	TROLLFJORD NETT AS	63	2223,41	2474,09	3014,68	155,72	0	0	0
rd	i111	2018	Conv	5464,37701	TROLLFJORD NETT AS	63	398,77	0	2667,1	0	0	0	0
rd	i111	2019	Conv	5284,58214	TROLLFJORD NETT AS	63	398,77	0	2667,1	0	0	0	0
rd	i112	2015	Conv	31989,1311	HAMMERFEST ENERGI NETT AS	65	23056,7438	2380,76	9230,52276	2533,39186	0	0	0
rd	i112	2016	Conv	31305,5321	HAMMERFEST ENERGI NETT AS	65	22852,0783	2380,76	9230,52276	2533,39186	0	0	0
rd	i112	2017	Conv	33212,1043	HAMMERFEST ENERGI NETT AS	65	22852,0783	2380,76	9644,17539	2533,39186	0	0	0
rd	i112	2018	Conv	28454,9859	HAMMERFEST ENERGI NETT AS	65	22852,07	2380,76	9644,17	2533,39	0	0	0
rd	i112	2019	Conv	28377,7379	HAMMERFEST ENERGI NETT AS	65	22880,17	2380,76	9644,17	2533,39	0	0	0
rd	i113	2015	Conv	135775,902	HELGELAND KRAFT NETT AS	71	71895,61	14013,24	32746,43	1478,58	0	0	0
rd	i113	2016	Conv	117869,302	HELGELAND KRAFT NETT AS	71	71915,56	14013,24	34940,9	1478,58	0	0	0
rd	i113	2017	Conv	111520,044	HELGELAND KRAFT NETT AS	71	72956,75	14013,24	34940,9	1478,58	0	0	0
rd	i113	2018	Conv	98593,2144	HELGELAND KRAFT NETT AS	71	73287,44	14013,24	33996,69	1596,89	0	0	0
rd	i113	2019	Conv	92974,0801	HELGELAND KRAFT NETT AS	71	73442,69	14013,24	38340,04	1596,89	0	0	0
rd	i114	2015	Conv	20095,9081	ISTAD NETT AS	86	15855,42	0	17223,08	1368,41	0	0	0
rd	i114	2016	Conv	19807,5259	ISTAD NETT AS	86	15855,42	0	17223,08	1368,41	0	0	0
rd	i114	2017	Conv	18986,2674	ISTAD NETT AS	86	15855,42	0	16927,87	1368,41	0	0	0
rd	i114	2018	Conv	16537,5144	ISTAD NETT AS	86	15855,42	0	18060,48	1368,41	0	0	0
rd	i114	2019	Conv	19477,1212	ISTAD NETT AS	86	15855,42	0	18225	1368,41	0	0	0
rd	i115	2015	Conv	7247,56978	KRAGERØ ENERGI AS	93	3561,21	0	5313,78	0	0	0	0
rd	i115	2016	Conv	7106,59723	KRAGERØ ENERGI AS	93	3561,21	0	5313,78	0	0	0	0
rd	i115	2017	Conv	7502,73377	KRAGERØ ENERGI AS	93	3019,59	0	5336,25	0	0	0	0
rd	i115	2018	Conv	4968,3052	KRAGERØ ENERGI AS	93	3019,59	0	5336,25	0	0	0	0
rd	i115	2019	Conv	4618,12673	KRAGERØ ENERGI AS	93	3187,78	0	5336,25	0	0	0	0
rd	i116	2015	Conv	6972,45936	LUOSTEJOK KRAFTLAG SA	103	14210,98	0	2791,85	78,35	0	0	0
rd	i116	2016	Conv	8716,36088	LUOSTEJOK KRAFTLAG SA	103	14210,98	0	2791,85	99,76	0	0	0
rd	i116	2017	Conv	7583,88266	LUOSTEJOK KRAFTLAG SA	103	14210,98	0	2791,85	99,76	0	0	0
rd	i116	2018	Conv	7517,75344	LUOSTEJOK KRAFTLAG SA	103	14210,98	0	2791,85	99,76	0	0	0
rd	i116	2019	Conv	7289,04818	LUOSTEJOK KRAFTLAG SA	103	14210,98	0	2791,85	99,76	0	0	0
rd	i117	2015	Conv	2833,36867	LÆRDAL ENERGI AS	106	2247,76	0	2798,46	0	0	0	0
rd	i117	2016	Conv	2140,80951	LÆRDAL ENERGI AS	106	2247,76	0	2798,46	0	0	0	0
rd	i117	2017	Conv	2404,75736	LÆRDAL ENERGI AS	106	2247,76	0	2798,46	0	0	0	0
rd	i117	2018	Conv	3326,86662	LÆRDAL ENERGI AS	106	2247,76	0	2798,46	0	0	0	0

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
rd	i117	2019	Conv	2464,16785	LÆRDAL ENERGI AS	106	2247,76	0	2798,46	0	0	0	0
rd	i118	2015	Conv	21936,8099	NORD-SALTEN KRAFT NETT AS	132	23997,71	307,81	10696,57	596,25	0	0	0
rd	i118	2016	Conv	21323,3498	NORD-SALTEN KRAFT NETT AS	132	23997,71	307,81	10800,22	596,25	0	0	0
rd	i118	2017	Conv	24805,9429	NORD-SALTEN KRAFT NETT AS	132	23943,72	307,81	11065,79	607,81	0	0	0
rd	i118	2018	Conv	23394,2692	NORD-SALTEN KRAFT NETT AS	132	23943,72	307,81	11150,25	607,81	0	0	0
rd	i118	2019	Conv	21333,8933	NORD-SALTEN KRAFT NETT AS	132	23548,97	307,81	11150,25	607,81	0	0	0
rd	i119	2015	Conv	15752,4287	YMBER NETT AS	133	26820,08	1038,57	5399,88	1206,8	0	0	0
rd	i119	2016	Conv	14143,0867	YMBER NETT AS	133	26820,08	1038,57	5366,98	1206,8	0	0	0
rd	i119	2017	Conv	17653,9167	YMBER NETT AS	133	28912,67	1038,57	5366,98	1206,8	0	0	0
rd	i119	2018	Conv	17457,8873	YMBER NETT AS	133	28912,67	1038,57	5366,98	1206,8	0	0	0
rd	i119	2019	Conv	16433,0549	YMBER NETT AS	133	28912,67	1038,57	5366,98	1206,8	0	0	0
rd	i120	2015	Conv	4723,57073	NORDKYN KRAFTLAG SA	138	14693,24	0	2819,22	0	0	0	0
rd	i120	2016	Conv	4079,44027	NORDKYN KRAFTLAG SA	138	14693,24	0	2819,22	0	0	0	0
rd	i120	2017	Conv	4927,73423	NORDKYN KRAFTLAG SA	138	14693,24	0	2819,22	0	0	0	0
rd	i120	2018	Conv	4207,08746	NORDKYN KRAFTLAG SA	138	14693,24	0	2819,22	596,05	0	0	0
rd	i120	2019	Conv	4364,70111	NORDKYN KRAFTLAG SA	138	14693,24	0	2819,22	596,05	0	0	0
rd	i121	2015	Conv	19723,6025	ODDA ENERGI NETT AS	146	4917,02	1673,23	9428,56	3284	0	0	0
rd	i121	2016	Conv	18844,9488	ODDA ENERGI NETT AS	146	4898,42	1673,23	9432,57	3281,23	0	0	0
rd	i121	2017	Conv	23649,3935	ODDA ENERGI NETT AS	146	4898,42	1673,23	9432,57	3281,23	0	0	0
rd	i121	2018	Conv	20333,7421	ODDA ENERGI NETT AS	146	4898,42	1673,23	9432,57	3281,23	0	0	0
rd	i121	2019	Conv	18359,1286	ODDA ENERGI NETT AS	146	4898,42	1721,07	9432,57	3922,41	0	0	0
rd	i122	2015	Conv	12520,5619	REPVÅG KRAFTLAG SA	164	28626,27	2234,12	6314,21	2177,52	0	0	0
rd	i122	2016	Conv	9097,66811	REPVÅG KRAFTLAG SA	164	28626,27	2234,12	6314,21	2177,52	0	0	0
rd	i122	2017	Conv	16291,1193	REPVÅG KRAFTLAG SA	164	28626,27	2234,12	6314,21	2177,52	0	0	0
rd	i122	2018	Conv	10387,8436	REPVÅG KRAFTLAG SA	164	28626,27	2234,12	6856,05	2177,52	0	0	0
rd	i122	2019	Conv	10546,5569	REPVÅG KRAFTLAG SA	164	28626,27	2234,12	7126,65	2142,32	0	0	0
rd	i123	2015	Conv	2213,55694	RØROS E-VERK NETT AS	173	5828,94	0	1515,16	0	0	0	0
rd	i123	2016	Conv	1763,90186	RØROS E-VERK NETT AS	173	5828,94	0	1515,16	0	0	0	0
rd	i123	2017	Conv	1575,62456	RØROS E-VERK NETT AS	173	5828,94	0	1515,16	0	0	0	0
rd	i123	2018	Conv	1174,78746	RØROS E-VERK NETT AS	173	5828,94	0	1515,16	0	0	0	0
rd	i123	2019	Conv	2148,47535	RØROS E-VERK NETT AS	173	5828,94	0	1515,16	0	0	0	0
rd	i124	2015	Conv	14341,5402	SOGNEKRAFT AS	197	10242,13	0	5790,99	21,4	0	0	0
rd	i124	2016	Conv	10990,5311	SOGNEKRAFT AS	197	10349,71	0	5807,27	114,28	0	0	0
rd	i124	2017	Conv	19955,4456	SOGNEKRAFT AS	197	12217,74	0	9214	262,26	0	0	0
rd	i124	2018	Conv	21982,3206	SOGNEKRAFT AS	197	12217,74	0	9631,66	663,74	0	0	0
rd	i124	2019	Conv	21938,714	SOGNEKRAFT AS	197	12217,74	0	9631,66	922,71	0	0	0
rd	i125	2015	Conv	152308,441	TENSIO TS AS	215	129545,97	6033,93	119122,18	26754,32	0	0	0
rd	i125	2016	Conv	152794,423	TENSIO TS AS	215	131061,44	6033,93	120159,76	27144,18	0	0	0
rd	i125	2017	Conv	139418,828	TENSIO TS AS	215	129740,08	6033,93	122521,95	27570,35	0	0	0
rd	i125	2018	Conv	160328,183	TENSIO TS AS	215	131870,55	7811,44	126610,78	29045,53	0	0	0
rd	i125	2019	Conv	180890,289	TENSIO TS AS	215	140534,71	7811,44	133141,93	31236,77	0	0	0
rd	i126	2015	Conv	110374,721	TROMS KRAFT NETT AS	227	43335,59	19864,17	55814,91	17013,36	0	0	0
rd	i126	2016	Conv	100100,358	TROMS KRAFT NETT AS	227	43335,59	19864,17	55814,91	14116,12	0	0	0
rd	i126	2017	Conv	110823,84	TROMS KRAFT NETT AS	227	43335,59	19864,17	60277,31	18332,63	0	0	0
rd	i126	2018	Conv	114927,826	TROMS KRAFT NETT AS	227	43415,71	19918,86	59650,01	18425,85	0	0	0
rd	i126	2019	Conv	119367,939	TROMS KRAFT NETT AS	227	43449,23	19918,86	62004,78	19505,49	0	0	0
rd	i127	2015	Conv	2362,21009	HARDANGER ENERGI NETT AS	238	1933,43	416,53	2583,31	0	0	0	0
rd	i127	2016	Conv	2012,68895	HARDANGER ENERGI NETT AS	238	1933,43	416,53	3057,44	0	0	0	0
rd	i127	2017	Conv	1599,50355	HARDANGER ENERGI NETT AS	238	1933,43	416,53	3174,17	0	0	0	0
rd	i127	2018	Conv	1973,38149	HARDANGER ENERGI NETT AS	238	1933,43	416,53	2804,23	0	0	0	0
rd	i127	2019	Conv	2218,3641	HARDANGER ENERGI NETT AS	238	1933,43	416,53	2616,2	0	0	0	0
rd	i128	2015	Conv	46417,601	VARANGER KRAFTNETT AS	249	37993,38	0	19627,41	30,47	0	0	0
rd	i128	2016	Conv	54831,9513	VARANGER KRAFTNETT AS	249	39288,69	0	22956,18	257,74	0	0	0
rd	i128	2017	Conv	63909,3399	VARANGER KRAFTNETT AS	249	39288,69	0	22956,18	286,04	0	0	0
rd	i128	2018	Conv	75442,4073	VARANGER KRAFTNETT AS	249	39949,44	0	25765,6	634,11	0	0	0
rd	i128	2019	Conv	80585,5999	VARANGER KRAFTNETT AS	249	41020,69	0	25869,25	634,11	0	0	0

