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ECONOMIC IMPACT ASSESSMENT OF ILMATAR OFFSHORE AB STORMSKÄR AND VÄDERSKÄR OFFSHORE WIND FARM PROJECT

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Project	**Economic Impact Assessment of Ilmatar Offshore Ab Stormskär and Väderskär Offshore Wind Farm Project**
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EXECUTIVE SUMMARY

Ilmatar Offshore plans to develop, build and operate a large offshore wind farm in the territorial waters of Åland Islands, approximately 15 kilometers north of the coast of Åland and 45 km off the coast of Finland. The wind farm consists of two distinct production areas, Stormskär and Väderskär, with a total of 123 windmills and a production capacity of 2460 MW. If realized, the project will increase renewable energy production in the Nordic countries and contribute to mitigating climate change while also creating new cross-sector value chains in Åland, the rest of Finland and internationally.

Assessment model

The regional economic impacts of the planned project were assessed with Ramboll's resource flow model. This model is a regionalized input-output-based model which allows for assessing the direct and indirect impacts from production and consumption that arise across value chains as a result of multiplicative effects from the project. The modelling was conducted at current prices (2023) and at sectoral level, and the results were not discounted. The results were analyzed at the regional level of Åland and spread throughout the rest of Finland in total.

Three scenarios

Three distinct scenarios were modelled for three distinct phases: development and planning, construction and operational period where more procurements could be made locally if a strong focus was put on competence building.

- Scenario A: **Coordination project**, where products and services are sourced from current and existing market players without regional focus.
- Scenario B: **Co-operation project**, where the market is expected to develop regionally and nationally to provide more products to support the construction and operation of offshore wind farms and a clear focus is put on utilizing local and national resources.
- Scenario C: **Co-development project**, which builds on the same foundations as co-operation project but extends the cooperation to strong local capability building and supporting investments on both sides.

Regardless of the scenario clear regional economic impacts follow the execution of the project.

Åland jobs and revenue

Regionally on the Åland Islands, most of the impacts will be realized during the operational period, where labour demand of 4 105 – 7 209 FTEs will occur cumulatively with a 25-year wind farm lifespan as a result of multiplicative impacts. If the wind farm is repowered, the operation will continue, and labour demand will grow by 60 % even without considering additional investments and related work needed. At the same time, over 730 - 1 140 million of revenue will cumulatively accumulate across Åland industries during the project lifetime, and the annual GDP of Åland is expected to rise by over 1,5 % as nearly half of the output is value added. The most significant regional impact will target the sea transportation industry, insurance services and the maintenance sector.

During the construction phase, a vast amount of economic activity will also come up where over 330 – 1 100 million euros of output will accumulate across Åland industries and a labour demand of nearly 1 997 – 6 739 FTEs. These impacts will primarily target the construction sector and installation services. Additionally, a labour demand of 347 - 522 will come up during the development and planning phase. Across the project's lifetime, over 185 – 383 million euros of taxes will accumulate as a result of activity in Åland, of which over 20 % will be paid to Åland and its municipalities.

Direct impacts from Ilmatar's own activity in Åland will also have significant economic impacts as electricity worth billions of euros will be generated and sold during the project's lifetime. Also, direct employment of 288 - 588 FTEs is expected during the project lifetime.

National jobs and revenue

The Åland offshore wind projects also creates significant economic impacts nationally, as Finland already has many established market actors that can provide products and services for the project. Compared to the regional impacts in Åland, most of the national impacts occur during the construction phase of the project, where Finnish experts can be utilized in the design, permitting, manufacturing of cables, installations and many other activities related to the project.

Across the project lifetime, over 5 600 – 8 800 million euros of output will be generated spread throughout the companies in the rest of Finland as a result of various procurements and multiplicative impacts. At the same time, a labor demand of over 28 000 – 45 000 FTEs will occur cumulatively in the rest of Finland, and 1 300 – 1 800 million euros of taxes will accumulate.

Opportunities and challenges

The economic impacts to come from the project are very large but reflect the current economy. As technology and the market develop, some tasks might become less labour intensive, and the employment impacts smaller. At the same time, new expertise needs to be developed both locally and nationally to serve the project needs and the quickly growing offshore wind market overall. Currently, both Finland and Åland have a massive opportunity to set themselves up strong within the value chains of offshore wind farm projects. After all, the presented significant impacts reflect only the consequences arising from realizing the Stormskär and Väderskär projects. However, to take a place in these value chains does require a forward-looking mindset and development of companies' product and service offerings even before the construction begins.

In Åland, the progression and the regionalization of impacts can be supported by focusing on local capability building and cooperation. It is integral that local expertise exists already during the construction phase but, especially during the wind farm operation phase. This includes both the officials and market actors. Also, new temporary and permanent housing might be needed, and infrastructure to be strengthened towards northern Åland. New stress will target the system as many relocating workers are expected to bring their families. This will bring more local impacts to Åland and a growing need for official services such as education and healthcare. Overall, the key to project and regional success is a transparent and constant dialogue with private companies, such as Ilmatar Offshore, and the regional officials about the project status, needs and potential impacts,

SAMMANFATTNING

Ilmatar Offshore planerar att utveckla, bygga och driva havsbaserad vindkraft i Ålands territorialvatten, cirka 15 kilometer norr om Ålands kust och 45 kilometer utanför Finlands kust. Vindparken består av två separata produktionsområden, Stormskär och Väderskär, med totalt 123 vindkraftverk och en produktionskapacitet på 2460 MW. Om projektet förverkligas ökar det markant produktionen av förnybar energi i de nordiska länderna och bidrar till att mildra klimatförändringarna, samtidigt som det skapar nya värdekedjor som involverar olika på Åland, i övriga Finland och internationellt.

Bedömningsmodell

De regionala ekonomiska effekterna av det planerade projektet bedömdes med Rambolls resursflödesmodell. Modellen är en regionaliserad input-output-baserad modell som möjliggör bedömning av de direkta effekterna och de indirekta effekterna från den produktion och konsumtion som uppstår i värdekedjorna som ett resultat av multiplikativa effekter från projektet. Modelleringen använder aktuella priser (2023) och har utförts på sektorsnivå utan att justera för diskontering. Resultaten analyserades på regional nivå på Åland och spreds över resten av Finland totalt.

Tre scenarier

Rapporten modellerar tre olika scenarier för projektets tre olika faser: utveckling och planering, konstruktion och drift där fler upphandlingar kan göras lokalt om ett starkt fokus läggs på att bygga upp lokal kompetens.

- Scenario A: **"Samordningsprojekt"**, där produkter och tjänster köps in från nuvarande och befintliga marknadsaktörer utan regionalt fokus.
- Scenario B: **"Samarbetsprojekt"**, där marknaden förväntas utvecklas regionalt och nationellt för att kunna tillhandahålla fler produkter som stöder byggandet och driften av havsbaserad vindkraft och tydligt fokus läggs på att utnyttja lokala och nationella resurser.
- Scenario C: **"Samutvecklingsprojekt"**, som bygger på samma grunder som ett samarbetsprojekt men utökar samarbetet till stark lokal kapacitetsuppbyggnad och stödinvesteringar från båda sidor.

Oavsett scenario följer tydliga regionala ekonomiska effekter av projektets genomförande.

Arbetsplatser och intäkter på Åland

På Åland realiseras de flesta effekterna under driftsperioden, där en arbetskraftsefterfrågan på 4 105 – 7 209 heltidsekvivalenter uppstår kumulativt resultat av multiplikativa effekter, beräknat på en 25-årig livslängd för vindkraftsparken. Om vindparken förnyas, en process som kallas "repowering", fortsätter driften och efterfrågan på arbetskraft ökar med 60 procent, även utan hänsyn till ytterligare investeringar och relaterat arbete som behövs. Samtidigt ackumuleras mellan 730 miljoner och 1,14 miljarder i intäkter i åländska industrier under projektets livstid. Ålands årliga BNP förväntas öka med över 1,5 % eftersom nästan hälften av produktionen är förädlad. De största effekterna på Åland syns inom sjöfartsindustrin, försäkringstjänster och underhållssektorn.

En omfattande ekonomisk aktivitet uppstår även under byggfasen, då 330 miljoner – 1,1 miljarder euro i produktion ackumuleras över åländska industrier och det skapas en efterfrågan på arbetskraft på 1 997 - 6 739 heltidsanställda. Dessa effekter är till stor del riktade mot byggsektorn och installationstjänster. Under utvecklings- och planeringsfasen uppstår dessutom ett arbetskraftsbehov på 347 - 522 heltidsanställda. Under projektets livstid förväntas över 185 - 383 miljoner euro i skatter ackumuleras som ett resultat av aktiviteter på Åland, varav över 20 % antas tillfalla Åland och dess kommuner. Detta handlar alltså inte om fastighetsskatter utan om skatt från nya arbetsplatser och den ekonomiska aktivitet som skapas.

Direkta effekter till följd av Ilmatars egen verksamhet på Åland har också betydande ekonomiska effekter eftersom el till ett värde av miljarder euro förväntas genereras och säljas under projektets livstid. Dessutom förväntas en direkt sysselsättning på 288 - 588 heltidsekvivalenter ske under projektets livstid.

Arbetsplatser och intäkter i Finland

De åländska vindkraftsprojekten skapar även omfattande ekonomiska effekter nationellt, eftersom Finland redan har många etablerade marknadsaktörer som kan tillhandahålla produkter och tjänster för projektet. Till skillnad från de regionala effekterna på Åland uppstår de flesta nationella effekterna under projektets konstruktionsfas, där finska experter kan användas vid utformning, tillstånd, tillverkning av kablar, installationer och många andra aktiviteter relaterade till projektet.