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
rd	i129	2015	Conv	13461,7072	VEST-TELEMARK KRAFTLAG AS	251	9592,81	0	6779,83	70,29	0	0	0
rd	i129	2016	Conv	13317,5582	VEST-TELEMARK KRAFTLAG AS	251	9592,81	0	6779,83	70,29	0	0	0
rd	i129	2017	Conv	13345,0776	VEST-TELEMARK KRAFTLAG AS	251	9592,81	0	6779,83	46,14	0	0	0
rd	i129	2018	Conv	14418,4998	VEST-TELEMARK KRAFTLAG AS	251	9586,36	0	6931,9	46,14	0	0	0
rd	i129	2019	Conv	10723,5299	VEST-TELEMARK KRAFTLAG AS	251	9586,36	0	6931,9	46,14	0	0	0
rd	i130	2015	Conv	18555,1967	DALANE NETT AS	257	6372,83	61,36	7101,72	347,67	0	0	0
rd	i130	2016	Conv	18142,3898	DALANE NETT AS	257	6372,83	61,36	8968,84	418,79	0	0	0
rd	i130	2017	Conv	20671,363	DALANE NETT AS	257	7309,03	61,36	10307,81	418,99	0	0	0
rd	i130	2018	Conv	20759,4449	DALANE NETT AS	257	7309,03	61,36	10307,81	418,99	0	0	0
rd	i130	2019	Conv	18021,1803	DALANE NETT AS	257	7309,03	61,36	10307,81	418,99	0	0	0
rd	i131	2015	Conv	45336,4841	SFE NETT AS	269	39807,03	278,82	23500,25	2051,93	0	0	0
rd	i131	2016	Conv	54850,7139	SFE NETT AS	269	39893,09	1042,26	23119,82	5504,36	0	0	0
rd	i131	2017	Conv	57860,2077	SFE NETT AS	269	39956,04	1042,26	22298,43	5504,36	0	0	0
rd	i131	2018	Conv	53289,9919	SFE NETT AS	269	39767,97	1042,26	22375,22	5504,36	0	0	0
rd	i131	2019	Conv	61237,3416	SFE NETT AS	269	40796,34	1042,26	22441,77	3899,08	0	0	0
rd	i132	2015	Conv	14251,9724	HALLINGDAL KRAFTNETT AS	275	7612,09	0	9663,22	339,11	0	0	0
rd	i132	2016	Conv	14907,4338	HALLINGDAL KRAFTNETT AS	275	7612,09	0	9663,22	339,11	0	0	0
rd	i132	2017	Conv	12133,9299	HALLINGDAL KRAFTNETT AS	275	7612,09	0	9663,22	339,11	0	0	0
rd	i132	2018	Conv	15660,782	HALLINGDAL KRAFTNETT AS	275	7612,09	0	9663,22	339,11	0	0	0
rd	i132	2019	Conv	13607,8316	HALLINGDAL KRAFTNETT AS	275	7612,09	0	9663,22	339,11	0	0	0
rd	i133	2015	Conv	9316,58225	GUDBRANDSDAL ENERGI NETT AS	295	7644,37	0	9216,87	2022,32	0	0	0
rd	i133	2016	Conv	9130,81547	GUDBRANDSDAL ENERGI NETT AS	295	7681,34	0	8531,97	2117,06	0	0	0
rd	i133	2017	Conv	17600,8544	GUDBRANDSDAL ENERGI NETT AS	295	7681,34	0	7943,33	2117,06	0	0	0
rd	i133	2018	Conv	11496,5954	GUDBRANDSDAL ENERGI NETT AS	295	7681,34	0	8743,86	2117,06	0	0	0
rd	i133	2019	Conv	11368,7847	GUDBRANDSDAL ENERGI NETT AS	295	7681,34	0	8743,86	2117,06	0	0	0
rd	i134	2015	Conv	67360,0495	NEAS AS	311	34668,2	25738,9	28071,16	7242,56	0	0	0
rd	i134	2016	Conv	61722,2285	NEAS AS	311	34668,2	25738,9	25345,56	7532,1	0	0	0
rd	i134	2017	Conv	59138,6945	NEAS AS	311	34668,2	25738,9	24165,64	7532,1	0	0	0
rd	i134	2018	Conv	59006,0401	NEAS AS	311	34668,2	25738,9	24200,19	7532,1	0	0	0
rd	i134	2019	Conv	61294,9401	NEAS AS	311	34668,2	25738,9	24200,19	7532,1	0	0	0
rd	i135	2015	Conv	5346,05238	HEMSEDAL ENERGI AS	343	1810,17	0	2575,41	277,25	0	0	0
rd	i135	2016	Conv	5371,81881	HEMSEDAL ENERGI AS	343	1810,17	0	2575,41	277,25	0	0	0
rd	i135	2017	Conv	5216,44551	HEMSEDAL ENERGI AS	343	1810,17	0	2575,41	277,25	0	0	0
rd	i135	2018	Conv	4268,8261	HEMSEDAL ENERGI AS	343	1810,17	0	2575,41	277,25	0	0	0
rd	i135	2019	Conv	3969,57052	HEMSEDAL ENERGI AS	343	1810,17	0	2575,41	277,25	0	0	0
rd	i136	2015	Conv	74881,5098	LOFOTKRAFT AS	354	24841,06	12544,17	12282,21	2589,86	0	0	0
rd	i136	2016	Conv	35475,9621	LOFOTKRAFT AS	354	17181,34	10853,25	12282,21	2497,06	0	0	0
rd	i136	2017	Conv	49763,9194	LOFOTKRAFT AS	354	20146,57	21551,06	16175,51	2769,83	0	0	0
rd	i136	2018	Conv	66851,6516	LOFOTKRAFT AS	354	20248,51	22059,7	16175,51	2598,52	0	0	0
rd	i136	2019	Conv	73925,4312	LOFOTKRAFT AS	354	20613,71	22059,7	16175,51	2598,52	0	0	0
rd	i137	2015	Conv	15585,5461	HÅLOGALAND KRAFT NETT AS	433	17070,95	206,82	18371,82	412,9	0	0	0
rd	i137	2016	Conv	27177,3789	HÅLOGALAND KRAFT NETT AS	433	17070,95	206,82	19643,36	704,41	0	0	0
rd	i137	2017	Conv	27821,0372	HÅLOGALAND KRAFT NETT AS	433	17070,95	206,82	20129,59	704,41	0	0	0
rd	i137	2018	Conv	20218,5176	HÅLOGALAND KRAFT NETT AS	433	17070,95	206,82	20683,91	704,41	0	0	0
rd	i137	2019	Conv	17302,7273	HÅLOGALAND KRAFT NETT AS	433	17070,95	206,82	20683,91	704,41	0	0	0
rd	i138	2015	Conv	121218,947	MØRENETT AS	460	65461,04	24537,22	58476,8	18912,98	0	0	0
rd	i138	2016	Conv	117384,175	MØRENETT AS	460	65448,77	24839,73	60113,25	18912,98	0	0	0
rd	i138	2017	Conv	108003,324	MØRENETT AS	460	64692,82	24839,73	60724,05	18774,91	0	0	0
rd	i138	2018	Conv	124184,974	MØRENETT AS	460	64352,47	24839,73	65253,25	19168,09	0	0	0
rd	i138	2019	Conv	125058,287	MØRENETT AS	460	64473,98	25367	66079,94	19150,15	0	0	0
rd	i139	2015	Conv	13088,5627	VESTERÅLSKRAFT NETT AS	464	9868,24	1000,31	4991,21	329,7	0	0	0
rd	i139	2016	Conv	12130,3671	VESTERÅLSKRAFT NETT AS	464	9877,04	1000,31	5024,11	366,1	0	0	0
rd	i139	2017	Conv	14197,4776	VESTERÅLSKRAFT NETT AS	464	9877,04	1000,31	5024,11	366,1	0	0	0

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
rd	i139	2018	Conv	19228,6156	VESTERÅLSKRAFT NETT AS	464	9886,7	1000,31	5568,68	333,98	0	0	0
rd	i139	2019	Conv	12366,354	VESTERÅLSKRAFT NETT AS	464	9886,7	1000,31	5568,68	333,98	0	0	0
rd	i140	2015	Conv	129762,281	HAUGALAND KRAFT NETT AS	503	67025,04	7330,92	67081,16	15887,7	0	0	0
rd	i140	2016	Conv	123597,229	HAUGALAND KRAFT NETT AS	503	66091,64	7970,09	69099,5	16234	0	0	0
rd	i140	2017	Conv	121574,873	HAUGALAND KRAFT NETT AS	503	70694,76	4434,18	69237,22	16550,51	0	0	0
rd	i140	2018	Conv	113481,439	HAUGALAND KRAFT NETT AS	503	70694,76	4434,18	69298,65	16550,51	0	0	0
rd	i140	2019	Conv	110242,048	HAUGALAND KRAFT NETT AS	503	74548,34	4435,44	70651,23	16640,83	0	0	0
rd	i141	2015	Conv	230910,941	LYSE ELNETT AS	511	79834,32	2774,4	103827,73	58211,95	0	0	0
rd	i141	2016	Conv	200026,203	LYSE ELNETT AS	511	79834,32	2774,4	104429,56	58211,95	0	0	0
rd	i141	2017	Conv	180775,029	LYSE ELNETT AS	511	79459,78	2774,4	104130,74	60009,44	0	0	0
rd	i141	2018	Conv	173979,449	LYSE ELNETT AS	511	79048,58	2774,4	106144,68	60916,16	0	0	0
rd	i141	2019	Conv	166401,078	LYSE ELNETT AS	511	84720,89	3388,06	128693,77	59616,35	0	0	0
rd	i142	2015	Conv	320519,337	BKK NETT AS	566	118677,43	41926,7	145868,71	57101,12	0	0	0
rd	i142	2016	Conv	361709,583	BKK NETT AS	566	123839,87	149493,57	158263,74	58519,65	0	0	0
rd	i142	2017	Conv	434494,801	BKK NETT AS	566	123839,87	149493,57	160693,79	58519,65	0	0	0
rd	i142	2018	Conv	218421,896	BKK NETT AS	566	106479,73	43310,43	140577,41	35786,59	0	0	0
rd	i142	2019	Conv	216278,285	BKK NETT AS	566	104805,25	43310,43	144078,35	38140,78	0	0	0
rd	i143	2015	Conv	7473,1818	MIDTKRAFT NETT AS	591	5449,01	0	4537,55	107,04	0	0	0
rd	i143	2016	Conv	7849,45691	MIDTKRAFT NETT AS	591	5424,99	0	4537,55	171,27	0	0	0
rd	i143	2017	Conv	7712,92818	MIDTKRAFT NETT AS	591	5424,99	0	4537,55	171,27	0	0	0
rd	i143	2018	Conv	7916,85716	MIDTKRAFT NETT AS	591	5424,99	0	4537,55	171,27	0	0	0
rd	i143	2019	Conv	7659,75797	MIDTKRAFT NETT AS	591	5424,99	0	4537,55	171,27	0	0	0
rd	i144	2015	Conv	272261,38	SKAGERAK NETT AS	611	220457,36	2149,85	212378,23	7234,05	0	0	0
rd	i144	2016	Conv	274426,318	SKAGERAK NETT AS	611	220886,23	2149,85	212606,89	7234,05	0	0	0
rd	i144	2017	Conv	274088,162	SKAGERAK NETT AS	611	222857,49	2149,85	215508,13	7234,05	0	0	0
rd	i144	2018	Conv	325788,847	SKAGERAK NETT AS	611	224115,74	2149,85	215927,26	7234,05	0	0	0
rd	i144	2019	Conv	269008,277	SKAGERAK NETT AS	611	224738,2	2149,85	221088,77	7234,05	0	0	0
rd	i145	2015	Conv	126239,965	GLITRE ENERGI NETT AS	615	130023,54	0	128237,76	13217,65	0	0	0
rd	i145	2016	Conv	111968,197	GLITRE ENERGI NETT AS	615	130024,99	0	127884,66	13281,76	0	0	0
rd	i145	2017	Conv	117310,294	GLITRE ENERGI NETT AS	615	131136,38	0	131919,08	13827,26	0	0	0
rd	i145	2018	Conv	129242,401	GLITRE ENERGI NETT AS	615	132014,41	0	130833,24	13827,26	0	0	0
rd	i145	2019	Conv	132919,57	GLITRE ENERGI NETT AS	615	132819,86	0	130617,55	13975,01	0	0	0
rd	i146	2015	Conv	209014,642	AGDER ENERGI NETT AS	624	154082,96	0	150323,03	12244,35	0	0	0
rd	i146	2016	Conv	240373,31	AGDER ENERGI NETT AS	624	157216,32	0	152934,4	13568,14	0	0	0
rd	i146	2017	Conv	256711,596	AGDER ENERGI NETT AS	624	162720,87	0	157335,91	17439,94	0	0	0
rd	i146	2018	Conv	260752,857	AGDER ENERGI NETT AS	624	161022,17	0	157685,18	17280,63	0	0	0
rd	i146	2019	Conv	270501,541	AGDER ENERGI NETT AS	624	160774,02	0	162046,79	18482,8	0	0	0
rd	i147	2015	Conv	5320,23233	VOSS ENERGI NETT AS	625	6621,13	0	7373,12	139,16	0	0	0
rd	i147	2016	Conv	7686,66131	VOSS ENERGI NETT AS	625	6621,13	0	7806,06	139,16	0	0	0
rd	i147	2017	Conv	9981,92188	VOSS ENERGI NETT AS	625	6621,13	0	8467,57	165,87	0	0	0
rd	i147	2018	Conv	9748,69404	VOSS ENERGI NETT AS	625	6621,13	0	9219,66	165,87	0	0	0
rd	i147	2019	Conv	9277,59862	VOSS ENERGI NETT AS	625	6621,13	0	9219,66	165,87	0	0	0
rd	i148	2015	Conv	21864,4836	NORDKRAFT NETT AS	637	5302,06	1458,41	8606,52	2590,04	0	0	0
rd	i148	2016	Conv	18098,043	NORDKRAFT NETT AS	637	5302,06	1458,41	8573,61	2590,04	0	0	0
rd	i148	2017	Conv	16398,8464	NORDKRAFT NETT AS	637	5226,89	1458,41	8573,61	2655,69	0	0	0
rd	i148	2018	Conv	18324,7897	NORDKRAFT NETT AS	637	5226,9	1458,41	8573,62	2655,69	0	0	0
rd	i148	2019	Conv	14947,7057	NORDKRAFT NETT AS	637	5226,9	1458,41	8573,62	2655,69	0	0	0
rd	i149	2015	Conv	5099,49282	STANGE ENERGI NETT AS	669	447,68	0	5156,24	0	0	0	0
rd	i149	2016	Conv	1951,89456	STANGE ENERGI NETT AS	669	447,68	0	3181,99	0	0	0	0
rd	i149	2017	Conv	4067,94407	STANGE ENERGI NETT AS	669	447,68	0	4925,92	0	0	0	0
rd	i149	2018	Conv	4097,05285	STANGE ENERGI NETT AS	669	447,68	0	4958,82	0	0	0	0
rd	i149	2019	Conv	3754,90035	STANGE ENERGI NETT AS	669	447,68	0	5090,44	0	0	0	0
rd	i150	2015	Conv	908777,319	ELVIA AS	675	366433,37	14431,31	694825,1	192648,42	0	0	0
rd	i150	2016	Conv	807135,254	ELVIA AS	675	366809,11	14716,62	697088,55	185894,73	0	0	0
rd	i150	2017	Conv	830917,537	ELVIA AS	675	367822,26	14716,62	705110,55	186269,93	0	0	0
rd	i150	2018	Conv	900225,734	ELVIA AS	675	365739,84	15293,78	710832,76	191398,29	0	0	0

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
rd	i150	2019	Conv	975594,494	ELVIA AS	675	365695,45	15293,79	707399,45	194549,7	0	0	0
rd	i151	2015	Conv	118948,247	TENSIO TN AS	699	99694,68	2063,08	55161,33	7273,79	0	0	0
rd	i151	2016	Conv	132186,173	TENSIO TN AS	699	99609,63	2063,08	55830,62	7656,07	0	0	0
rd	i151	2017	Conv	128350,297	TENSIO TN AS	699	101057,86	2070,14	56903,34	7890,19	0	0	0
rd	i151	2018	Conv	131781,13	TENSIO TN AS	699	101096,45	2183,44	56479,34	7842,69	0	0	0
rd	i151	2019	Conv	129605,787	TENSIO TN AS	699	101046,09	2183,44	56479,34	7842,69	0	0	0
rd	i152	2015	Conv	62486,624	NORDLANDSNETT AS	726	60665,97	5719,93	49912,75	4328,04	0	0	0
rd	i152	2016	Conv	65674,5673	NORDLANDSNETT AS	726	62591,99	5719,93	50078,41	5434,95	0	0	0
rd	i152	2017	Conv	69292,8982	NORDLANDSNETT AS	726	62570,09	5719,93	46536,18	8175,58	0	0	0
rd	i152	2018	Conv	69621,6128	NORDLANDSNETT AS	726	63210,12	5719,93	46501,63	6919,45	0	0	0
rd	i152	2019	Conv	71412,2692	NORDLANDSNETT AS	726	63210,12	5719,93	46581,98	6919,45	0	0	0
rd	i153	2015	Conv	17516,2889	MIP INDUSTRINETT AS	743	3354,76	0	13310,15	776,31	0	0	0
rd	i153	2016	Conv	16297,5793	MIP INDUSTRINETT AS	743	3354,76	0	13310,15	776,31	0	0	0
rd	i153	2017	Conv	17448,4612	MIP INDUSTRINETT AS	743	3354,76	0	13310,15	776,31	0	0	0
rd	i153	2018	Conv	18705,5955	MIP INDUSTRINETT AS	743	3354,76	0	13378,73	776,31	0	0	0
rd	i153	2019	Conv	12200,4183	MIP INDUSTRINETT AS	743	3354,76	0	13775,78	776,31	0	0	0
rd	i154	2015	Conv	32324,9377	Aktieselskabet Saudefaldene	753	4946,8	0	9920,56	2181,14	0	0	0
rd	i154	2016	Conv	17249,0176	Aktieselskabet Saudefaldene	753	4946,8	0	10052,18	2181,14	0	0	0
rd	i154	2017	Conv	22811,4443	Aktieselskabet Saudefaldene	753	4946,8	0	10052,18	2181,14	0	0	0
rd	i154	2018	Conv	28540,3231	Aktieselskabet Saudefaldene	753	4946,8	0	10052,18	2181,14	0	0	0
rd	i154	2019	Conv	18898,8514	Aktieselskabet Saudefaldene	753	4946,8	0	10052,18	2181,14	0	0	0
rd	i155	2015	Conv	14826,0725	HERØYA NETT AS	852	868,08	2608,17	18515,02	4066,72	0	0	0
rd	i155	2016	Conv	15505,6522	HERØYA NETT AS	852	868,08	2608,17	18515,02	4066,72	0	0	0
rd	i155	2017	Conv	14911,8442	HERØYA NETT AS	852	868,08	2608,17	18515,02	4066,72	0	0	0
rd	i155	2018	Conv	13630,891	HERØYA NETT AS	852	868,08	2608,17	18515,02	4066,72	0	0	0
rd	i155	2019	Conv	14983,8922	HERØYA NETT AS	852	868,08	2608,17	18515,02	4066,72	0	0	0
rd	i156	2015	Spec	2,2	FINNÅS KRAFTLAG SA	43	0	0	805,72	0	0	0	0
rd	i156	2016	Spec	2,2	FINNÅS KRAFTLAG SA	43	0	0	805,72	0	0	0	0
rd	i156	2017	Spec	2,2	FINNÅS KRAFTLAG SA	43	0	0	805,72	0	0	0	0
rd	i156	2018	Spec	2,2	FINNÅS KRAFTLAG SA	43	0	0	805,72	0	0	0	0
rd	i156	2019	Spec	302,162012	FINNÅS KRAFTLAG SA	43	0	0	805,72	0	0	0	0
rd	i157	2015	Spec	3540,55741	JÆREN EVERK KOMMUNALT FORETAK I HÅ	88	0	0	3134,36	0	0	0	0
rd	i157	2016	Spec	3066,44712	JÆREN EVERK KOMMUNALT FORETAK I HÅ	88	0	0	3134,36	0	0	0	0
rd	i157	2017	Spec	3714,40896	JÆREN EVERK KOMMUNALT FORETAK I HÅ	88	0	0	3134,36	0	0	0	0
rd	i157	2018	Spec	3629,87286	JÆREN EVERK KOMMUNALT FORETAK I HÅ	88	0	0	3134,36	0	0	0	0
rd	i157	2019	Spec	2787,36904	JÆREN EVERK KOMMUNALT FORETAK I HÅ	88	0	0	3134,36	0	0	0	0
rd	i158	2015	Spec	1719,96566	KVÆNANGEN KRAFTVERK AS	98	0	0	94,01	0	0	0	0
rd	i158	2016	Spec	3696,89027	KVÆNANGEN KRAFTVERK AS	98	0	0	94,01	0	0	0	0
rd	i158	2017	Spec	1366,20377	KVÆNANGEN KRAFTVERK AS	98	0	0	94,01	0	0	0	0
rd	i158	2018	Spec	1306,93692	KVÆNANGEN KRAFTVERK AS	98	0	0	94,01	0	0	0	0
rd	i158	2019	Spec	1282,45127	KVÆNANGEN KRAFTVERK AS	98	0	0	94,01	0	0	0	0
rd	i159	2015	Spec	8088,96174	LUSTER ENERGIVERK AS	104	2477,05	0	1456,97	154,14	0	0	0
rd	i159	2016	Spec	8088,96174	LUSTER ENERGIVERK AS	104	2477,05	0	1456,97	154,14	0	0	0
rd	i159	2017	Spec	8088,96174	LUSTER ENERGIVERK AS	104	2477,05	0	1456,97	154,14	0	0	0
rd	i159	2018	Spec	8088,96174	LUSTER ENERGIVERK AS	104	2477,05	0	1456,97	154,14	0	0	0
rd	i159	2019	Spec	9969,61162	LUSTER ENERGIVERK AS	104	2477,05	0	1456,97	154,14	0	0	0
rd	i160	2015	Spec	82,1161005	MELØY ENERGI NETT AS	116	0	0	333,77	0	0	0	0
rd	i160	2016	Spec	273,481536	MELØY ENERGI NETT AS	116	0	0	672,21	0	0	0	0
rd	i160	2017	Spec	294,272577	MELØY ENERGI NETT AS	116	0	0	672,21	0	0	0	0
rd	i160	2018	Spec	181,170143	MELØY ENERGI NETT AS	116	0	0	672,21	0	0	0	0
rd	i160	2019	Spec	171,400413	MELØY ENERGI NETT AS	116	0	0	672,21	0	0	0	0
rd	i161	2015	Spec	103,964573	NORD-ØSTERDAL KRAFTLAG SA	135	0	0	551,59	0	0	0	0

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
rd	i161	2016	Spec	99,367053	NORD-ØSTERDAL KRAFTLAG SA	135	0	0	551,59	0	0	0	0
rd	i161	2017	Spec	93,827002	NORD-ØSTERDAL KRAFTLAG SA	135	0	0	551,59	0	0	0	0
rd	i161	2018	Spec	89,286951	NORD-ØSTERDAL KRAFTLAG SA	135	0	0	551,59	0	0	0	0
rd	i161	2019	Spec	219,689431	NORD-ØSTERDAL KRAFTLAG SA	135	0	0	551,59	0	0	0	0
rd	i162	2015	Spec	522,666425	PORSA KRAFTLAG AS	156	0	0	998,14	0	0	0	0
rd	i162	2016	Spec	521,699138	PORSA KRAFTLAG AS	156	0	0	998,14	0	0	0	0
rd	i162	2017	Spec	547,140843	PORSA KRAFTLAG AS	156	0	0	998,14	0	0	0	0
rd	i162	2018	Spec	487,00168	PORSA KRAFTLAG AS	156	0	0	998,14	0	0	0	0
rd	i162	2019	Spec	279,794252	PORSA KRAFTLAG AS	156	0	0	998,14	0	0	0	0
rd	i163	2015	Spec	2437,02509	RAULAND KRAFTFORSYNINGSLAG SA	161	2235,54	0	1414,09	10,7	0	0	0
rd	i163	2016	Spec	2454,41975	RAULAND KRAFTFORSYNINGSLAG SA	161	2235,54	0	1414,09	10,7	0	0	0
rd	i163	2017	Spec	2351,15495	RAULAND KRAFTFORSYNINGSLAG SA	161	2235,54	0	1414,09	10,7	0	0	0
rd	i163	2018	Spec	2605,36348	RAULAND KRAFTFORSYNINGSLAG SA	161	2235,54	0	1414,09	10,7	0	0	0
rd	i163	2019	Spec	1377,86478	RAULAND KRAFTFORSYNINGSLAG SA	161	2235,54	0	1414,09	10,7	0	0	0
rd	i164	2015	Spec	1623,1237	RAUMA ENERGI AS	162	0	0	1166,93	0	0	0	0
rd	i164	2016	Spec	1745,81847	RAUMA ENERGI AS	162	0	0	1730,31	0	0	0	0
rd	i164	2017	Spec	1894,799	RAUMA ENERGI AS	162	0	0	1894,83	0	0	0	0
rd	i164	2018	Spec	1983,65777	RAUMA ENERGI AS	162	0	0	1894,83	0	0	0	0
rd	i164	2019	Spec	3098,02407	RAUMA ENERGI AS	162	0	0	1951,1	0	0	0	0
rd	i165	2015	Spec	823,888589	STRANDA ENERGI AS	204	0	0	230,32	0	0	0	0
rd	i165	2016	Spec	1092,16585	STRANDA ENERGI AS	204	0	0	230,32	0	0	0	0
rd	i165	2017	Spec	946,63185	STRANDA ENERGI AS	204	0	0	230,32	0	0	0	0
rd	i165	2018	Spec	922,95466	STRANDA ENERGI AS	204	0	0	230,32	0	0	0	0
rd	i165	2019	Spec	914,24956	STRANDA ENERGI AS	204	0	0	230,32	0	0	0	0
rd	i166	2015	Spec	1412,29979	SYKKYLVEN ENERGI AS	213	0	0	460,65	0	0	0	0
rd	i166	2016	Spec	1412,29979	SYKKYLVEN ENERGI AS	213	0	0	460,65	0	0	0	0
rd	i166	2017	Spec	1412,29979	SYKKYLVEN ENERGI AS	213	0	0	460,65	0	0	0	0
rd	i166	2018	Spec	1337,00608	SYKKYLVEN ENERGI AS	213	0	0	460,65	0	0	0	0
rd	i166	2019	Spec	1128,79943	SYKKYLVEN ENERGI AS	213	0	0	460,65	0	0	0	0
rd	i167	2015	Spec	378,212945	TINFOS AS	222	34,63	0	1495,4	0	0	0	0
rd	i167	2016	Spec	365,362916	TINFOS AS	222	34,63	0	1495,4	0	0	0	0
rd	i167	2017	Spec	350,570356	TINFOS AS	222	34,63	0	1495,4	0	0	0	0
rd	i167	2018	Spec	337,720327	TINFOS AS	222	34,63	0	1495,4	0	0	0	0
rd	i167	2019	Spec	322,927767	TINFOS AS	222	34,63	0	1495,4	0	0	0	0
rd	i168	2015	Spec	1,4	ÅRDAL ENERGI NETT AS	267	0	0	670,22	0	0	0	0
rd	i168	2016	Spec	1,4	ÅRDAL ENERGI NETT AS	267	0	0	670,22	0	0	0	0
rd	i168	2017	Spec	1,4	ÅRDAL ENERGI NETT AS	267	0	0	670,22	0	0	0	0
rd	i168	2018	Spec	1,4	ÅRDAL ENERGI NETT AS	267	0	0	670,22	0	0	0	0
rd	i168	2019	Spec	483,00204	ÅRDAL ENERGI NETT AS	267	0	0	670,22	0	0	0	0
rd	i169	2015	Spec	2802,255	SVORKA ENERGI AS	274	966,71	0	1401,07	62,08	0	0	0
rd	i169	2016	Spec	3342,9218	SVORKA ENERGI AS	274	966,71	0	1401,07	62,08	0	0	0
rd	i169	2017	Spec	3301,78139	SVORKA ENERGI AS	274	966,71	0	1401,07	62,08	0	0	0
rd	i169	2018	Spec	3549,52745	SVORKA ENERGI AS	274	966,71	0	1474,2	62,08	0	0	0
rd	i169	2019	Spec	3775,70183	SVORKA ENERGI AS	274	966,71	0	1474,2	62,08	0	0	0
rd	i170	2015	Spec	304,320605	USTEKVEIKJA KRAFTVERK DA	287	540,73	0	0	0	0	0	0
rd	i170	2016	Spec	288,631568	USTEKVEIKJA KRAFTVERK DA	287	540,73	0	0	0	0	0	0
rd	i170	2017	Spec	272	USTEKVEIKJA KRAFTVERK DA	287	540,73	0	0	0	0	0	0
rd	i170	2018	Spec	272	USTEKVEIKJA KRAFTVERK DA	287	540,73	0	0	0	0	0	0
rd	i170	2019	Spec	272	USTEKVEIKJA KRAFTVERK DA	287	1081,47	0	0	0	0	0	0
rd	i171	2015	Spec	1002,40422	EVERKET AS	349	0	0	1825,58	711,11	0	0	0
rd	i171	2016	Spec	834,764711	EVERKET AS	349	0	0	1769,17	711,11	0	0	0