Under projektets livstid genereras 5,6 – 8,8 miljarder euro i produktion fördelat på företagen i övriga Finland, som ett resultat av olika upphandlingar och multiplikativa effekter. Till det kommer en arbetskraftsefterfrågan på över 28 000 – 45 000 heltidsekvivalenter som uppstår kumulativt i resten av Finland. Mellan 1,3 och 1,8 miljarder euro i skatter kommer att ackumuleras.

Möjligheter och utmaningar

De ekonomiska effekterna av projektet är mycket stora, men återspeglar den nuvarande ekonomin. Detta innebär att i takt med att tekniken och marknaden utvecklas kan vissa uppgifter bli mindre arbetsintensiva och sysselsättningseffekterna mindre. Samtidigt måste ny expertis utvecklas både lokalt och nationellt för att tillgodose projektbehoven och den snabbt växande marknaden för havsbaserad vindkraft överlag. För närvarande har både Finland och Åland en enorm möjlighet att etablera sig starkt inom värdekedjorna för projekt för havsbaserad vindkraft. Denna rapport återspeglar trots allt endast de effekter som uppstår vid förverkligandet av just Stormskär- och Väderskär-projekten. För att ta plats i värdekedjorna krävs dock ett proaktivt tankesätt och utveckling av företagens produkt- och tjänsteutbud redan innan byggandet börjar.

På Åland kan utvecklingen och regionaliseringen av effekterna stödjas genom att man fokuserar på lokal kapacitetsuppbyggnad och samarbete. Det är viktigt att lokal expertis finns att tillgå redan under byggfasen men särskilt under driften av vindkraftsparken. Detta inkluderar både tjänstemän och marknadsaktörer. Nya tillfälliga och permanenta bostäder kan också behövas och infrastrukturen måste stärkas mot norra Åland. Ytterligare tryck riktas också mot systemet eftersom många av de omlokaliserade arbetstagarna förväntas ta med sig sina familjer. Detta medför fler lokala effekter på Åland, men också ett växande behov av offentliga tjänster som utbildning och hälsovård. Nyckeln till projektets och regionens framgång är en transparent och konstant dialog mellan privata bolag såsom Ilmatar Offshore och de regionala tjänstemännen om projektets status, behov och potentiella effekter, samt öppenhet för nya synergier på båda sidor och över regionala marknader.

TIIVISTELMÄ

Ilmatar Offshore suunnittelee suuren merituulipuiston kehittämistä, rakentamista ja operoimista Ahvenanmaan aluevesille noin 15 kilometrin päähän Ahvenanmaan pohjoisrannikosta ja 45 km päähän Suomen mantereen rannikosta. Suunnitteilla oleva merituulipuisto koostuu kahdesta tuotanto alueesta Stormskäristä ja Väderskäristä, joihin sijoittuisi yhteensä noin 123 tuulimyllyä muodostaen yhteensä 2 460 MW tuotantokapasiteetin. Toteutuessaan projekti tulee kasvattamaan Pohjoismaista uusiutuvan energian tuotantoa, edistää ilmastonmuutoksen hillintää ja luoden samalla uusia monialaisia arvoketjuja Ahvenanmaalla, muualla Suomessa ja kansainvälisesti.

Mallinnustyökalu

Hankkeesta seuraavat aluetaloudelliset vaikutukset arvioitiin Rambollin resurssivirtamallilla, joka on alueellistettu panostuotos malli. Malliilla voidaan arvioida sekä hankkeesta seuraavia suoria ja epävasuoria vaikutuksia koko arvoketjun tasolla, joita syntyy tuotannon ja kulutuksen kerrannaisvaikutusten seurauksena. Mallinnus toteutettiin käypiin hintoihin toimialatasolla, eikä tuloksia diskontattu. Mallinnuksen tuloksia arvioitiin Ahvenanmaan ja muun Suomen tasolla.

Kolme skenaariota

Mallinnus tehtiin kolmelle eri projektin vaiheelle: suunnittelu ja kehitys-, rakentamis- ja operointivaiheelle, joissa paikallisesti voitaisiin tehdä enemmän hankintoja, jos vahva painopiste asetettaisiin osaamisen kehittämiseen.

- Skenaario A: **Koordinointiprojekti**, missä tuotteita ja palveluita hankitaan nykyisiltä olemassa olevilta yrityksiltä ilman alueellista painotusta.
- Skenaario B: **Yhteistyöprojekti**, missä markkinoiden odotetaan alueellisesti ja kansallisesti kehittyvän, jolloin niiltä voidaan ja tullaan hankkimaan enemmän tuotteita ja palveluita merituulipuiston rakentamiseen ja operoinnin aikana.
- Skenaario C: **Yhteiskehittämisprojekti**, joka perustuu samoihin perustuksiin kuin yhteistyöprojekti, mutta laajentaa osapuolten välistä yhteistyötä vahvaan paikallisen osaamisen yhteiskehittämiseen ja molemminpuolisiin alueellisiin investointeihin.

Tarkasteltavasta skenaariosta riippumatta hankkeesta seuraa selkeitä aluetaloudellisia vaikutuksia.

Työpaikat ja liikevaihto Ahvenanmaalle

Ahvenanmaalla eniten vaikutuksia tulee syntymään operointivaiheen aikana, jolloin työvoiman kysyntää syntyy yhteensä 4 105 – 7 209 htv edestä kumulatiivisesti kerrannaisvaikutusten seurauksena 25-vuotta kestävän operointivaiheen aikana. Mikäli merituulipuisto voimaannutetaan uudelleen (repower), tulee tuotanto jatkumaan, ja operointivaiheesta seuraavat kumulatiiviset työllisyysvaikutukset kasvamaan noin 60 % ottamatta huomioon toimenpiteen edellyttämiä lisäinvestointeja ja näistä seuraavia kerrannaisvaikutuksia. Toiminnan aikana syntyy kumulatiivisesti yhteensä yli 730 – 1 140 miljoonan euron edestä uutta liikevaihtoa alueella toimiville yrityksille ja Ahvenmaan vuosittaisen BKT arvioidaan kasvavan yli 1,5 % tämän seurauksena, sillä noin puolet syntyvästä liikevaihdosta on arvonlisäystä. Ahvenanmaan toimialoista suurimmat aluetaloudelliset vaikutukset kohdistuvat operointivaiheen aikana vesiliikenteen toimialalle, vakuutuspalveluihin sekä huoltotoimintaa tarjoaville yrityksille.

Ahvenanmaalle syntyy suuri määrä taloudellisia vaikutuksia myös rakentamisvaiheen aikana, jolloin uutta liikevaihtoa syntyy alueen toimialoilla kumulatiivisesti yhteensä yli 330 – 1 100 miljoonan euron edestä. Samalla alueella syntyy kumulatiivisesti työvoiman kysyntää 1 997 – 6 739 htv edestä. Rakentamisvaiheen vaikutukset kohdistuvat suurissa määrin rakentamisen toimialalle sekä asennuspalveluita tarjoaville toimijoille. Lisäksi suunnittelu- ja kehitysvaiheen aikana syntyy työvoiman kysyntää kumulatiivisesti 347 – 522 htv edestä. Projektin elinkaaren aikana kerrannaisvaikutusten seurauksena veroja kertyy Ahvenmaalla syntyvän toiminnan seurauksena yli 185 – 383 miljoonan euron edestä, joista yli 20 % maksetaan Ahvenanmaalle ja alueen kunnille.

Ilmattaren toiminnasta Ahvenanmaalla seuraa myös suuria suoria taloudellisia vaikutuksia, sillä merituulivoimapuistossa tullaan tuottamaan sen toiminnan aikana miljardien eurojen edestä myytävää sähköä. Toiminnan seurauksena syntyy kumulatiivisesti myös yhteensä noin 288 – 588 htv edestä uutta työvoiman kysyntää.

Työpaikat ja liikevaihto Suomeen

Ahvenanmaan merituulivoimaprojektista syntyy myös suuria kansallisia vaikutuksia, sillä Suomessa toimii jo useita yrityksiä, jotka voivat tarjota tuotteitaan ja palveluitaan projektin tarpeisiin. Ahvenanmaalle kohdistuvista vaikutuksista poiketen, suurimmat kansalliset vaikutukset syntyvät rakentamisen aikana, jolloin suomalaiset yritykset ja asiantuntijat tarjoavat projektille suunnittelu- ja asennuspalveluita sekä tuottavat kaapeleita ja muita hankkeen toteuttamiseksi tarvittavia tuotteita ja palveluita.

Projektin elinkaaren aikana kumulatiivisesti yli 5 600 – 8 800 miljoonan euron edestä uutta liikevaihtoa muodostuu muualla Suomessa toimivissa yrityksissä, johtuen projektin aikana tehtävistä hankinnoista ja kerrannaisvaikutusten seurauksena. Samalla työvoiman kysyntää syntyy yli 28 000 – 45 000 htv edestä ja muualla Suomessa tapahtuvan toiminnan seurauksen veroja tulee kertymään noin 1,3 – 1,8 miljardin euron edestä.