Grid	ID	y	SpecDum	TOTXDEA	comp	old_id	wvol	wvsc	wvss	wvuc	hv	ss	sub
rd	i171	2017	Spec	760,33881	EVERKET AS	349	0	0	2286,01	711,11	0	0	0
rd	i171	2018	Spec	552,925309	EVERKET AS	349	0	0	2286,01	711,11	0	0	0
rd	i171	2019	Spec	545,511808	EVERKET AS	349	0	0	2286,01	711,11	0	0	0
rd	i172	2015	Spec	6141,36246	E-CO ENERGI AS	447	0	0	2958,78	708,64	0	0	0
rd	i172	2016	Spec	5688,06029	E-CO ENERGI AS	447	0	0	2958,78	708,64	0	0	0
rd	i172	2017	Spec	7575,18261	E-CO ENERGI AS	447	0	0	2958,78	708,64	0	0	0
rd	i172	2018	Spec	5795,64628	E-CO ENERGI AS	447	0	0	2958,78	708,64	0	0	0
rd	i172	2019	Spec	3476,115	E-CO ENERGI AS	447	0	0	2958,78	708,64	0	0	0
rd	i173	2015	Spec	1709,24622	LYSE PRODUKSJON AS	512	0	0	5106,32	0	0	0	0
rd	i173	2016	Spec	1701,06914	LYSE PRODUKSJON AS	512	0	0	5106,32	0	0	0	0
rd	i173	2017	Spec	1260,66461	LYSE PRODUKSJON AS	512	0	0	5106,32	0	0	0	0
rd	i173	2018	Spec	1577,11561	LYSE PRODUKSJON AS	512	0	0	6894,75	0	0	0	0
rd	i173	2019	Spec	1294,02664	LYSE PRODUKSJON AS	512	0	0	6894,75	0	0	0	0
rd	i174	2015	Spec	489,447004	VOKKS NETT AS	542	0	0	230,32	0	0	0	0
rd	i174	2016	Spec	481,796061	VOKKS NETT AS	542	0	0	230,32	0	0	0	0
rd	i174	2017	Spec	471,078724	VOKKS NETT AS	542	0	0	230,32	0	0	0	0
rd	i174	2018	Spec	790,262959	VOKKS NETT AS	542	0	0	230,32	0	0	0	0
rd	i174	2019	Spec	399,266056	VOKKS NETT AS	542	0	0	230,32	0	0	0	0
rd	i175	2015	Spec	4,4	NESSET KRAFT AS	593	0	0	1368,37	0	0	0	0
rd	i175	2016	Spec	4,4	NESSET KRAFT AS	593	0	0	1368,37	0	0	0	0
rd	i175	2017	Spec	4,4	NESSET KRAFT AS	593	0	0	1368,37	0	0	0	0
rd	i175	2018	Spec	4,4	NESSET KRAFT AS	593	0	0	1368,37	0	0	0	0
rd	i175	2019	Spec	1005,50606	NESSET KRAFT AS	593	0	0	1368,37	0	0	0	0
rd	i176	2015	Spec	220,92757	SUNNDAL ENERGI KF	599	0	0	98,71	0	0	0	0
rd	i176	2016	Spec	220,92757	SUNNDAL ENERGI KF	599	0	0	98,71	0	0	0	0
rd	i176	2017	Spec	220,92757	SUNNDAL ENERGI KF	599	0	0	98,71	0	0	0	0
rd	i176	2018	Spec	220,92757	SUNNDAL ENERGI KF	599	0	0	98,71	0	0	0	0
rd	i176	2019	Spec	220,92757	SUNNDAL ENERGI KF	599	0	0	98,71	0	0	0	0
rd	i177	2015	Spec	2410,96008	MIDT-TELEMARK ENERGI AS	659	0	0	2130,44	0	0	0	0
rd	i177	2016	Spec	3328,48319	MIDT-TELEMARK ENERGI AS	659	0	0	2130,44	0	0	0	0
rd	i177	2017	Spec	1785,95044	MIDT-TELEMARK ENERGI AS	659	0	0	2130,44	0	0	0	0
rd	i177	2018	Spec	1259,98124	MIDT-TELEMARK ENERGI AS	659	0	0	2130,44	0	0	0	0
rd	i177	2019	Spec	1179,90656	MIDT-TELEMARK ENERGI AS	659	0	0	2130,44	0	0	0	0
rd	i178	2015	Spec	434,905903	STATKRAFT ENERGI AS	685	0	0	413,65	0	0	0	0
rd	i178	2016	Spec	425,021235	STATKRAFT ENERGI AS	685	0	0	413,65	0	0	0	0
rd	i178	2017	Spec	2477,86134	STATKRAFT ENERGI AS	685	0	0	776,04	10,09	0	0	0
rd	i178	2018	Spec	2420,7773	STATKRAFT ENERGI AS	685	0	0	776,04	10,09	0	0	0
rd	i178	2019	Spec	7209,16704	STATKRAFT ENERGI AS	685	0	0	776,04	10,09	0	0	0
rd	i179	2015	Spec	312,321393	YARA NORGE AS	686	0	0	1670,09	0	0	0	0
rd	i179	2016	Spec	531,249834	YARA NORGE AS	686	0	0	1295,51	0	0	0	0
rd	i179	2017	Spec	328,490684	YARA NORGE AS	686	0	0	1295,51	0	0	0	0
rd	i179	2018	Spec	189,34655	YARA NORGE AS	686	0	0	1295,51	0	0	0	0
rd	i179	2019	Spec	76,608935	YARA NORGE AS	686	0	0	1295,51	0	0	0	0
rd	i180	2015	Spec	4,4	NORSKE SKOG SKOGN AS	902	8382,49	0	2952,71	309,24	0	0	0
rd	i180	2016	Spec	4,4	NORSKE SKOG SKOGN AS	902	8382,49	0	2952,71	309,24	0	0	0
rd	i180	2017	Spec	4,4	NORSKE SKOG SKOGN AS	902	8382,49	0	2952,71	309,24	0	0	0
rd	i180	2018	Spec	4,4	NORSKE SKOG SKOGN AS	902	8382,49	0	2952,71	309,24	0	0	0
rd	i180	2019	Spec	1068,4	NORSKE SKOG SKOGN AS	902	8382,49	0	2952,71	309,24	0	0	0

Appendix B: GAMS code

```
$TITLE NVE EFFICIENCY ANALYSES

SETS
itot index of dmus /i1*i180/
ild(itot) local units /i1*i105/
ird(itot) regional units /i106*i180/

ildConv(ild) index of dmus conventional local /i1*i94/
ildSpec(ild) index of dmus special local /i95*i105/
irdConv(ird) index of dmus conventional regional /i106*i155/
irdSpec(ird) index of dmus special regional /i156*i180/

t set of periods /2015*2019/
g set of grids   /ld,rd/
s set of conventional or special units /Conv,Spec/
sC(s) subset conventional /Conv/
sSp(s) subset special /Spec/

v all variables /Grid,ID,y,SpecDum,
              TOTXDEA,comp,old_id,
              wvol, wvsc, wvss, wvuc,
              hv, ss, sub/
*Output sets
n(v) inputs /TOTXDEA/
m(v) outputs local dist /wvol, wvsc, wvss, wvuc
                     hv, ss, sub/
mrd(m) /wvol, wvsc, wvss, wvuc/
mld(m) /hv, ss, sub/

i(itot) endogenous units for estimation
mend(m)

qset quantiles /qu1*qu5/
;

set
```

```
DtotDim(g,itot,t,s,m) totalt sett med rett dimensjon / ld.#ildConv.#t.Conv.#mld
                                    ld.#ildSpec.#t.Spec.#mld
                                    rd.#irdConv.#t.Conv.#mrd
                                    rd.#irdSpec.#t.Spec.#mrd/
CtotDim(g,itot,t,s,n) totalt sett med rett dimensjon / ld.#ildConv.#t.Conv.#n
                                    ld.#ildSpec.#t.Spec.#n
                                    rd.#irdConv.#t.Conv.#n
                                    rd.#irdSpec.#t.Spec.#n/

DredDim(g,itot,t,m) redusert sett med rett dimensjon / ld.#ild.#t.#mld
                                    rd.#ird.#t.#mrd/
CredDim(g,itot,t,n) redusert sett med rett dimensjon / ld.#ild.#t.#n
                                    rd.#ird.#t.#n/

var(g,m) set containing right variables /ld.#mld,rd.#mrd/
varext(g,s,m) set containing right variables /ld.#s.#mld,rd.#s.#mrd/
unit(g,itot) set containing right units /ld.#ild,rd.#ird/
unitext(g,itot,s) set containing right units /ld.#ildConv.Conv,ld.#ildSpec.Spec
                                rd.#irdConv.Conv,rd.#irdSpec.Spec/
;

Display DtotDim, DredDim;

alias(itot,jtot)
alias(i,j,j2)
alias(t,t2)
;

PARAMETERS
D(g,itot,t,s,v) Data matrix full (for decomposing conventional and special DMUs)
Dcorr(g,itot,t,s,v) Data matric corrected
Ccorr(g,itot,t,s,v)

Dred(g,itot,t,v) Reduced data matrix original
Dredcorr(g,itot,t,v)
Credcorr(g,itot,t,v)

Y(itot,t,m) outputs
Yavg(itot,m) avg output
Y2019(itot,m) outputs 2019
Y0(m) outputs for looping
Y1(m) outputs for looping
```

```
C(itot,t) costs
Cavg(itot) avg costs
C2019(itot) costs 2019

u(itot,jtot,m) kernel calcaulations
K1(itot,jtot,m) kernel calcualtions
Kint(itot,jtot) kernel calcualtions
K(itot) selected Kernel weights

BWD Bandwidth /1000/


Tauval(qset) Relevant quantiles /qu1 0.2,qu2 0.4,qu3 0.6,qu4 0.8,qu5 0.999/
Tau selected quantile

*Efficiencies
EffVRS(itot)
EffVRStype(itot)
EffCRS(itot)
EffCRSavg(itot)
EffCRSpanel(itot)
EffCRStype(itot)
FEav(itot)
FEavtype(itot)
FEmax
FEmaxtype
EffCNLS(itot)
EffCNLStype(itot)
EffQUANTILE(qset,itot)
EffKERNEL(itot)

* Cost norms
NormCNLS(itot,t)
NormCNLStype(itot,t)
NormQUANTILE(itot)
NormKERNEL(itot)
;

$libinclude xlimport D C:\Users\klr\Dropbox\NVE2021\DEAdata.xls a1:n901
$libinclude xlimport Dred  C:\Users\klr\Dropbox\NVE2021\DEAdata.xls a1:n901
```

```
Dcorr(g,itot,t,s,m)=D(g,itot,t,s,m)$DtotDim(g,itot,t,s,m);
Display Dcorr;
Ccorr(g,itot,t,s,n)=D(g,itot,t,s,n)$CtotDim(g,itot,t,s,n);
Display Ccorr;

Dredcorr(g,itot,t,m)=Dred(g,itot,t,m)$DredDim(g,itot,t,m);
Display Dredcorr;
Credcorr(g,itot,t,n)=Dred(g,itot,t,n)$CredDim(g,itot,t,n);
Display Credcorr;

****************************************************
*VARIABLE DEFININTION

VARIABLES
E(itot,t) Composite error term (v + u)
Ered(itot) Composite error reduced dimension

SS Sum of squares of residuals

Cval cost minimum DEA
;

POSITIVE VARIABLES
Theta(itot) intensity variables DEA
Thetaint(itot,t) intensity variables panel DEA

B(itot,t,m) Beta-coefficients CNLS
Bred(itot,m) Beta-coefficients reduced dimension

Yhat(itot,t) Estimated output of firm i
Yhatred(itot)

Epos(itot) positive errors

Eneg(itot) negative errors
;

EQUATIONS

**** DEA equations
OBJDEA  objective function DEA
YCONS(m) output constraints grid - condition on Y2019
```

```
YCONSadj(m) output constraints grid - condition on Yavg(2015-2019)
YCONSint(m) output constraints grid - panel data
CCONS cost constraint grid
CCONSint cost constraint - panel DEA
ICONS scale constraint grid

****CNLS EQUATIONS PANEL DATA
OBJPANEL objective function = sum of squares of residuals for panel data
QREG(itot,t) regression equation
QCFUNC(itot,t) supporting hyperplanes of the nonparametric cost function
QCONV(itot,jtot,t,t2) convexity constraint (Afriat inequalities)

****CNLS EQUATIONS CROSS SECTION DATA
OBJQUANT objective function quantile regression
OBJKERNEL objective function kernel regression

QREGred(itot) regression equation
QREGredQUANT(itot) quantile regression equation
QCFUNCred(itot) supporting hyperplanes of the nonparametric cost function
QCONVred(itot,jtot) convexity constraint (Afriat inequalities)
QCONVredKERN(itot,jtot) convexity constraint (Afriat inequalities)
QKERNCONS(itot) kernel error constraints
;

*DEFINE DEA
OBJDEA.. SS =e= Cval ;
YCONS(mend).. sum(i,Theta(i)*Yavg(i,mend))=g= Y0(mend);
YCONSadj(mend).. sum(i,Theta(i)*Yavg(i,mend))=g= Y1(mend);
CCONS..    sum(i,Theta(i)*Cavg(i)) =l= Cval;
ICONS..    sum(i,Theta(i)) =e= 1;

*panel CRS
YCONSint(mend).. sum((i,t),Thetaint(i,t)*Y(i,t,mend))=g= Y1(mend);
CCONSint..    sum((i,t),Thetaint(i,t)*C(i,t)) =l= Cval;

*DEFINE CNLS PANEL
OBJPANEL.. SS =e= sum((i,t),E(i,t)*E(i,t));
QREG(i,t).. log(C(i,t)) =e= log(Yhat(i,t)+0.01) + E(i,t);
QCFUNC(i,t).. Yhat(i,t) =e= sum(mend, B(i,t,mend)*Y(i,t,mend))-0.01;
QCONV(i,j,t,t2).. sum(mend, B(i,t,mend)*Y(i,t,mend)) =g=  sum(mend,
B(j,t2,mend)*Y(i,t,mend));
```

```
*DEFINE CNLS QUANTILE AND KERNELS
OBJQUANT.. SS =e= sum((i),Tau*(Eneg(i)*Eneg(i)) + (1-Tau)*(Epos(i)*Epos(i)) );
OBJKERNEL.. SS =e= sum((i),K(i)*(Ered(i)*Ered(i)));

QREGred(i).. log(Cavg(i)) =e= log(Yhatred(i)+0.01) + Ered(i);
QREGredQUANT(i).. log(Cavg(i)) =e= log(Yhatred(i)+0.01) + Epos(i)-Eneg(i);
QCFUNCred(i).. Yhatred(i) =e= sum(mend, Bred(i,mend)*Yavg(i,mend))-0.01;
QCONVred(i,j).. sum(mend, Bred(i,mend)*Yavg(i,mend)) =g= sum(mend,
Bred(j,mend)*Yavg(i,mend));
QCONVredKERN(i,j).. K(i)*sum(mend, Bred(i,mend)*Yavg(i,mend)) =g=
K(i)*sum(mend, Bred(j,mend)*Yavg(i,mend));
QKERNCONS(i).. K(i)*Ered(i) =g= 0;
;

MODEL DEAVRS /OBJDEA,YCONS,CCONS,ICONS/
MODEL DEACRS /OBJDEA,YCONS,CCONS/
MODEL DEACRSavg /OBJDEA,YCONSadj,CCONS/
MODEL DEACRSpanel /OBJDEA,YCONSint,CCONSint/

MODEL CNLSPANEL /OBJPANEL,QREG,QCFUNC,QCONV/

MODEL CNLSQUANTILE
/OBJQUANT,QREGredQUANT,QCFUNCred,QCONVred/
MODEL CNLSKERNEL
/OBJKERNEL,QREGred,QCFUNCred,QCONVredKERN,QKERNCONS/
;

** MODELS ESTIMATED PER GRID TYPE

loop(g,

mend(m)$var(g,m) = YES;
i(itot)$unit(g,itot) = YES;

*DEFINE VARIABLES

C(i,t) = Credcorr(g,i,t,"TOTXDEA");
Cavg(i) = sum(t,C(i,t))/5;
C2019(i) = Credcorr(g,i,"2019","TOTXDEA");
Display C2019;

Y(i,t,mend) = Dredcorr(g,i,t,mend);
Yavg(i,mend) = sum(t,Y(i,t,mend))/5;
```

```
Display Y;

*Kernel estimation
u(i,j,m) = (Yavg(i,m)-Yavg(j,m))/BWD;
display u;

K1(i,j,m)$var(g,m) = (3/4)*(1-(u(i,j,m)*u(i,j,m)));
Display K1;

Kint(i,j) = prod(m$var(g,m),K1(i,j,m)$(K1(i,j,m) ge 0));
Display Kint;

*DEA estimation
loop(j,

Y0(mend)=Y(j,"2019",mend);
Y1(mend)=Yavg(j,mend);

SOLVE DEAVRS using LP Minimizing SS;
EffVRS(j)= SS.l/C2019(j);
SOlVE DEACRS using LP Minimizing SS;
EffCRS(j)= SS.l/C2019(j);
SOlVE DEACRSavg using LP Minimizing SS;
EffCRSavg(j)= SS.l/Cavg(j);
SOlVE DEACRSpanel using LP Minimizing SS;
EffCRSpanel(j)= SS.l/Cavg(j);
)
;

*CNLS panel estimation
OPTION NLP = MINOS;
OPTION iterlim = 10000000;
OPTION reslim = 10000000;

SOLVE CNLSPANEL using NLP Minimizing SS;
*efficiency following Eskelinen and Kuosmanen, 2013
FEav(i) = sum(t,(exp(-E.l(i,t))))/5;
FEmax = smax(i,FEav(i));
Display FEmax;
EffCNLS(i) = FEav(i)/FEmax;
if(CNLSPANEL.modelstat ne 2, EffCNLS(i) = 999;);
```

```
NormCNLS(i,t) = Yhat.l(i,t);

*QUANTILE ESTIMATION
loop(qset,
Tau = Tauval(qset);
SOLVE CNLSQUANTILE using NLP Minimizing SS;
EffQUANTILE(qset,i) = 1/exp(Epos.l(i));
if(CNLSQUANTILE.modelstat ne 2, EffQUANTILE(qset,i) = 999;);
NormQUANTILE(i) = Yhatred.l(i);
)
;

*KERNEL-ESTIMATION
loop(j2,
*Kernel vars defined as independent
K(i)=Kint(i,j2);

Display K;

SOLVE CNLSKERNEL using NLP Minimizing SS;
EffKERNEL(j2) = 1/exp(Ered.l(j2));
if(CNLSKERNEL.modelstat ne 2, EffKERNEL(i) = 999;);
NormKERNEL(j2) = Yhatred.l(j2);
)
;

*Nullify selected inputs
mend(m)=No;
i(itot)=NO;
OPtion clear = FEav;
OPtion clear = FEmax;
Option clear=C;
Option clear= Cavg;
Option clear= C2019;
Option clear=Y;
Option clear = Y0;
Option clear = Y1;
Option clear= Yavg;
Option clear = u;
Option clear = K1;
Option clear = Kint;
Option clear = K;
```

```
)
;


***DEA APPLIED TO SUBSET OF SPECIALIZED AND CONVENTIONAL UNITS

loop(g,

loop(sC,

mend(m)$varext(g,sC,m) = YES;
i(itot)$unitext(g,itot,sC) = YES;

*DEFINE VARIABLES
C(i,t) = Ccorr(g,i,t,sC,"TOTXDEA");
Cavg(i) = sum(t,C(i,t))/5;
C2019(i) = Ccorr(g,i,"2019",sC,"TOTXDEA");
Display C2019;

Y(i,t,mend) = Dcorr(g,i,t,sC,mend);
Yavg(i,mend) = sum(t,Y(i,t,mend))/5;

Display Y;

*DEA estimation
loop(j,

Y0(mend)=Y(j,"2019",mend);

SOLVE DEAVRS using LP Minimizing SS;
EffVRStype(j)= SS.l/C2019(j);
SOlVE DEACRS using LP Minimizing SS;
EffCRStype(j)= SS.l/C2019(j);
)
;

*Nullify selected inputs
mend(m)=No;
i(itot)=NO;

*OPtion clear = FEmaxtype;
```

```
Option clear=C;
Option clear= Cavg;
Option clear= C2019;
Option clear=Y;
Option clear= Y0;
Option clear= Yavg;
)
;

*CNLS panel estimation


loop(sSp,
mend(m)$varext(g,sSp,m) = YES;
i(itot)$unitext(g,itot,sSp) = YES;

*DEFINE VARIABLES
C(i,t) = Ccorr(g,i,t,sSp,"TOTXDEA");

Y(i,t,mend) = Dcorr(g,i,t,sSp,mend);

SOLVE CNLSPANEL using NLP Minimizing SS;
*efficiency following Eskelinen and Kuosmanen, 2013
FEavtype(i) = sum(t,(exp(-E.l(i,t))))/5;
FEmaxtype = smax(i,FEavtype(i));
EffCNLStype(i) = FEavtype(i)/FEmaxtype;
if(CNLSPANEL.modelstat ne 2, EffCNLStype(i) = 999;);
NormCNLStype(i,t) = Yhat.l(i,t);

*Nullify selected inputs
mend(m)=No;
i(itot)=NO;

OPtion clear = FEavtype;
OPtion clear = FEmaxtype;
Option clear=C;
Option clear=Y;
)
;

)
;
```

```
*EXPORT RESULTS
$libinclude xldump EffVRS C:\Users\klr\Dropbox\NVE2021\Results.xls EffVRS a1:cw120
$libinclude xldump EffVRStype C:\Users\klr\Dropbox\NVE2021\Results.xls EffVRStype a1:cw120
$libinclude xldump EffCRS C:\Users\klr\Dropbox\NVE2021\Results.xls EffCRS a1:cw120
$libinclude xldump EffCRSavg C:\Users\klr\Dropbox\NVE2021\Results.xls EffCRSavg a1:cw120
$libinclude xldump EffCRSpanel C:\Users\klr\Dropbox\NVE2021\Results.xls EffCRSpanel a1:cw120
$libinclude xldump EffCRStype C:\Users\klr\Dropbox\NVE2021\Results.xls EffCRStype a1:cw120
$libinclude xldump EffCNLS C:\Users\klr\Dropbox\NVE2021\Results.xls EffCNLS a1:cw120
$libinclude xldump NormCNLS C:\Users\klr\Dropbox\NVE2021\Results.xls NormCNLS a1:cw120
$libinclude xldump EffCNLStype C:\Users\klr\Dropbox\NVE2021\Results.xls EffCNLStype a1:cw120
$libinclude xldump NormCNLStype C:\Users\klr\Dropbox\NVE2021\Results.xls NormCNLStype a1:cw120
$libinclude xldump EffKERNEL C:\Users\klr\Dropbox\NVE2021\Results.xls EffKERNEL a1:cw120
$libinclude xldump NormKERNEL C:\Users\klr\Dropbox\NVE2021\Results.xls NormKERNEL a1:cw120
$libinclude xldump EffQUANTILE C:\Users\klr\Dropbox\NVE2021\Results.xls EffQUANTILE a1:cw120
$libinclude xldump NormQUANTILE C:\Users\klr\Dropbox\NVE2021\Results.xls NormQUANTILE a1:cw120
```