Mahdollisuudet ja haasteet

Hankkeen toteutumisesta seuraavat taloudelliset vaikutukset ovat erittäin suuria, mutta peilaavat nykyisiä talouden rakenteita. Tämä merkitsee sitä, että teknologian ja markkinoiden kehittyessä jotkut tehtävät saattavat muuttua vähemmän työvoimaintensiivisiksi ja työllisyysvaikutukset samalla pienemmiksi. Samaan aikaan uutta osaamista on kehitettävä sekä paikallisesti että kansallisesti, jotta voidaan palvella sekä projektin tarpeita että nopeasti kasvavia merituulivoimamarkkinoita yleisesti. Tällä hetkellä sekä Suomella että Ahvenanmaalla on erinomainen mahdollisuus vahvistaa asemaansa tulevien merituulivoimahankkeiden arvoketjuissa. Loppujen lopuksi esitetyt suuret vaikutukset heijastavat vain Stormskär ja Väderskär -hankkeen toteutumisesta seuraavia vaikutuksia. Vaikutusten realisoituminen edellyttää kuitenkin tulevaisuuteen suuntautuneen ajattelutavan omaksumista ja yritysten tuote- ja palveluvalikoiman kehittämistä jo ennen rakentamisen aloittamista.

Ahvenanmaalla vaikutusten realisoitumista voidaan edesauttaa yhteistyöllä ja panostamalla alueellisen osaamisen kasvattamiseen. On tärkeää, että alueellista osaamista on saatavilla jo rakentamisen vaiheessa, mutta sitäkin tärkeämpää, että sitä on saatavilla operointivaiheen aikana. Sekä Ahvenanmaan viranomaisten että alueella toimivien yritysten on panostettava tähän ja käytävä vuoropuhelua. Lisäksi uusia väliaikaisia ja pysyviä asuntoja saatetaan tarvita rakentamisen ja operoinnin aikana ja alueen infrastruktuuria on vahvistettava etenkin Ahvenanmaan pohjoisrannikolla. Systeemiin tulee kohdistumaan myös uutta painetta, sillä osan alueelle muuttavien henkilöiden odotetaan tuovan mukanaan heidän perheensä. Tästä seuraa yhä enemmän vaikutuksia alueelle, mutta samalla se edellyttää viranomaispalveluiden resursoinnin lisäämistä mm. koulutuksessa ja terveydenhuollon palveluissa. Avain hankkeen kokonaisvaltaiseen onnistumiseen ja merkittäviin alueellisiin vaikutuksiin on jatkuva ja avoin vuoropuhelu yksityisten yritysten, kuten Ilmattaren, ja Ahvenanmaan viranomaisten välillä hankkeen tilanteesta, tarpeista ja mahdollisista vaikutuksista, samoin kuin avoimuus uusille synergioille molemminpuolisesti ja laajemmin alueellisilla markkinoilla.

CONTENTS

1. BACKGROUND AND OBJECTIVE

1.1 Background

Ilmatar Offshore Ab (Ilmatar Offshore) plans to develop, build and operate a large offshore wind farm in territorial waters of Åland Islands approximately 15 kilometers north of the coast of Åland, 45 km off the coast of Finland and 60 km off the coast of Sweden. The offshore wind farm is spread on two distinct production areas by the name of Stormskär and Väderskär that are situated close to one and other.

Stormskär area covers around 475 km² and Väderskär area around 96 km². The planned offshore wind farm comprises of 123 windmills, with a maximum height of 400 meters and individual capacity of 20 MW. The total capacity of the offshore wind farm's power generation used in the assessment is 2 460 MW.

If realized, the project will increase renewable energy production in the Nordic countries and contributes to mitigating climate change, while also creating new cross-sector value chains in Åland, rest of Finland and internationally. It will have significant economic effects locally, regionally and nationally. To understand these effects, an assessment of regional economic impacts was conducted for the project. This assessment utilizes an input-output based resource flow modeling approach, which is a modeling method that allows for the examination of multiplicative impacts arising from the project as a result of increased demand in many sectors.

1.2 Objective

The objective of this assessment is to estimate and examine the diverse economic impacts brought about by the offshore wind farm development in the territorial waters of Åland by Ilmatar Offshore Ab. The assessment covers various regional economic impacts brought by the offshore wind farm project during the development and planning, construction and operational phases.

The direct regional economic impacts of the planned project are assessed as well as the impacts due to production and consumption multiplicative effects. The results of modeling show the impacts on output, value added, and investments at sectoral level as well as the resulting changes in labor demand and tax impacts. The impacts are examined and analyzed both at the regional level of Åland and spread throughout the rest of Finland in total.

2. APPROACH

2.1 Methodology for calculating regional economic impacts

The approach to assess the regional economic impacts is based on the resource flow model that was developed through collaboration between Ramboll Finland and Luke (Natural Resources Institute Finland) under the commission of SITRA (The Finnish Innovation Fund) during 2013-2015 (Hokkanen et al., 2015).

The resource flow model is a regionalized environmentally extended input-output model (EEIO). The model was developed based on input-output analysis and illustrates how monetary and material resources flow into regional production, inter-sectoral intermediate use, private and public consumption, and exports from the region. The resource flow model has been tested and utilized in numerous cases. It has also been presented to the international scientific community in Davos, Switzerland (World Resource Forum 2015), and published in scientific journal (Hokkanen et al., 2017).

Input-output models are typically used to analyze the interdependencies between the economy and its sectors. The models of linear systems of equations that describe the distribution of sector inputs and outputs in the economy. Typically, the impacts are modeled by presenting changes in demand or supply. Most commonly, modeling is conducted from a demand perspective.

Mathematics behind input-output analysis were developed already in 1930s and the early contributor behind the analysis, Wassily Leontief, was awarded a Nobel Prize in Economics for the work in 1973. Input-output analysis and its applications continue to be used in impact assessments worldwide to examine the diverse effects in economy that by e.g., new investments, legislative changes and tax reforms cause. In recent decades, the significant increase in computing power has enabled to expand the scope of analysis and increased utilization of the method.

The resource flow model used for this assessment is continuously developed, updated and tested by Ramboll to allow for the analysis of multiple impacts at various regional levels. The model is maintained up-to-date with the latest available statistics (e.g., Association of Finnish Municipalities, 2023; Statistics Finland, 2023; Tulli, 2023; Vero, 2023) to accurately reflect the current structure of the economy and inter-industry dependencies.

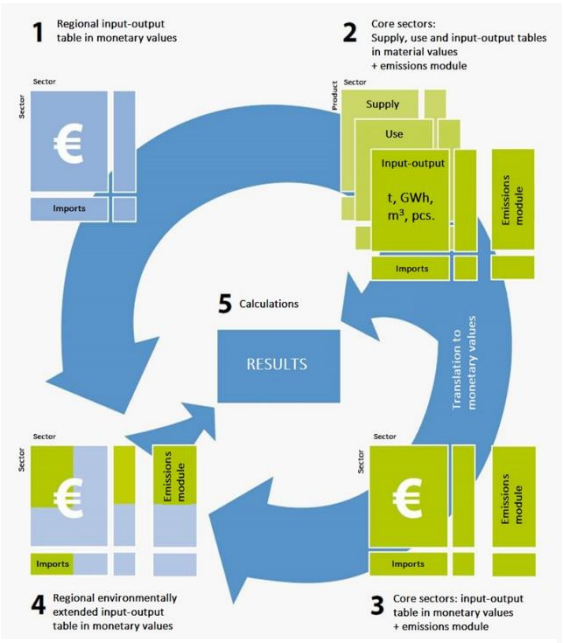

Figure 2-1. Illustration of the Formation of Regional Resource Flow Model

First the modelling focuses on describing the current socio-economic and regional economic status in the region (in this case Åland) and identifying the inter-industry relationships on which the assessment of economic impacts is based on. Therefore, an up-to-date regional input-output table is created based on the region's resource flows. Necessary changes are made to the model, including updating the employment, regional imports and exports, public procurement and data related to use of products (figure 2-1). This is followed by constructing assessment scenarios, including them as inputs into the model.

The resource flow model provides visibility to all resource flows during the project development, construction and operation phases, including resource flows related to production, services, and consumption. The model can also depict the significance of different industries and actors within the region.

The model is multidimensional, and both direct and indirect (as a result of multiplicative effects) linkages between industries and companies can be identified and taken into account with it. This includes capturing all multiplicative impacts (production and consumption) that arise from the interaction between two companies/actors that affect other companies and industries throughout the entire value chain. Multiplicative effects arise when a company needs to procure products and services from other companies in order to produce its own output (product/service). These other companies, in turn, need to procure

products and services to produce their own output (product/service) and so forth, creating a chain of dependencies involving multiple actors. At the same time, companies pay wages and salaries to their employees, a significant portion of which circulates back into the economy through consumption, leading to product and service purchases, thus initiating a similar chain of effects (figure 2-2).

The modeling is carried out in two stages, where the current state is first modeled, followed by scenario modelling (changes in the economy, demand). The current state illustrates the direct and indirect effects of the area's organizations on the economy: the turnover, value added, employment, wage compensation, new investments and taxes. After the current state analysis, the impacts of the scenarios on the economy are assessed, using the same variables to describe the impacts. Based on these impacts, it is possible to calculate the impacts on a limited set of other variables, such as gross domestic product. By comparing the difference between the current state and the scenario state, the magnitude of the assessed change is revealed (figure 2-3).