Appendix C: Stata postestimation code

```
***********************************************
* NVE - VISUALISERE RESULTATER
***********************************************

local macro "EffVRS EffVRStype EffCRS EffCRSavg EffCRSpanel EffCRStype EffCNLS
EffCNLStype EffKERNEL NormKERNEL"

foreach i of local macro{
  import excel using  "C:\Users\klr\Dropbox\NVE2021/Results.xls", firstrow sheet("`i'")

  gen A = .
            reshape long i, i(A) j(ID)
            drop A
            rename i `i'
            save "C:\Users\klr\Dropbox\NVE2021/`i'.dta",replace
            clear
}

//Kvantiler
local EffQuant "EffQUANTILE"

foreach eq of local EffQuant{
import excel using  "C:\Users\klr\Dropbox\NVE2021/Results.xls", firstrow sheet("`eq'")
reshape long i, i(A) j(ID)

//lager separate datasett per quantile
local quant "qu1 qu2 qu3 qu4 qu5"
di "`quant'"

foreach q of local quant{
            local eqq `eqq' `eq'`q'
            di "`eqq'" //lager makro til senere

            preserve
            keep if A=="`q'"
            drop A
```

```
		rename i `eq'`q'
		save "C:\Users\klr\Dropbox\NVE2021/`eq'`q'.dta",replace
		restore
}
}
clear

*******
*KOMBINERE

use "C:\Users\klr\Dropbox\NVE2021/EffVRS.dta"
erase "C:\Users\klr\Dropbox\NVE2021/EffVRS.dta"

local macro "EffVRStype EffCRS EffCRSavg EffCRSpanel EffCRStype EffCNLS
EffCNLStype EffKERNEL EffQUANTILEqu1 EffQUANTILEqu2 EffQUANTILEqu3
EffQUANTILEqu4 EffQUANTILEqu5 NormKERNEL"

*forvalues i=3/`=`n_faner'-1'{
*		if inlist(`i',7) continue

foreach i of local macro{
		merge 1:1 ID using "C:\Users\klr\Dropbox\NVE2021/`i'.dta", nogenerate
		erase "C:\Users\klr\Dropbox\NVE2021/`i'.dta"
}

save "C:\Users\klr\Dropbox\NVE2021/Resultater/Efficiencies.dta"
clear

//Legg til data
import excel using  "C:\Users\klr\Dropbox\NVE2021/DEAdata.xls", firstrow
keep ID Grid SpecDum
by ID, sort: keep if _n==1
replace ID = subinstr(ID,"i","",.)
destring ID, replace
sort ID

merge 1:1 ID using "C:\Users\klr\Dropbox\NVE2021/Resultater/Efficiencies.dta"
save "C:\Users\klr\Dropbox\NVE2021/Resultater/Efficiencies.dta", replace

*****************************************************************************
**
*LAGE PLOTS
```

```
//makro for alle variabler
ds Eff*, has(type numeric)
local allvar `r(varlist)'
di "`allvar'"

//makro for detaljresultater
ds *type
local Efftype `r(varlist)'

//makro for alle effektivitetsscore utenom
local selvar: list allvar - Efftype
di "`selvar'"

local EffVRSname "Efficiency, DEA VRS"
local EffCRSname "Efficiency, DEA CRS"
local EffCRSavgname "Efficiency, DEA CRS avg.unit"
local EffCRSpanelname "Efficiency, panel DEA CRS"

local EffCNLSname "Panel CNLS, all units"

local EffKERNELname "Locally weighted DEA"

local EffQUANTILEqu1name "Quantile DEA, rho = 0.2"
local EffQUANTILEqu2name "Quantile DEA, rho = 0.4"
local EffQUANTILEqu3name "Quantile DEA, rho = 0.6"
local EffQUANTILEqu4name "Quantile DEA, rho = 0.8"
local EffQUANTILEqu5name "Quantile DEA, rho = 1.0"

*************************************
*Konsistens i rangering
ktau `selvar'

*Sammenlikne resultater generelt
local Grid "ld rd"
local ldname "Local grid"
local rdname "Regional grid"

foreach gr of local Grid{
foreach var of local selvar{

twoway ///
```

```
(histogram `var' if `var'!=999&Grid=="`gr'"&SpecDum=="Conv",freq fcolor(sand)
lcolor(none)) ///
(histogram `var' if `var'!=999&Grid=="`gr'"&SpecDum=="Spec", fcolor(none)
lcolor(black) freq ), ///
graphregion(color(white)) ytitle("Frequency") xtitle("``var'name'") ///
legend(label(1 "Efficiency, conventional") label(2 "Efficency, special")) ///
note("``gr'name'") ///
saving("C:\Users\klr\Dropbox\NVE2021\Resultater/`var'_`gr'")

}
}

//Detaljerte DEA-resultater
local Grid "ld rd"
local ldname "Local grid"
local rdname "Regional grid"

local DEA "EffVRS EffCRS"
foreach gr of local Grid{
foreach var of local DEA{
twoway ///
(histogram `var' if `var'!=999&Grid=="`gr'"&SpecDum=="Conv",freq fcolor(sand)
lcolor(none)) ///
(histogram `var'type if `var'!=999&Grid=="`gr'"&SpecDum=="Conv", fcolor(none)
lcolor(black) freq ), ///
graphregion(color(white)) ytitle("Frequency") ///
legend(label(1 "Efficiency, bm all units") label(2 "Efficency, bm conv units")) ///
note("``gr'name'") ///
saving("C:\Users\klr\Dropbox\NVE2021\Resultater/`var'type_`gr'")
}
}

//Paneldata for spesielle enheter
local Grid "ld rd"
local ldname "Local grid"
local rdname "Regional grid"

foreach gr of local Grid{
twoway ///
(histogram EffCNLStype if Grid=="`gr'",freq fcolor(sand) lcolor(black)), ///
graphregion(color(white)) ytitle("Frequency") ///
legend(label(1 "Efficiency")) ///
note("``gr'name'") ///
```

```
saving("C:\Users\klr\Dropbox\NVE2021\Resultater/EffCNLStype_`gr'")
}

clear

******************************************************************************
*
* COST NORMS


//Norms

import excel using  "C:\Users\klr\Dropbox\NVE2021/Results.xls", firstrow
sheet("NormCNLS")

rename A ID
replace ID = subinstr(ID,"i","",.)
destring ID, replace

reshape long y, i(ID) j(Year)
rename y Norm

save "C:\Users\klr\Dropbox\NVE2021/Resultater/NormCNLS.dta",replace

clear

//Legg til data
import excel using  "C:\Users\klr\Dropbox\NVE2021/DEAdata.xls", firstrow
keep ID y Grid SpecDum TOTXDEA
replace ID = subinstr(ID,"i","",.)
destring ID, replace
sort ID y
rename y Year

merge 1:1 ID Year using "C:\Users\klr\Dropbox\NVE2021/Resultater/NormCNLS.dta"
save "C:\Users\klr\Dropbox\NVE2021/Resultater/NormCNLS.dta", replace

//scatter
local Grid "ld rd"
local ldname "Local grid"
local rdname "Regional grid"
```

```
foreach gr of local Grid{

twoway  ///
(scatter Norm TOTXDEA if Grid=="`gr'"&SpecDum=="Conv", mfcolor(sand)
mcolor(black)), ///
graphregion(color(white)) ytitle("Cost Norm, CNLS") xtitle("Reported costs") ///
note("``gr'name'") ///
legend(label(1 "Conventional units")) ///
saving("C:\Users\klr\Dropbox\NVE2021\Resultater/NormCNLSConv_`gr'")

twoway ///
(scatter Norm TOTXDEA if Grid=="`gr'"&SpecDum=="Spec", mfcolor(sand)
mcolor(black) ), ///
graphregion(color(white)) ytitle("Cost Norm, CNLS") xtitle("Reported costs") ///
note("``gr'name'") ///
legend(label(1 "Special units")) ///
saving("C:\Users\klr\Dropbox\NVE2021\Resultater/NormCNLSSpecial_`gr'")

}

*************************************************
* 4-component CNLS

gen DepVar = ln(TOTXDEA) - ln(Norm)

iis ID
tis Year

keep if Grid=="rd"

xtreg DepVar, re

predict RanEff, u

predict Error, e

//
frontier Error,  ///
cost distribution(hnormal) // Time varying efficiency

predict TransEff4C, te
```

```
preserve

by ID, sort: keep if _n==1

frontier RanEff, cost distribution(hnormal)

predict PerEff4C, te // Persistent efficency

save "C:\Users\klr\Dropbox\NVE2021/Resultater/Persistent"

restore

merge m:1 ID using "C:\Users\klr\Dropbox\NVE2021/Resultater/Persistent",
nogenerate keepusing(PerEff4C)

erase "C:\Users\klr\Dropbox\NVE2021/Resultater/Persistent.dta"

gen Eff4C = 1/(PerEff4C*TransEff4C)

twoway  ///
(histogram Eff4C if Grid=="rd"&SpecDum=="Conv",freq fcolor(sand) lcolor(none)) ///
(histogram Eff4C if Grid=="rd"&SpecDum=="Spec", fcolor(none) lcolor(black) freq ),
///
graphregion(color(white)) ytitle("Frequency") xtitle("Efficiency CNLS, 4 component
model") ///
legend(label(1 "Efficiency, conventional") label(2 "Efficency, special")) ///
note("Regional distribution") ///
saving("C:\Users\klr\Dropbox\NVE2021\Resultater/EffCNLS4comp_rd")

clear
```

Appendix D: Results

Grid	ID	SpecDum	EffVRS	EffVRS type	EffCRS	EffCRS avg	EffCRS panel	EffCRS type	EffCNLS	EffCNLStype	EffKERNEL	EffQUANTILEqu1	EffQUANTILEqu2	EffQUANTILEqu3	EffQUANTILEqu4	EffQUANTILEqu5
Id	1	Conv	0,71	0,74	0,69	0,70	0,58	0,72	0,09		999,00	999,00	999,00	999,00	999,00	999,00
Id	2	Conv	0,62	0,74	0,53	0,58	0,47	0,68	0,09		999,00	999,00	999,00	999,00	999,00	999,00
Id	3	Conv	0,44	0,57	0,43	0,46	0,39	0,45	0,07		999,00	999,00	999,00	999,00	999,00	999,00
Id	4	Conv	0,68	1,05	0,68	0,65	0,51	0,90	0,09		999,00	999,00	999,00	999,00	999,00	999,00
Id	5	Conv	0,97	0,98	0,96	0,93	0,81	0,96	0,14		999,00	999,00	999,00	999,00	999,00	999,00
Id	6	Conv	0,67	0,80	0,67	0,69	0,56	0,73	0,09		999,00	999,00	999,00	999,00	999,00	999,00
Id	7	Conv	1,00	1,00	0,93	0,92	0,75	1,00	0,12		999,00	999,00	999,00	999,00	999,00	999,00
Id	8	Conv	0,59	0,65	0,54	0,55	0,46	0,62	0,08		999,00	999,00	999,00	999,00	999,00	999,00
Id	9	Conv	0,60	0,70	0,60	0,59	0,51	0,63	0,09		999,00	999,00	999,00	999,00	999,00	999,00
Id	10	Conv	0,46	0,73	0,45	0,48	0,40	0,45	0,06		999,00	999,00	999,00	999,00	999,00	999,00
Id	11	Conv	0,58	0,69	0,58	0,52	0,43	0,58	0,07		999,00	999,00	999,00	999,00	999,00	999,00
Id	12	Conv	0,64	0,64	0,59	0,59	0,48	0,64	0,08		999,00	999,00	999,00	999,00	999,00	999,00
Id	13	Conv	0,48	0,55	0,46	0,49	0,41	0,52	0,07		999,00	999,00	999,00	999,00	999,00	999,00
Id	14	Conv	0,64	0,69	0,58	0,57	0,47	0,67	0,08		999,00	999,00	999,00	999,00	999,00	999,00
Id	15	Conv	0,70	0,70	0,60	0,59	0,48	0,66	0,08		999,00	999,00	999,00	999,00	999,00	999,00
Id	16	Conv	0,74	0,85	0,73	0,72	0,62	0,73	0,10		999,00	999,00	999,00	999,00	999,00	999,00
Id	17	Conv	0,76	0,85	0,76	0,79	0,66	0,78	0,11		999,00	999,00	999,00	999,00	999,00	999,00
Id	18	Conv	0,80	0,82	0,78	0,78	0,65	0,81	0,11		999,00	999,00	999,00	999,00	999,00	999,00
Id	19	Conv	0,86	0,93	0,86	0,81	0,69	0,86	0,11		999,00	999,00	999,00	999,00	999,00	999,00
Id	20	Conv	0,83	0,97	0,82	0,77	0,66	0,82	0,11		999,00	999,00	999,00	999,00	999,00	999,00
Id	21	Conv	0,62	0,70	0,62	0,58	0,49	0,66	0,08		999,00	999,00	999,00	999,00	999,00	999,00
Id	22	Conv	0,86	1,04	0,85	0,81	0,67	0,86	0,10		999,00	999,00	999,00	999,00	999,00	999,00
Id	23	Conv	0,62	0,66	0,61	0,61	0,52	0,61	0,08		999,00	999,00	999,00	999,00	999,00	999,00
Id	24	Conv	0,69	0,77	0,69	0,62	0,51	0,73	0,08		999,00	999,00	999,00	999,00	999,00	999,00
Id	25	Conv	0,70	0,78	0,55	0,48	0,38	0,76	0,07		999,00	999,00	999,00	999,00	999,00	999,00
Id	26	Conv	0,61	0,74	0,61	0,66	0,54	0,66	0,09		999,00	999,00	999,00	999,00	999,00	999,00
Id	27	Conv	0,56	0,78	0,56	0,50	0,41	0,64	0,07		999,00	999,00	999,00	999,00	999,00	999,00
Id	28	Conv	0,55	0,64	0,55	0,56	0,46	0,60	0,08		999,00	999,00	999,00	999,00	999,00	999,00
Id	29	Conv	1,02	1,02	0,75	0,74	0,58	1,02	0,11		999,00	999,00	999,00	999,00	999,00	999,00
Id	30	Conv	0,97	0,97	0,72	0,69	0,55	0,94	0,10		999,00	999,00	999,00	999,00	999,00	999,00
Id	31	Conv	0,91	0,93	0,79	0,73	0,59	0,93	0,10		999,00	999,00	999,00	999,00	999,00	999,00
Id	32	Conv	0,59	0,79	0,47	0,44	0,35	0,70	0,07		999,00	999,00	999,00	999,00	999,00	999,00
Id	33	Conv	0,56	0,67	0,55	0,55	0,46	0,61	0,08		999,00	999,00	999,00	999,00	999,00	999,00
Id	34	Conv	0,87	0,93	0,87	0,84	0,70	0,87	0,11		999,00	999,00	999,00	999,00	999,00	999,00
Id	35	Conv	0,86	0,94	0,86	0,85	0,69	0,88	0,12		999,00	999,00	999,00	999,00	999,00	999,00
Id	36	Conv	0,74	0,88	0,66	0,61	0,50	0,81	0,09		999,00	999,00	999,00	999,00	999,00	999,00
Id	37	Conv	0,59	0,68	0,59	0,57	0,47	0,63	0,07		999,00	999,00	999,00	999,00	999,00	999,00
Id	38	Conv	0,62	0,66	0,45	0,42	0,33	0,64	0,07		999,00	999,00	999,00	999,00	999,00	999,00
Id	39	Conv	0,66	0,85	0,65	0,68	0,56	0,66	0,09		999,00	999,00	999,00	999,00	999,00	999,00
Id	40	Conv	0,93	1,05	0,91	0,81	0,67	1,00	0,11		999,00	999,00	999,00	999,00	999,00	999,00
Id	41	Conv	0,33	0,72	0,32	0,40	0,33	0,34	0,06		999,00	999,00	999,00	999,00	999,00	999,00
Id	42	Conv	0,73	0,94	0,73	0,63	0,50	0,83	0,09		999,00	999,00	999,00	999,00	999,00	999,00
Id	43	Conv	0,68	0,73	0,67	0,70	0,57	0,71	0,09		999,00	999,00	999,00	999,00	999,00	999,00
Id	44	Conv	0,51	0,60	0,50	0,51	0,42	0,52	0,07		999,00	999,00	999,00	999,00	999,00	999,00
Id	45	Conv	0,62	0,69	0,62	0,61	0,50	0,62	0,08		999,00	999,00	999,00	999,00	999,00	999,00
Id	46	Conv	0,66	0,79	0,65	0,63	0,53	0,68	0,09		999,00	999,00	999,00	999,00	999,00	999,00