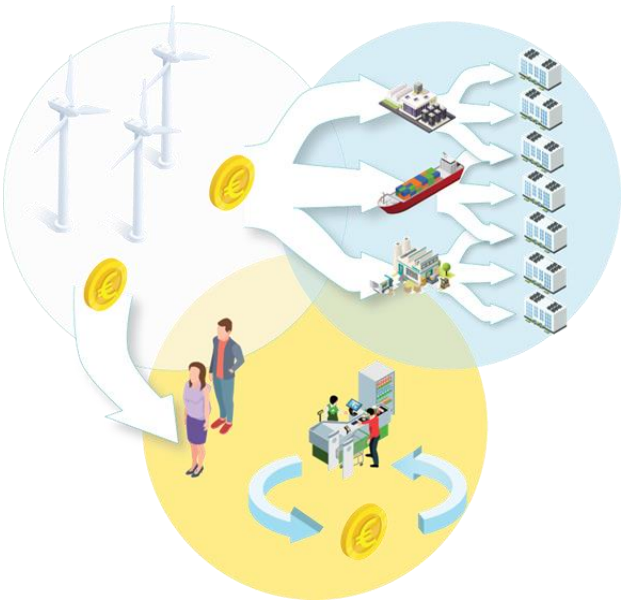

Figure 2-2. Descriptive image of multiplicative impacts from production and consumption; purchases throughout the value chain generate additional demand for products and services

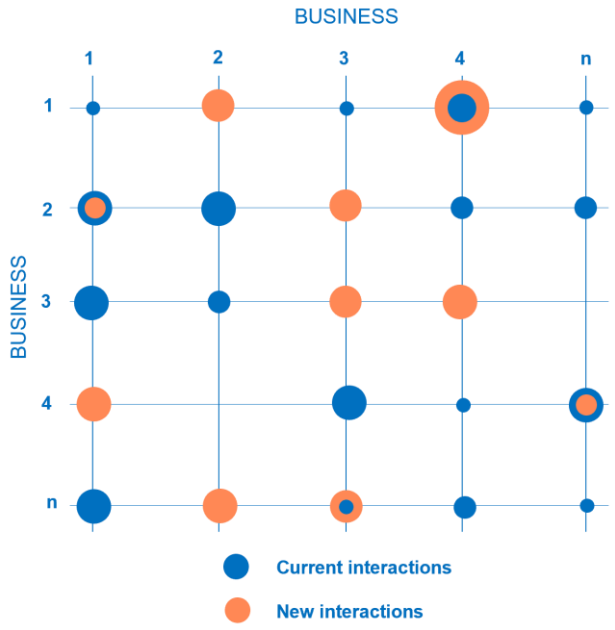

Figure 2-3. Basic element of the Resource Flow Model, where an empty node represents: no interaction between sectors. The size of the ball represents the magnitude of

The required input data for the model has been compiled mainly from publicly available sources. The modeling is conducted at current prices (2023) and at sectoral level and the results have not been discounted. Some of the effects will generate entirely new activity and labor demand, while others will be directed towards existing operations leading to expansion, development or upkeep of the actors' operation. The new market actors may also "capture" a portion of the products and services currently acquired by other market actors (e.g., current export products being redirected for further processing domestically) if they offer more competitive prices for products and services than existing market players. At the same time, the new activity may take market share of other players if supply ends up exceeding the market demand and new high-quality products/services are produced at a more competitive price. These negative effects have not been directly accounted for in the modeling process.

By examining the results of the modeling in detail, one can both analyze the magnitude of the impacts that the project has on the economy and use them to understand what kind of services and activities are needed in the area in future to match the demand. However, when reviewing the results, it is important to understand the uncertainties, limitations, and constraints associated with the modeling process, as well as the assumptions made in the assessed scenarios.

2.2 Abbreviations

In the interpretation of results and use of Resource Flow Model, the key terms are as follows:

Direct impacts = The direct impacts were assessed mainly for the operational period, where the impacts result from the immediate activities of the offshore wind farm. These include impacts such as generated turnover from the sale of electricity, employment, gross value added as well as taxes and tax-like payments resulting from the activities, including taxes withheld from employee wages and other tax-related charges.

Multiplicative impacts from production = The production multiplicative impacts are impacts on other industries that result from the project development, construction and operation of the offshore wind farm. In practice, this means that in order to establish and maintain wind farm operations, goods, services, and raw materials are required in the upstream value chain, creating new demand for other industries.

Multiplicative impacts from consumption = The consumption multiplicative impacts describe the new consumption arising from increased wage compensation as new economic activity is required to satisfy it. The consumption multiplicative effects are taken into account at both regional and national levels.

Full-time equivalent = In the assessment, employment refers to gross employment, which is measured in full-time equivalents (FTE). This means that, for example, two half-time workers or two workers employed for half-year are counted as one full person-year. Full-time equivalents can be further calculated to obtain average employment (number of jobs) by dividing number of FTEs with the duration of the life cycle phase under consideration. In the assessment, FTEs are referred as both as cumulative number of FTEs accumulated during lifecycle phases and as yearly averages by lifecycle phase. The assessment does not take a stance on whether the labor demand (employment) is met to what extent by existing jobs and to what extent by new jobs.

Value added = Value added refers to the value created by a unit participating in production. In market production, it is calculated by subtracting the intermediate inputs (goods and services) used in production from the unit's output. In non-market production, it is calculated by summing up compensation of employees, consumption of fixed capital and any production and import taxes. Value added represents the portion of a company's production on which value-added tax is paid.

Output = Output represents the monetary value that businesses in the examined area have received from selling their products or services. In national accounting, the total value of production is referred to as output or while in business accounting, the equivalent term is revenue or turnover. For clarity, this report will also use both the term revenue and turnover to refer to output.

Taxes

1) Taxes on products and production, which are paid to the state,
2) municipal tax, which are paid to the municipalities where the employees reside,
3) value added tax, which are paid to the state,
4) corporation tax, of which approximately 1/4 are paid to the municipalities and 3/4 to the state in mainland Finland,
5) real Estate tax, which are paid to the municipalities where the properties are located, and
6) income tax, which are paid to the state.

In terms of taxes, the modeling results account for the taxes to be paid due to increased activity that the project causes.

Taxes on products and production = Product and production taxes consist of compulsory, non-reciprocal payments, either in monetary or in-kind form, paid for production, importation of goods and services, use of labor, ownership or use of land, buildings, or other assets used in production. These taxes must be paid regardless of whether the activity is profitable or not.

Municipal tax = Municipal tax is levied on the earned income of the taxpayer. The taxpayer pays municipal tax to the municipality that was their municipality of residence on the last day of the year preceding the tax year. Municipal tax varies from municipality to municipality. The municipal tax rates are fixed for year 2024 and vary between 4,40-10,80 in mainland Finland and between 16,50-19,70 in Åland.

Value added tax = Value Added Tax (VAT) is a consumption tax that is levied on the buyer every time a good or service is sold. The seller adds the VAT to the price of the goods or services and remits the VAT collected from their sales to the state.

Corporation tax = Corporation tax refers to the tax imposed on a company's profits. The revenue from corporation tax is divided between the state and municipalities, with the state's share being approximately three-fourths and the municipalities' share being approximately one-fourth in mainland Finland.

Real estate tax = Property tax (or real estate tax) is a tax based on the value of land and buildings, which is paid to the municipality where the property is located (though it goes through the Tax Administration). The property tax rate is determined by the municipality.

The windfarm tax rates were calculated according to the current legislation and taxation (2023). The taxation is calculated based on the reacquisition value of the property tax base, taking into account annual depreciation of 2,5%. The property tax base consists of part of the construction costs, and the minimum taxable value after depreciation is 40%. Property tax is paid according to the municipality's general property tax rate which varies by municipality. For sources other than wind farms, property tax was y calculated based on the property tax paid and the net fixed capital stock by industry.

Income tax = Income tax refers to the taxes levied by the state on individuals' earned income and capital gains.

2.3 Uncertainties in the assessment

Assessing impacts and predicting the future always involves uncertainties. In this assessment, the key uncertainties are related to the realization of investments, input data, as well as technological developments and regional business environment developments in the future. The main uncertainties in the assessment are as follows.

1. Degree of domesticity

The main uncertainties of the assessment are related to the degree of domesticity, as the procurements will be subject to competitive tendering. The degree of domestic content will depend on the availability of domestic and local expertise and products, as well as how competitive the prices offered by different actors are. Therefore, the preliminary degree of domesticity will only be known when the first contracts for the construction and operation are made as currently confirmed and preliminary data were only available of project development (phase 1) costs. At that point, the key to the realization of the estimated economic impacts is in how the competence centers, clusters and singular companies operating in Åland, and different regions can adapt and develop their operation to offer competitive products and services when the construction begins to realize.

It is also crucial that local companies respond to the changing demand during the operation phase of the wind farm and are able to develop their operations in the right direction in a timely manner. Now the regional distributions of particular investments are derived from the degree of domesticity that accounts the availability of different services and products in Finland and Åland, as well as how much of Finnish and regional expertise and components may be within the main categories. Based on these considerations, the allocation of procurement between Åland and the rest of Finland was assessed, taking into account the concentration of expertise in different regions, current socio-economic situations and inter-industry relationships.

2. Electricity price

Wind turbines generate a significant amount of electricity, and therefore the price of electricity has a major impact on the profitability and direct economic impacts of the operation. The unit price of electricity used in the assessment was approximated at 45-55 €/MWh based on a mix of wholesale and capture price. The price is in line with many recent forecasts of long-term electricity price trends. The electricity price is expected to remain high in the coming years but decline towards start of the next decade. The estimated price is clearly lower than the electricity price level in Finland during recent years (average of 115 €/MWh in 2022-8/2023) but higher than the price trend observed in years previous to this (average

of 42 €/MWh in 2010-2021) and slightly higher than long-term electricity price forecasts from a couple of years ago (e.g., Sitra, 2021; TEM, 2019). In the future, the day-to-day price of electricity is expected to vary significantly.