Grid	ID	SpecDum	EffVRS	EffVRS type	EffCRS	EffCRS avg	EffCRS panel	EffCRS type	EffCNLS	EffCNL Stype	EffKERNEL	EffQUANTILEqu1	EffQUANTILEqu2	EffQUANTILEqu3	EffQUANTILEqu4	EffQUANTILEqu5
ld	47	Conv	0,56	0,69	0,56	0,55	0,44	0,64	0,08		999,00	999,00	999,00	999,00	999,00	999,00
ld	48	Conv	0,84	0,84	0,81	0,85	0,72	0,84	0,13		999,00	999,00	999,00	999,00	999,00	999,00
ld	49	Conv	0,64	0,72	0,63	0,57	0,47	0,68	0,08		999,00	999,00	999,00	999,00	999,00	999,00
ld	50	Conv	0,87	0,87	0,79	0,77	0,64	0,85	0,10		999,00	999,00	999,00	999,00	999,00	999,00
ld	51	Conv	0,86	0,94	0,86	0,91	0,73	0,90	0,13		999,00	999,00	999,00	999,00	999,00	999,00
ld	52	Conv	0,72	0,78	0,67	0,60	0,49	0,75	0,08		999,00	999,00	999,00	999,00	999,00	999,00
ld	53	Conv	0,63	0,89	0,62	0,57	0,47	0,65	0,07		999,00	999,00	999,00	999,00	999,00	999,00
ld	54	Conv	0,71	0,87	0,71	0,63	0,50	0,77	0,09		999,00	999,00	999,00	999,00	999,00	999,00
ld	55	Conv	0,68	0,68	0,57	0,60	0,49	0,67	0,08		999,00	999,00	999,00	999,00	999,00	999,00
ld	56	Conv	0,76	0,76	0,64	0,66	0,53	0,75	0,09		999,00	999,00	999,00	999,00	999,00	999,00
ld	57	Conv	0,75	0,78	0,72	0,62	0,51	0,77	0,08		999,00	999,00	999,00	999,00	999,00	999,00
ld	58	Conv	0,82	0,86	0,82	0,83	0,70	0,82	0,11		999,00	999,00	999,00	999,00	999,00	999,00
ld	59	Conv	0,45	0,64	0,45	0,49	0,41	0,50	0,07		999,00	999,00	999,00	999,00	999,00	999,00
ld	60	Conv	0,65	0,65	0,60	0,51	0,42	0,65	0,07		999,00	999,00	999,00	999,00	999,00	999,00
ld	61	Conv	0,64	0,69	0,61	0,59	0,48	0,67	0,08		999,00	999,00	999,00	999,00	999,00	999,00
ld	62	Conv	0,84	0,85	0,84	0,82	0,68	0,84	0,11		999,00	999,00	999,00	999,00	999,00	999,00
ld	63	Conv	0,78	0,81	0,77	0,79	0,66	0,79	0,10		999,00	999,00	999,00	999,00	999,00	999,00
ld	64	Conv	0,84	0,86	0,83	0,80	0,66	0,83	0,10		999,00	999,00	999,00	999,00	999,00	999,00
ld	65	Conv	0,67	0,67	0,63	0,63	0,53	0,67	0,09		0,76	999,00	999,00	999,00	999,00	999,00
ld	66	Conv	0,80	0,88	0,80	0,77	0,63	0,80	0,11		0,85	999,00	999,00	999,00	999,00	999,00
ld	67	Conv	0,50	0,56	0,50	0,51	0,43	0,52	0,07		0,60	999,00	999,00	999,00	999,00	999,00
ld	68	Conv	0,47	0,48	0,42	0,42	0,35	0,48	0,06		0,52	999,00	999,00	999,00	999,00	999,00
ld	69	Conv	0,57	0,73	0,57	0,58	0,47	0,65	0,08		0,63	999,00	999,00	999,00	999,00	999,00
ld	70	Conv	0,49	0,69	0,48	0,44	0,35	0,58	0,07		0,47	999,00	999,00	999,00	999,00	999,00
ld	71	Conv	0,83	0,83	0,77	0,74	0,62	0,83	0,10		0,91	999,00	999,00	999,00	999,00	999,00
ld	72	Conv	0,78	0,79	0,78	0,75	0,64	0,79	0,11		0,87	999,00	999,00	999,00	999,00	999,00
ld	73	Conv	0,60	0,63	0,57	0,56	0,47	0,62	0,08		0,65	999,00	999,00	999,00	999,00	999,00
ld	74	Conv	0,85	0,85	0,83	0,74	0,63	0,85	0,11		0,93	999,00	999,00	999,00	999,00	999,00
ld	75	Conv	0,78	0,79	0,78	0,78	0,63	0,78	0,12		0,85	999,00	999,00	999,00	999,00	999,00
ld	76	Conv	0,70	0,74	0,70	0,69	0,57	0,72	0,09		0,76	999,00	999,00	999,00	999,00	999,00
ld	77	Conv	0,82	0,83	0,82	0,79	0,65	0,83	0,12		0,94	999,00	999,00	999,00	999,00	999,00
ld	78	Conv	0,57	0,69	0,57	0,60	0,50	0,63	0,09		0,73	999,00	999,00	999,00	999,00	999,00
ld	79	Conv	0,70	0,73	0,70	0,74	0,62	0,70	0,10		0,86	999,00	999,00	999,00	999,00	999,00
ld	80	Conv	0,60	0,76	0,59	0,49	0,40	0,63	0,07		0,56	999,00	999,00	999,00	999,00	999,00
ld	81	Conv	0,56	0,65	0,56	0,56	0,46	0,59	0,07		0,65	999,00	999,00	999,00	999,00	999,00
ld	82	Conv	0,88	0,88	0,88	0,84	0,72	0,88	0,12		1,00	999,00	999,00	999,00	999,00	999,00
ld	83	Conv	0,83	0,85	0,82	0,88	0,73	0,82	0,11		1,00	999,00	999,00	999,00	999,00	999,00
ld	84	Conv	1,05	1,06	1,05	0,96	0,82	1,05	0,14		1,00	999,00	999,00	999,00	999,00	999,00
ld	85	Conv	0,81	0,81	0,80	0,80	0,68	0,81	0,11		1,00	999,00	999,00	999,00	999,00	999,00
ld	86	Conv	0,55	0,58	0,54	0,56	0,47	0,55	0,07		0,66	999,00	999,00	999,00	999,00	999,00
ld	87	Conv	0,75	0,79	0,73	0,71	0,60	0,77	0,10		0,88	999,00	999,00	999,00	999,00	999,00
ld	88	Conv	0,84	0,89	0,84	0,84	0,70	0,84	0,11		0,98	999,00	999,00	999,00	999,00	999,00
ld	89	Conv	0,74	0,76	0,73	0,73	0,61	0,73	0,09		0,82	999,00	999,00	999,00	999,00	999,00
ld	90	Conv	0,95	0,95	0,99	1,00	0,86	0,99	0,15		1,00	999,00	999,00	999,00	999,00	999,00
ld	91	Conv	0,66	0,67	0,66	0,68	0,57	0,66	0,08		0,77	999,00	999,00	999,00	999,00	999,00
ld	92	Conv	0,97	0,97	0,96	1,00	0,82	0,96	0,14		1,00	999,00	999,00	999,00	999,00	999,00
ld	93	Conv	0,64	0,64	0,57	0,61	0,51	0,63	0,09		0,81	999,00	999,00	999,00	999,00	999,00
ld	94	Conv	0,90	0,92	0,88	0,80	0,66	0,91	0,10		0,92	999,00	999,00	999,00	999,00	999,00
ld	95	Spec	0,61		0,46	0,50	0,27		0,08	0,40	0,63	999,00	999,00	999,00	999,00	999,00
ld	96	Spec	0,49		0,12	0,14	0,02		0,03	0,03	0,14	999,00	999,00	999,00	999,00	999,00
ld	97	Spec	1,48		1,48	1,00	0,68		0,25	0,27	1,00	999,00	999,00	999,00	999,00	999,00
ld	98	Spec	0,77		0,30	0,39	0,31		0,06	0,21	0,43	999,00	999,00	999,00	999,00	999,00
ld	99	Spec	0,05		0,00	0,00	0,00		0,00	0,00	0,00	999,00	999,00	999,00	999,00	999,00
ld	100	Spec	1,29		1,29	1,00	0,67		0,20	0,26	1,00	999,00	999,00	999,00	999,00	999,00
ld	101	Spec	0,16		0,15	0,14	0,09		0,03	0,03	0,14	999,00	999,00	999,00	999,00	999,00
ld	102	Spec	0,13		0,13	0,11	0,08		0,02	0,04	0,12	999,00	999,00	999,00	999,00	999,00