3. Investment realization

The assessed investments are to be done in the future and are still in the planning phase as the impact assessments progress. As a result, there were no precise calculations or production plans available of the specific equipment, components, and services to be used as input data for the evaluation. Uncertainties and gaps in the input data were supplemented using literature, research data, expert assessments, as well as information from other operational and publicly available large-scale offshore wind projects. Multiple investment options and scenarios have been created by Ilmatar for the assessed projects, involving different choices and costs. This assessment utilized a combination of the two most probable options. However, since the investments are still in the pre-development phase, it is possible that the projects and related investments may not actualize to the extent or at all as assessed in this assessment.

4. Negative impacts

Possible adverse effects that the project as a whole may have on other industries or activities and the economy are not evaluated. However, in reality the project may have direct or indirect negative impacts on other activities. For example, some maritime routes might need to be rerouted and the project ties up a significant number of local resources in the construction phase, which cannot be used extensively on other projects during that time. However, these effects are clearly smaller than the positive impacts resulting from the project in the assessment context.

5. Property tax rates and seabed leases

Property tax and other fees make up a large portion of direct positive income to the public administration. The windfarm tax rates were calculated according to the current legislation, taxation practices and property tax rates (2023) but can change if new legislation is introduced. Many uncertainties on future property tax rates on wind farm exist as the tax rate can be set at a maximum of 3,10 percent but is currently significantly lower than this. A value of approximately 1,0 % was used in this study.

Additional costs that may generate positive income to the region include seabed leases and other fees to the public administration. These payments can vary significantly by country and area, ranging from tens of millions to hundreds of millions of euros in total for a wind park of this size. An approach used in study *Offshore wind roadmap for Åland* was utilized to determine the potential income from seabed lease to Åland in this assessment. The approach bases on high-level assumptions and evaluates the seabed lease amount as 2 % of the windfarm revenue with 40 €/MWh as revenue basis for the sale of electricity.

6. Repowering

The impacts of repowering were assessed as continuation of operational phase. In reality repowering needs additional investments in form of component replacements, installations etc. which generate additional impacts that have not been assessed. It also impacts part of the operating period as windmills need to be stopped for repowering works. Other end-of-life options for the wind firm also exist, such as new use or decommissioning which might become reality either right after the 25-year operating period or after repowered production ends.

7. Technological advancements in the future

The methodology used in this evaluation is commonly used and is based on scientifically validated calculation methods and techniques. The approach relies on actual interaction patterns and current economic structures, which introduces uncertainties as the investments may lead in changes in sectoral interaction patterns among various actor-entities due to technological or other advancements.

Technological disruptions can also have an impact on the products and services procured. The assessments and estimations regarding the origin of products, equipment, and services used in the scenarios are based on regional and the current offerings of technology suppliers. As technology evolves, new technologies may become more favorable alternatives for wind farms and turbines than the current options. The introduction of new technology would affect the geographical distribution of procurement and further the multiplicative impacts as the value chains associated with the new technology is likely to differ from the current scenarios.

8. The development of the business environment resulting from the operation

Currently the business environment of offshore wind sector is rapidly developing and growing. Several offshore wind power projects are planned for the Baltic Sea, bringing versatile economic impacts to Finland. However, at present, the major procurements for offshore wind farms are likely to be sourced from abroad, as assessed in this evaluation.

9. Windfarm lifespan

The lifespan of wind turbines varies depending on the specific case and location. Currently, the average lifespan of operational offshore wind turbines using current technology is estimated to be around 20-25 years. For the purposes of this assessment, a value of 25 years was used to represent the base lifespan of offshore wind turbines, although the actual lifespan may increase with technological advancements. A total 40-year production timespan was used to estimate impacts of repowering the wind farm. If the operational period of wind turbines significantly deviates from presented values, the estimated overall impacts throughout the lifespan will be affected. However, the annual operating costs and the average amount of electricity generated generally remain fairly consistent.

3. ASSESSMENT SCOPE AND AREA

3.1 The offshore wind farm

Ilmatar Offshore Ab (Ilmatar) plans to develop, build and operate large offshore wind farm in territorial waters of Åland Islands that increases renewable energy production in the Nordic countries and contributes to mitigating climate change, while also creating new cross-sector value chains in Åland, rest of Finland and internationally. The offshore wind farm consists of two distinct areas situated approximately 15 kilometers north of the coast of Åland, 45 km of the coast of Finland and 60 km of the coast of Sweden. Smaller of the two project areas Väderskär takes up surface area of around 96 km² and the larger of the two Stormskär surface area of around 475 km² (figure 3-1).

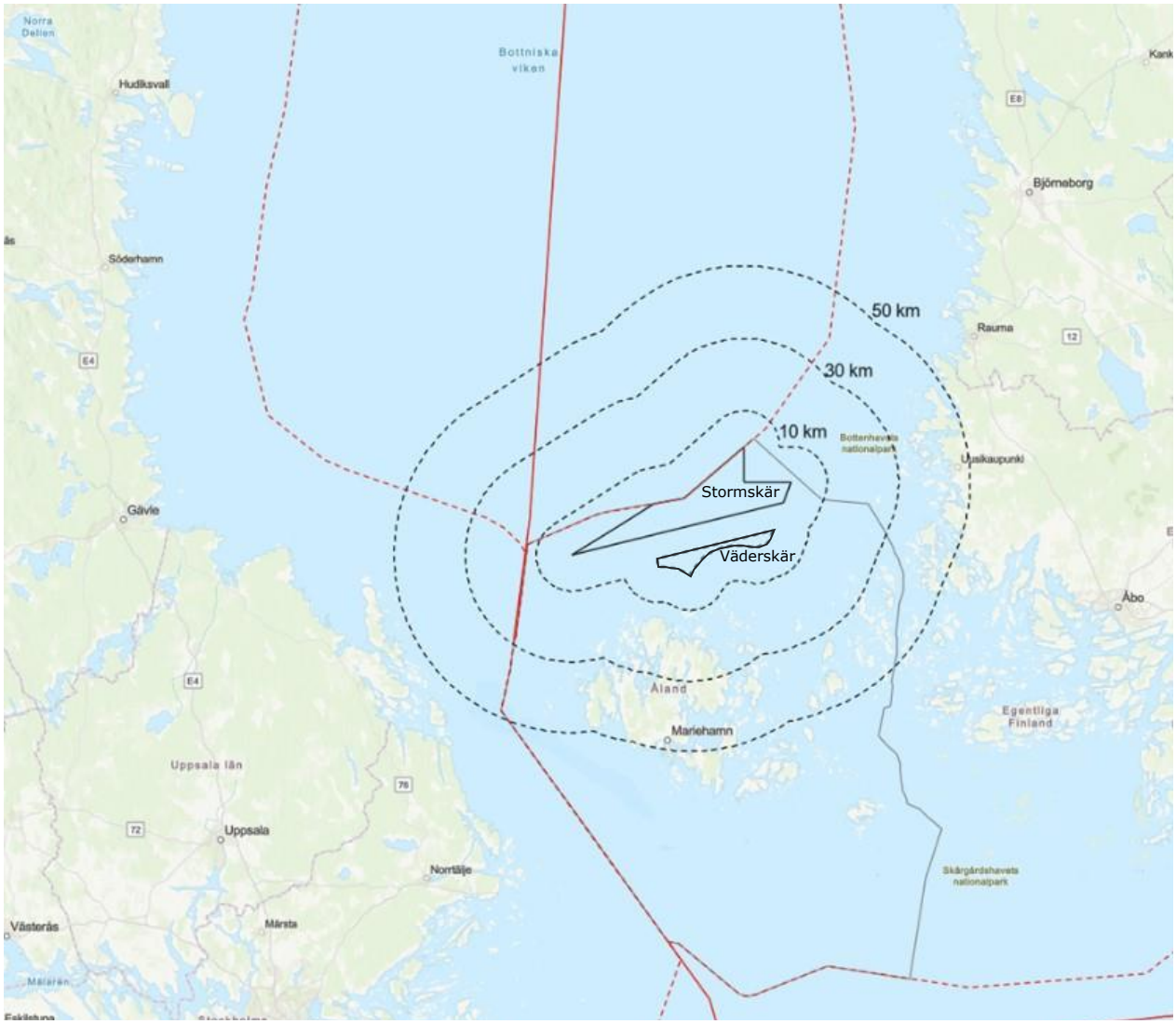

Figure 3-1. The location of the project area with distances. The red line with dashes represents the boundaries of territorial waters and the red line without dashes the boundaries of EEZ.

The estimated wind farm consists of 123 production units (windmills) with unit capacity of 20 MW making up the total capacity of 2 460 MW. One hundred of the windmills are to be located in Stormskär area and the rest (23 units) in Väderskär area (figure 3-2). On average the units are expected to produce yearly around 4 GWh of electricity per MW with life span of around 25 years if not repowered.

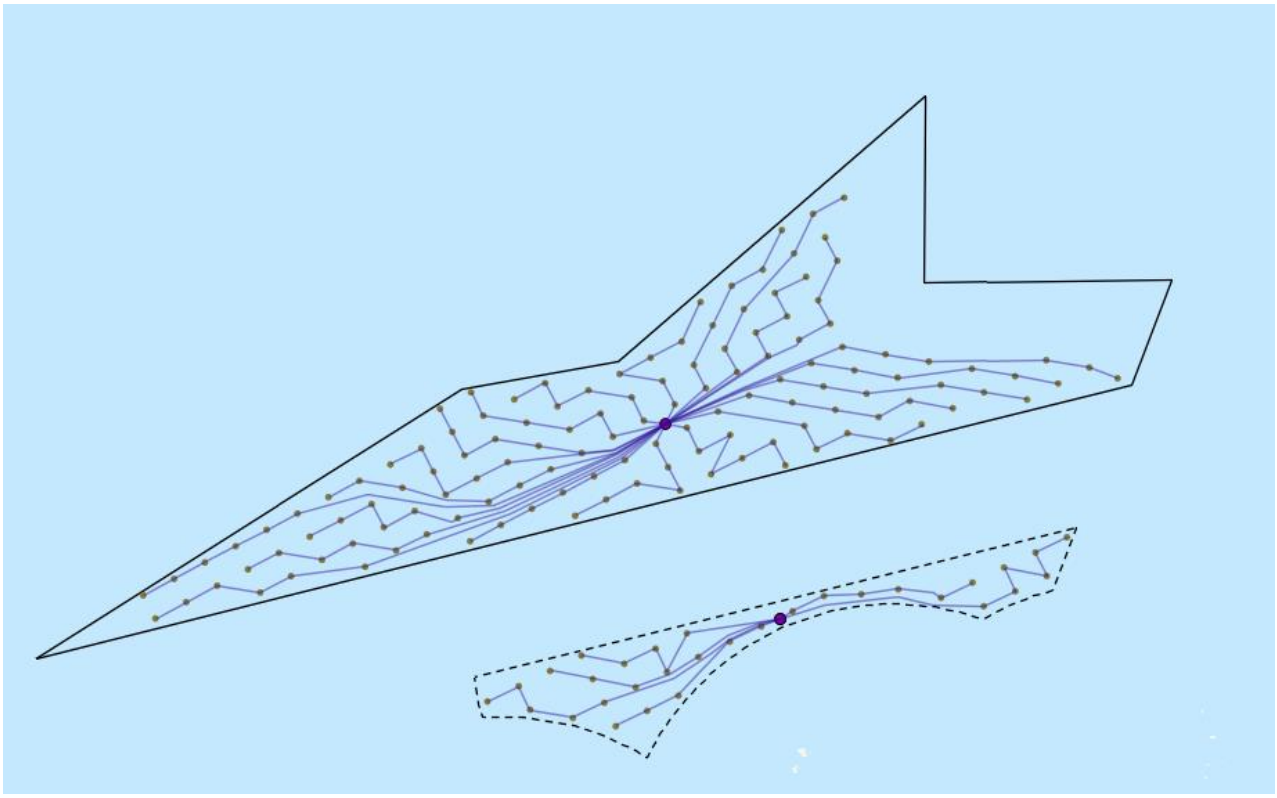

Figure 3-2. Illustrative visual of windmills (small dots), converter stations (large dots) and the cable network within the project area. The number of windmills and cable connections in the visual is fewer than the number used in the economic impact assessment.

Various equipment, such as transformer stations and internal cable networks, will also be installed in the wind farm area. The wind farm will be connected by transmission cables to grid network and substations are planned to be constructed both on- and offshore. The technology to be used in windmills and supporting infrastructure will be decided later as the technical planning advances and first contracts are made.

3.2 Scope of the assessment

The assessment covers evaluation of positive direct and indirect economic impacts that arise from the wind farm project. This includes both the windmills and ancillary support functions such as cables, substations and operational base. The indirect impacts include multiplicative impacts arising from both production and consumption activities connected to the project. Possible negative economic impacts that the project may have not been assessed. Possible adverse effects that the project as a whole may have on other industries or activities and the economy are not quantitatively evaluated.

The background data for the evaluation and assessed scenarios is gathered from the investment and technical plans and other relevant material of the wind farm project obtained from Ilmatar. Additional data for the evaluation was gathered from academic research (e.g., Stehly & Duffy, 2021; Tacx, 2021; Ibrahim et al., 2022), publicly available reports, legislation and statistics databases (e.g., Statistics Finland, 2023; Åsub, 2023). Building of the final investment scenarios was done in close co-operation with Ilmatar.

The estimated size of the investment is nearly 10 billion euros at today's prices excluding the operation & maintenance costs and possible repowering costs. However, fluctuation in the market can have impact on the final costs as we have recently seen significant rise in construction costs and in the price of many critical materials. On the other hand, some prices may decrease as construction of offshore wind farms becomes more common globally. However, as the conditions in the Baltic Sea are very unique and different to those of e.g., Atlantic Ocean not all solutions are applicable to be utilized there. The operation, maintenance and other yearly needed services of keeping up the wind farm operation is expected to cost around 100-150 million euros per annum on average including all product and service acquisitions as well as employee compensation. The real cost fluctuates annually. Investments related to potential repowering of the wind farm has not been estimated. The wind farm is expected to produce on average nearly 10

TWh of electricity annually that was expected to be sold with price of 45-55 €/MWh on average. The sale of electricity is expected to be a mix of wholesale and capture price.

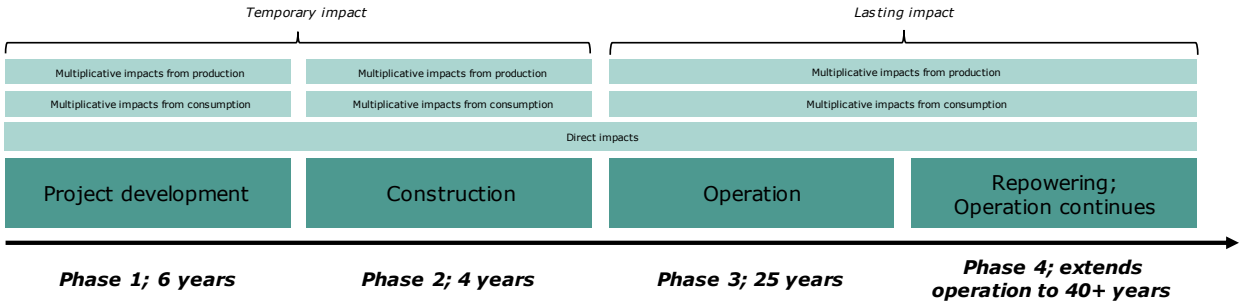

Figure 3-3. The timeline of the wind farm project and the level of analysis

The analysis of regional economic impacts covers the impacts arising from the project development, construction, operation and potential repowering of the offshore wind farm. The expected operational lifetime of the offshore wind farm is approximately 25 years, which reflects to the project's lifetime impacts. The windfarm can possibly be repowered when it nears the end of estimated operational lifetime in order to continue the operation by many years, up to 40+ years of total lifetime (figure 3-3). In reality the lifespan of the windfarm production might be even longer or shorter depending on the operational conditions, maintenance and major component replacements.

The wind farm is a major investment to the region and though the wind farm is to be built in the territorial waters of Åland the multiplicative (or ripple) effects will have a clear impact on both the Finnish and Åland Economy which are both analyzed. Additionally, the wind farm will have international economic impacts but the assessment of those is left outside of the evaluation scope. The impacts are evaluated through three project scenarios described as: "coordination project," "co-operation project," and "co-development." In each scenario more impacts are encountered as collaborative efforts made by both the region and the investor increase.

3.3 Socioeconomic situation of Åland

Åland is the only autonomous region of Finland. The demilitarized Åland islands are situated in archipelago in the Baltic Sea. Over 30 000 inhabitants live in Åland most of which live in the capital city of the region Marienhamn (39 % of inhabitants). Around 7 % of the inhabitants live in the archipelago and rest live in the rural district. The biggest municipalities of the rural district by population are Jomala, Finström and Lemland. Most of the population are aged 15-64 (60 %) though the share of those aged over 65 has seen clear rise in last 20 years. Currently the over 65-year-olds make up around 24 % of the population and those aged 0 to 14 make up around 16 % of the population. (Åsub, 2023)

The biggest industries of Åland by employed persons are public services, trade, transportation and storage, construction and the manufacturing industry. The size of the primary industry is also quite large in the region with nearly 500 persons employed in 2020. Figure 3-4 displays employed persons by industry in Åland (2020).