Grid	ID	SpecDum	EffVRS	EffVRS type	EffCRS	EffCRS avg	EffCRS panel	EffCRS type	EffCNLS	EffCNLStype	EffKERNEL	EffQUANTILEqu1	EffQUANTILEqu2	EffQUANTILEqu3	EffQUANTILEqu4	EffQUANTILEqu5
ld	103	Spec	0,07		0,07	0,07	0,05		0,02	0,02	0,07	999,00	999,00	999,00	999,00	999,00
ld	104	Spec	0,16		0,00	0,00	0,00		0,01	0,09	0,00	999,00	999,00	999,00	999,00	999,00
ld	105	Spec	0,38		0,03	0,04	0,01		1,00	1,00	0,04	999,00	999,00	999,00	999,00	999,00
rd	106	Conv	0,46	0,71	0,06	0,06	0,00	0,61	0,00		999,00	1,00	1,00	0,89	0,58	0,07
rd	107	Conv	0,40	0,57	0,12	0,12	0,07	0,57	0,00		999,00	1,00	1,00	0,89	0,69	0,13
rd	108	Conv	0,15	0,44	0,04	0,04	0,00	0,41	0,00		999,00	0,90	0,58	0,39	0,24	0,04
rd	109	Conv	0,65	0,65	0,08	0,05	0,00	0,61	0,00		999,00	1,00	0,99	0,85	0,67	0,06
rd	110	Conv	0,40	0,55	0,04	0,03	0,00	0,50	0,00		999,00	0,84	0,72	0,59	0,44	0,04
rd	111	Conv	0,04	0,38	0,04	0,56	0,52	0,36	0,00		999,00	1,00	0,98	0,89	0,84	0,57
rd	112	Conv	0,45	0,46	0,25	0,23	0,18	0,45	0,00		999,00	0,76	0,72	0,69	0,60	0,24
rd	113	Conv	0,90	0,90	0,38	0,32	0,29	0,56	0,00		999,00	0,82	0,74	0,68	0,61	0,32
rd	114	Conv	0,72	0,85	0,07	0,07	0,00	0,75	0,00		999,00	1,00	1,00	1,00	0,78	0,07
rd	115	Conv	0,33	0,92	0,08	0,06	0,00	0,83	0,00		999,00	1,00	1,00	0,74	0,47	0,07
rd	116	Conv	0,49	0,60	0,05	0,05	0,00	0,59	0,00		999,00	0,95	0,90	0,85	0,66	0,05
rd	117	Conv	0,08	0,83	0,08	0,08	0,00	0,83	0,00		999,00	1,00	1,00	1,00	0,64	0,09
rd	118	Conv	0,55	0,60	0,07	0,07	0,03	0,50	0,00		999,00	0,98	0,82	0,68	0,48	0,07
rd	119	Conv	0,74	0,74	0,19	0,20	0,15	0,62	0,00		999,00	1,00	1,00	0,95	0,78	0,20
rd	120	Conv	0,87	1,18	0,10	0,09	0,00	1,17	0,00		999,00	1,00	1,00	1,00	1,00	0,09
rd	121	Conv	0,73	0,78	0,36	0,30	0,19	0,76	0,00		999,00	0,94	0,98	1,00	1,00	0,32
rd	122	Conv	1,15	1,15	0,61	0,55	0,44	1,14	0,00		999,00	1,00	1,00	1,00	1,00	0,56
rd	123	Conv	0,08	0,83	0,07	0,09	0,00	0,83	0,00		999,00	1,00	1,00	1,00	1,00	0,09
rd	124	Conv	0,29	0,42	0,03	0,03	0,00	0,38	0,00		999,00	0,85	0,67	0,51	0,34	0,04
rd	125	Conv	0,99	0,99	0,22	0,22	0,10	0,75	0,00		999,00	1,00	1,00	1,00	1,00	0,23
rd	126	Conv	0,85	0,85	0,48	0,50	0,41	0,72	0,00		999,00	1,00	1,00	1,00	1,00	0,52
rd	127	Conv	0,52	0,92	0,52	0,58	0,47	0,88	0,00		999,00	1,00	1,00	1,00	1,00	0,60
rd	128	Conv	0,34	0,35	0,02	0,03	0,00	0,28	0,00		999,00	0,70	0,55	0,45	0,30	0,03
rd	129	Conv	0,35	0,62	0,05	0,04	0,00	0,53	0,00		999,00	0,99	0,74	0,59	0,39	0,04
rd	130	Conv	0,35	0,49	0,05	0,04	0,01	0,43	0,00		999,00	0,87	0,65	0,48	0,32	0,05
rd	131	Conv	0,43	0,43	0,08	0,09	0,04	0,39	0,00		999,00	0,83	0,79	0,72	0,62	0,10
rd	132	Conv	0,42	0,62	0,05	0,05	0,00	0,54	0,00		999,00	1,00	0,90	0,66	0,43	0,06
rd	133	Conv	0,60	0,79	0,13	0,13	0,00	0,76	0,00		999,00	1,00	1,00	1,00	1,00	0,14
rd	134	Conv	1,01	1,01	1,01	1,00	0,96	1,01	0,00		999,00	1,00	1,00	1,00	1,00	1,00
rd	135	Conv	0,05	0,67	0,05	0,04	0,00	0,52	0,00		999,00	0,95	0,77	0,64	0,52	0,04
rd	136	Conv	0,72	0,72	0,72	0,71	0,68	0,72	0,00		999,00	1,00	1,00	1,00	0,99	0,72
rd	137	Conv	0,95	1,08	0,12	0,09	0,02	0,91	0,00		999,00	1,00	1,00	0,89	0,58	0,10
rd	138	Conv	0,91	0,91	0,55	0,57	0,48	0,76	0,00		999,00	1,00	1,00	1,00	1,00	0,59
rd	139	Conv	0,33	0,50	0,22	0,19	0,16	0,45	0,00		999,00	0,80	0,65	0,57	0,48	0,20
rd	140	Conv	0,80	0,80	0,19	0,20	0,11	0,65	0,00		999,00	1,00	1,00	1,00	0,94	0,21
rd	141	Conv	1,23	1,23	0,30	0,25	0,04	1,18	0,00		999,00	1,00	1,00	1,00	1,00	0,27
rd	142	Conv	1,06	1,06	0,56	0,72	0,63	0,81	0,00		999,00	1,00	1,00	1,00	1,00	0,74
rd	143	Conv	0,15	0,52	0,04	0,04	0,00	0,49	0,00		999,00	1,00	0,83	0,63	0,41	0,05
rd	144	Conv	1,09	1,09	0,08	0,07	0,02	0,65	0,00		999,00	1,00	1,00	0,77	0,51	0,08
rd	145	Conv	0,96	0,96	0,07	0,08	0,00	0,83	0,00		999,00	1,00	1,00	1,00	1,00	0,09
rd	146	Conv	0,69	0,69	0,05	0,05	0,00	0,51	0,00		999,00	1,00	0,95	0,78	0,61	0,05
rd	147	Conv	0,57	0,85	0,07	0,07	0,00	0,73	0,00		999,00	1,00	1,00	0,93	0,60	0,08
rd	148	Conv	0,62	0,70	0,34	0,28	0,19	0,66	0,00		999,00	0,94	0,93	0,93	0,94	0,29
rd	149	Conv	0,31	1,03	0,10	0,09	0,00	0,97	0,00		999,00	1,00	1,00	0,87	0,52	0,10
rd	150	Conv	0,90	0,90	0,17	0,19	0,04	0,74	0,00		999,00	1,00	1,00	1,00	1,00	0,20
rd	151	Conv	0,72	0,72	0,08	0,08	0,04	0,44	0,00		999,00	0,86	0,78	0,66	0,52	0,08
rd	152	Conv	0,80	0,80	0,24	0,25	0,19	0,62	0,00		999,00	1,00	1,00	1,00	0,83	0,26
rd	153	Conv	0,76	0,92	0,08	0,06	0,00	0,83	0,00		999,00	1,00	1,00	0,77	0,57	0,07
rd	154	Conv	0,38	0,47	0,08	0,06	0,00	0,47	0,00		999,00	0,74	0,69	0,66	0,63	0,07
rd	155	Conv	0,99	0,99	0,57	0,58	0,41	0,99	0,00		999,00	1,00	1,00	1,00	1,00	0,60
rd	156	Spec	0,21		0,20	0,95	0,02		0,19	0,46	999,00	1,00	1,00	1,00	1,00	1,00
rd	157	Spec	0,11		0,08	0,07	0,00		0,00	0,00	999,00	1,00	0,99	0,64	0,37	0,08
rd	158	Spec	0,05		0,01	0,00	0,00		0,00	0,00	999,00	0,08	0,05	0,03	0,02	0,00

Grid	ID	SpecDum	EffVRS	EffVRS type	EffCRS	EffCRS avg	EffCRS panel	EffCRS type	EffCNLS	EffCNL Stype	EffKER NEL	EffQUANT ILEqu1	EffQUANT ILEqu2	EffQUANT ILEqu3	EffQUANT ILEqu4	EffQUANT ILEqu5
rd	159	Spec	0,01		0,01	0,01	0,00		0,00	0,00	999,00	0,33	0,29	0,24	0,18	0,01
rd	160	Spec	0,36		0,29	0,22	0,00		0,00	0,01	999,00	1,00	1,00	1,00	1,00	0,24
rd	161	Spec	0,28		0,18	0,33	0,01		0,00	0,01	999,00	1,00	1,00	1,00	1,00	0,37
rd	162	Spec	0,27		0,26	0,16	0,00		0,00	0,00	999,00	1,00	1,00	1,00	0,84	0,17
rd	163	Spec	0,08		0,08	0,05	0,00		0,00	0,00	999,00	1,00	0,92	0,75	0,50	0,05
rd	164	Spec	0,05		0,05	0,06	0,00		0,00	0,00	999,00	1,00	0,88	0,57	0,33	0,07
rd	165	Spec	0,07		0,02	0,02	0,00		0,00	0,00	999,00	0,41	0,26	0,17	0,10	0,02
rd	166	Spec	0,06		0,03	0,03	0,00		0,00	0,00	999,00	0,58	0,36	0,23	0,14	0,03
rd	167	Spec	0,35		0,34	0,31	0,01		0,00	0,01	999,00	1,00	1,00	1,00	1,00	0,34
rd	168	Spec	0,13		0,10	0,50	0,01		0,25	0,60	999,00	1,00	1,00	1,00	1,00	0,55
rd	169	Spec	0,03		0,03	0,03	0,00		0,00	0,00	999,00	0,76	0,56	0,41	0,28	0,03
rd	170	Spec	0,30		0,10	0,06	0,00		0,00	0,00	999,00	1,00	1,00	1,00	0,82	0,07
rd	171	Spec	1,50		0,92	0,68	0,01		0,01	0,01	999,00	1,00	1,00	1,00	1,00	0,74
rd	172	Spec	0,31		0,14	0,09	0,00		0,00	0,00	999,00	0,87	0,81	0,80	0,81	0,10
rd	173	Spec	1,98		0,39	0,28	0,01		0,00	0,01	999,00	1,00	1,00	1,00	1,00	0,31
rd	174	Spec	0,16		0,04	0,03	0,00		0,00	0,00	999,00	0,74	0,46	0,30	0,17	0,04
rd	175	Spec	0,10		0,10	0,49	0,01		0,16	0,39	999,00	1,00	1,00	1,00	1,00	0,54
rd	176	Spec	0,28		0,03	0,03	0,00		0,00	0,00	999,00	0,76	0,47	0,31	0,18	0,04
rd	177	Spec	0,13		0,13	0,08	0,00		0,00	0,00	999,00	1,00	1,00	0,73	0,42	0,09
rd	178	Spec	0,01		0,01	0,02	0,00		0,00	0,00	999,00	0,41	0,26	0,17	0,11	0,02
rd	179	Spec	1,27		1,24	0,35	0,01		0,00	0,01	999,00	1,00	1,00	1,00	1,00	0,38
rd	180	Spec	0,20		0,20	1,00	0,02		1,00	1,00	999,00	1,00	1,00	1,00	1,00	1,00

Appendix E: CNLS cost norms

While efficiency measurement suggests that some of the special units are highly influential "outliers", thereby leading to a majority of units being strongly inefficient, there is also a question about how the mean-value cost norm determined by the CNLS model differs from actual costs. In the DEA case, there is a 1:1 correspondence between the benchmark and the efficiency measure. The CNLS methodology, on the other hand, decomposes the error into efficiency and stochastic noise.

The NVE-RME uses a 3-stage approach to establish the cost benchmark, where the final stage implies adjusting the DEA benchmark to the mean cost level. CNLS provides the opportunity to estimate the average cost norm in one stage.

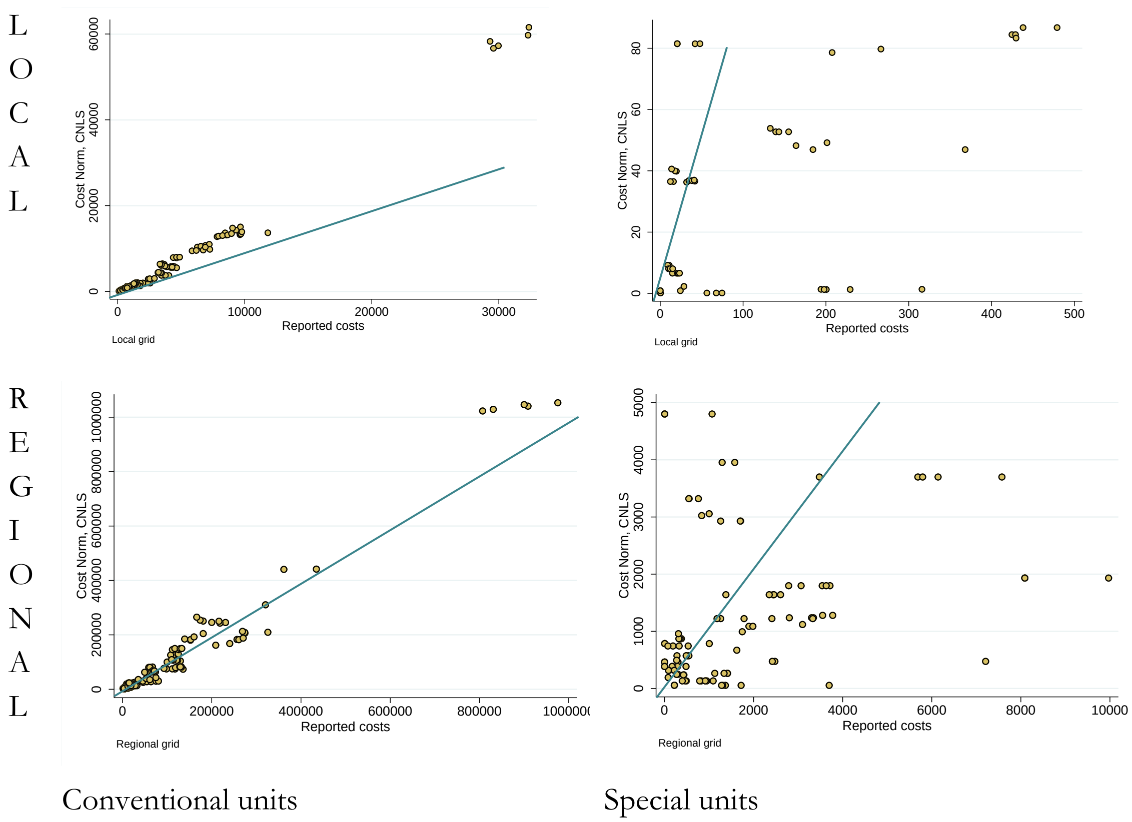


Figure 11-1: Comparison of CNLS cost norms and reported costs, by unit type (conventional/special) and grid (local/regional).

Figure 11-1 compares the CNLS benchmark under CRS to actual costs. Because of the significant difference in size among conventional and special units, we present scatterplots separately for the two groups. Each panel contains a line segment that indicates if the cost norm exceeds or falls short of reported costs.

Overall, the CNLS cost norm appears aligned with reported costs for small conventional units, while large conventional units receive benchmarks that exceed current costs.

Benchmarks for conventional units are more aligned with reported costs for regional grid operators than for local grid operators. Concerning special units, a majority of these DSOs receive a benchmark that fall short of their reported costs. This can be attributed to their modest size.

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Visiting and postal address:
Institute of Transport Economics
Gaustadalléen 21
NO-0349 Oslo

+ 47 22 57 38 00
toi@toi.no
www.toi.no