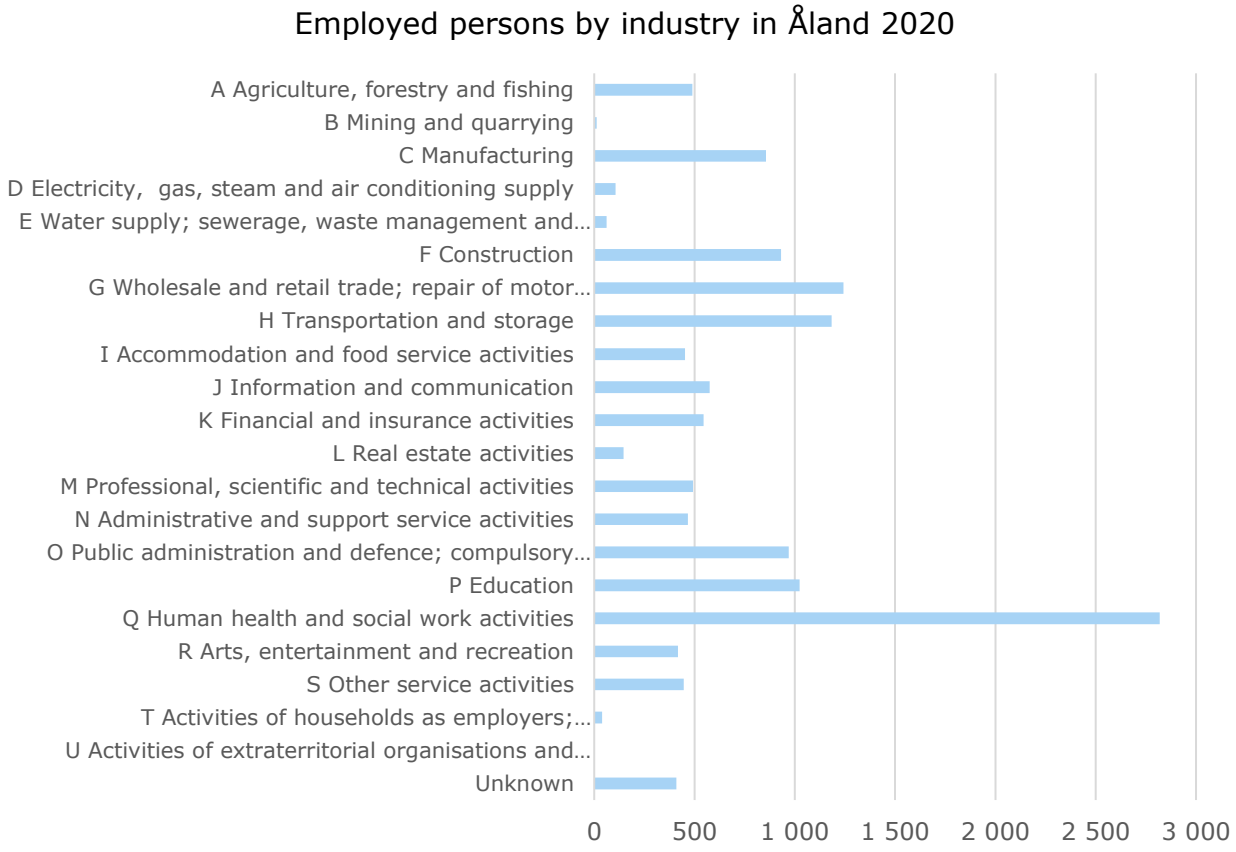

Figure 3-4. Employed persons in Åland by 22 industry groups (Åsub. 2023)

The total output of Åland was 2,1 billion euros in year 2020 of which value added made up nearly half of. Around 4 % of the total output was generated in the primary industry, 14-15 % in the manufacturing industry, around 10 % in the construction industry and over 71 % in the service industry (Statistics Finland, 2023). The gross fixed capital formation (GFCF) of Åland was around 294 million euros consisting mostly of buildings and structures (69 % of GFCF). Machinery equipment and transport equipment made up around 22 % of GFCF and the rest 9 %. The GFCF of Åland has been fluctuating around 250-340 million euros in recent years (2016-2020) as figure 3-5 displays.

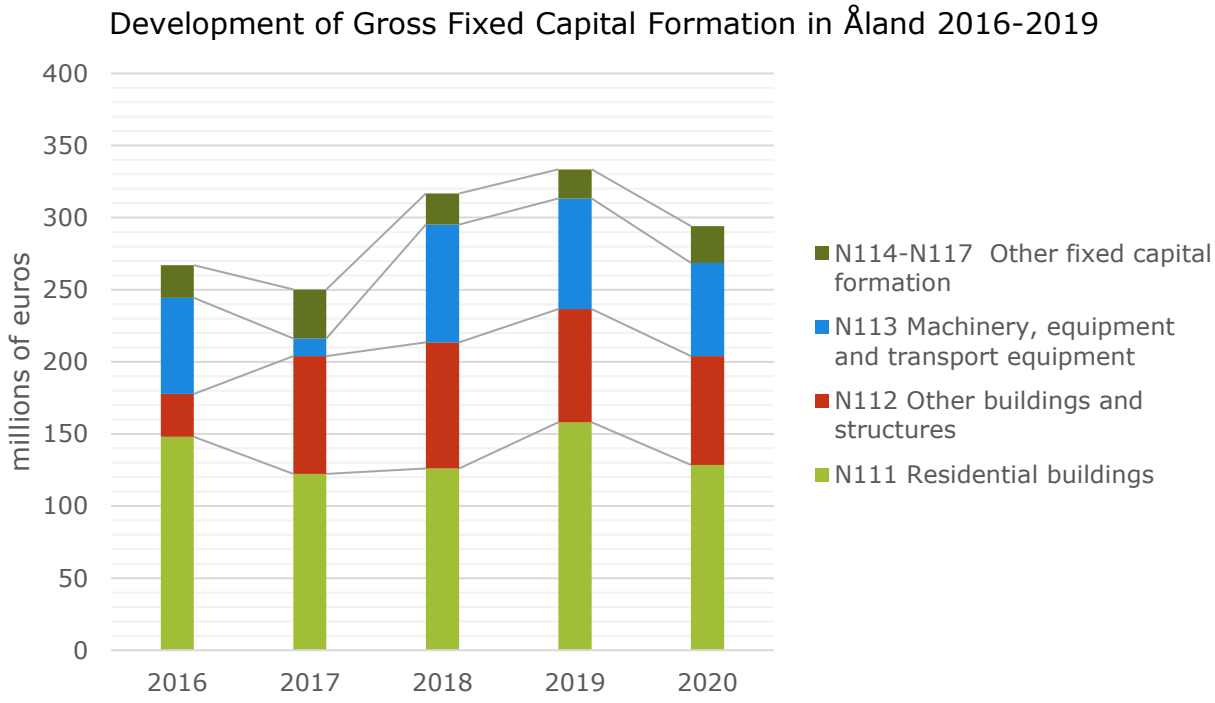

Figure 3-5. Development of GFCF in Åland in the years 2016-2020 (Statistics Finland, 2023)

At sectoral level the economy in Åland has been fluctuating in last 10 years though the islands yearly total output has hovered mostly around 2,3-2,5 billion euros within the time period. A slight decline was seen in 2020 is mostly due to effects from the COVID-19 pandemic (figure 3-6). The economy has seen a quick bounce back and is expected to stabilize a bit in the coming years. However, at industry-level we see that the wholesale trade activity will continue its slight decline if no major changes happen in the economy. Similarly, we expect the shipping industry not to catch the pre-covid year figures in the near future and at current pace. Meanwhile Åland sees slight rise in the food industry activity (including both downstream and upstream activities) and public affairs. Clear rise of activity can also be seen in the money handling industry in the coming years. At the same time number of small businesses continues to grow, especially in the building, energy, heating, water & sanitation sectors.

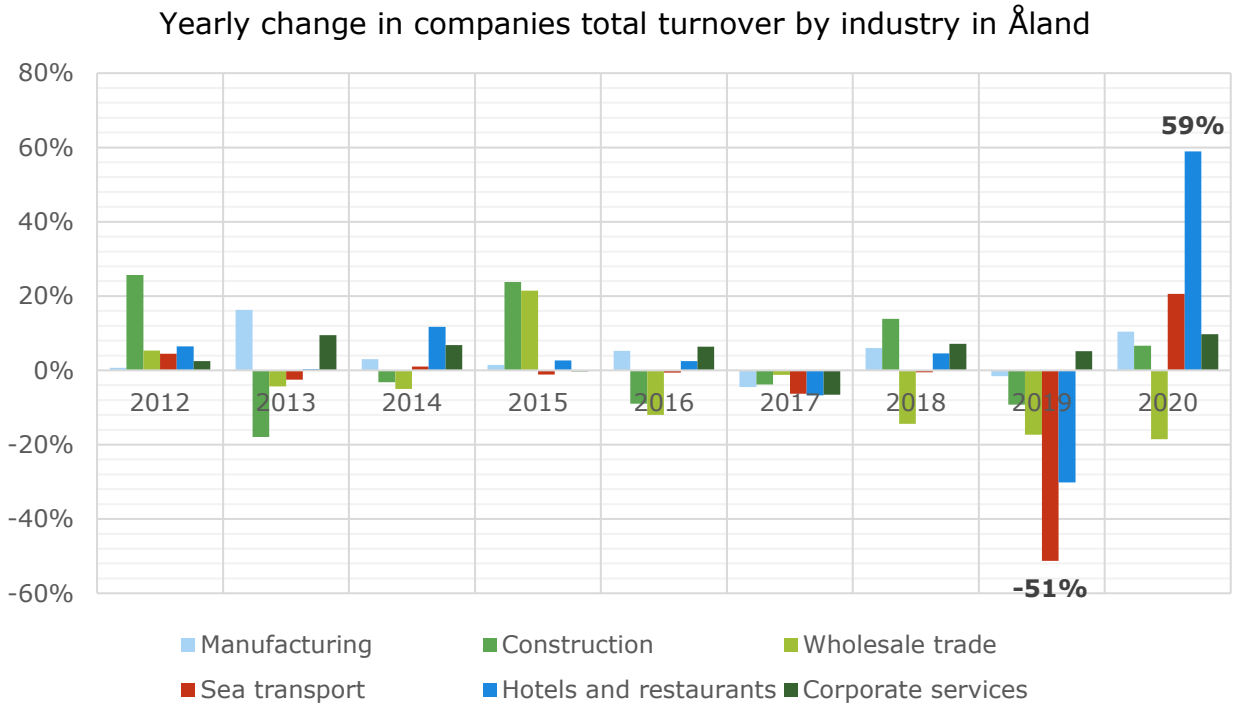

Figure 3-6. Yearly change in companies total turnover by industry in Åland 2012-2020 (Åsub, 2023)

Regional expertise, businesses, and workforce have a significant impact on the direct and wider economic impacts that new activities, such as the large-scale industrial investments can potentially have on the economy. Therefore, understanding both the current status of the economy and the potential are integral when assessing the impacts that these changes may have. Current economy lays the foundation to build on, and the potential the outcome that can be achieved with right building blocks. The building blocks consist of multiple factors such as current capabilities within the region and those capabilities that can be developed within reason in the set time frame, the readiness of the business ecosystem and companies' ability to adapt and to grow in order to adjust to the upcoming changes in the region to capture the positive impacts. This all is supported with regional public affairs and co-operation, R&D, education and many other things.

In Åland the current state of the economy and business ecosystem lays a good foundation to build upon considering the potential offshore-wind investments. The region has e.g., university of applied sciences that is active in fields that are important to offshore-wind production and its supporting activities. It is also well connected to both Finland and Sweden to attract talent to the region. Currently there is competent labor force already in the market that can be utilized in numerous activities regarding the planned offshore wind projects. However, the demand for workforce is very large and can't be filled completely with the current workforce. Additionally, many of the tasks require skills that are not available within the region or even in rest of Finland. Hence, new expertise needs to be developed.

Reality is that most significant acquisitions for the wind farm are likely to be purchased from abroad, especially technology wise. However, local Åland and Finnish entities can already prepare to produce some of the required spare parts, design and maintenance services, and other services needed for offshore wind construction and operation.

Locally, it’s advisable to anticipate that projects may accelerate migration to the region, first temporarily during construction and later permanently during operation. Migration should be expected especially if maintenance activities and other related operations for offshore windfarms are established in nearby areas.

In terms of infrastructure for example, ports of Åland (shipping industry) are not likely to be able to support the project much during the construction phase. With proactive development however, the ports may be well equipped to support the operational phase of the wind farm. Same applies to operation, maintenance & service activities where personnel needs to be trained in advance, during the construction phase at latest which requires inputs from local government.

The hospitality industry is most likely equipped to support the project throughout the lifetime and will encounter more business if the projects realize. However, some additional lodging is probably needed during the construction phase in the summer season.

4. RESULTS

4.1 Scenarios

The total estimated investment for the wind farm development and construction is nearly 10 billion euros at today's prices. This covers the project development and planning as well as construction cost and purchasing of wind turbines and all other needed materials. The largest investments in the project will be the wind turbines, offshore wind turbine foundations, vessels rents and logistics as well as cables and related installation work. Wind turbine foundations and a significant portion of equipment are likely to be primarily sourced from abroad. However, smaller equipment, cabling, design services as well as construction and installation work will also be sourced from Finland and Åland in a significant extent. Finnish ports are also expected to be used for shipping large major components during the construction phase.

Operation of the wind farm is expected to be run by a company set up by Ilmatar in Åland islands. Most of the services regarding upkeep and maintenance of the wind farm are likely to be outsourced. It is expected that ports and marine logistics operators in Åland are able to support the project during the operation phase. Major component replacements are to be purchased from outside of Finland from European and global markets but much of the other needed services and spare parts can be sourced from Finland and partially from Åland. At this stage we expect that expert services for turbine maintenance to be sourced from Finland and outside of Finland. However, in future this could also be done by a local subsidiary of larger service operator set up in Åland. In total operation of the wind farm is expected to cost approximately 100-150 million euros on a yearly basis. This includes both the purchased services, spare parts and internal costs.

The expected lifespan of the windfarm is approximately 25 years, and it is expected to produce on average 10 TWh of electricity in a year. For comparison the electricity generated by wind power in Finland in year 2022 was a record 11,6 TWh (Statistics Finland, 2023). The wind farm is expected to be well maintained during its lifetime and to be repowered before the expected lifespan ends, to keep it in operation for up to over 40 years in total. However, as this happens in the distant future other option might realize such as secondary use or decommissioning. The timeline the project is expected to follow is presented in figure 4-1.

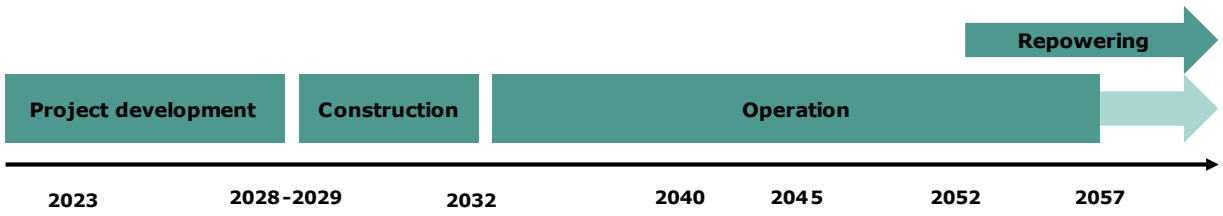

Figure 4-1. The expected timeline of the project

The impacts of the project are assessed through three distinctive scenarios that reflect on Ilmatar's regional inputs and the involvement of Åland in the project. The estimated scenarios are:

- Scenario A: **Coordination project**, where products and services are sourced from current and existing market players without regional focus.
- Scenario B: **Co-operation project,** where the market is expected to develop regionally and nationally to provide more products to support the construction and operation of offshore wind farms and a clear focus is put on utilizing local and national resources.
- Scenario C: **Co-development project**, which builds on the same foundations as co-operation project but extends the cooperation to strong local capability building and supporting investments on both sides.

The different scenarios actualize in the evaluation with more of the inputs being locally and nationally sourced which means that the demand for products and services rises. However, many of the required inputs are not available locally or even nationally in any scenarios. Table 1 summarizes the share of the services and products purchased from Åland, rest of Finland and out of Finland throughout the project lifetime in different scenarios.

Table 1. The share of purchased services and products by region

	Åland	Rest of Finland	Out of Finland
Scenario A	6 %	19 %	75 %
Scenario B	9 %	26 %	65 %
Scenario C	12 %	30 %	58 %

The degrees of domesticity and regional shares may differ from the current assessment, as agreements with equipment suppliers or contractors have not yet been made, which allows all project scenarios to be still developed. The assessment areas as well as regional and Finnish expertise and supply, may also develop as the project progresses and the share of local and domestic services and labor used in different phases of the project may differ significantly from what is estimated. The value chains and impacts of different phases also extend abroad, but they have not been separately examined in this work.

The following chapters represent the results through scenario B: co-operation project, as it is the most probable scenario. The main results of the other scenarios are presented in adjoined summarizing tables with a brief analysis on key differences.

4.2 Direct impacts

Direct impacts of the project follow the operation of Ilmatar, and possible future subsidiaries set up by Ilmatar in Åland. These companies oversee the development, construction and the operation of the wind farm. These operators are expected to employ personnel to amount of between 288-588 FTEs (full-time equivalents, job-years) cumulatively from project development to the end of the 25-year operation period depending on the organization structure. This accounts to around 8,2-16,8 FTEs employed yearly directly by the company in Åland on average as the development and construction phase are expected to take around 10 years in total and the operational phase 25 years. The cumulative amount FTEs grow if the wind farm is repowered, but the average annual employment of the companies is expected to stay very similar to before.

The main economic impact of the operation is the revenue generated from the sale of electricity from which major part is value added. During the project lifetime billions of revenues is expected to be generated which in turn generates positive monetary flows to Åland and rest of Finland in form of taxes, land leases and other required payments. Cumulatively throughout the lifetime of the project around 718 million euros worth of municipal taxes, property taxes and corporation taxes are expected to be paid to the region and municipalities of Åland as a direct result of the operation. Most of these taxes consist of real estate taxes (approx. 70 %, when 1 % tax rate is used for the offshore wind farm) which will be paid according to the current legislation and property tax rates at that time. Hence, they may be higher or lower at the time the wind farm is operational if higher tax rates are introduced. Additional positive monetary flows to the region might come from seabed leases or other fees if applied. We've globally seen these payments to range from tens of millions to hundreds of millions of euros for wind park of this size over the lifetime. For Åland this could be significant boost to regional income as AFRY (2021) has assessed that site leases, based on high-level assumptions, could cost as much as 2 % of the wind farm operation revenue with 40 €/MWh as revenue basis in Åland. If applied the seabed lease would cost approximately 8 million euros per year if scaled to the assessed wind farm size (figure 4-2). However, there are many uncertainties in the Finnish offshore wind framework to estimate the exact amount to be paid.

Figure 4-2. Yearly income to Åland as a result of Ilmatar direct operation. Other direct taxes include municipal taxes, share of the corporation tax as well as real estate taxes from properties other than the wind farm.

Nationally the amount of accumulated taxes is even larger and potentially more than 1 billion euros worth of taxes accumulate during the project lifetime. However, the amount of taxes accumulated is very dependent on VAT (value added tax) which in turn is very dependent on where the electricity is sold to.

4.3 Åland multiplicative impacts

4.3.1 Project development and planning

Economic impacts occur as demand increases for other operators in Åland and elsewhere in Finland. These impacts will depend largely on whether the companies in the area can offer their services and expertise during the phase and to what extent the activity generates consumption in the region. As the phase is temporary and short term, no large structural changes will occur in the regional economy. However, as the development and planning will happen gradually over a 6-year period, some changes can be visible in the regional offering and even in the economy during the time.

During the phase around 40 million euros worth of output (revenue) is generated in the region. This is a result of direct purchases and necessary subcontracting throughout the value chain. Nearly half of the output generated is value added and around 20 million euros worth of GDP is created. In total around 435 FTEs will be created in Åland cumulatively during the development and planning phase and approximately 13 million euros of employee compensation is paid. At the same time, tax revenues of approximately 8 million euros will be generated as a result of all the activity in the value chains.

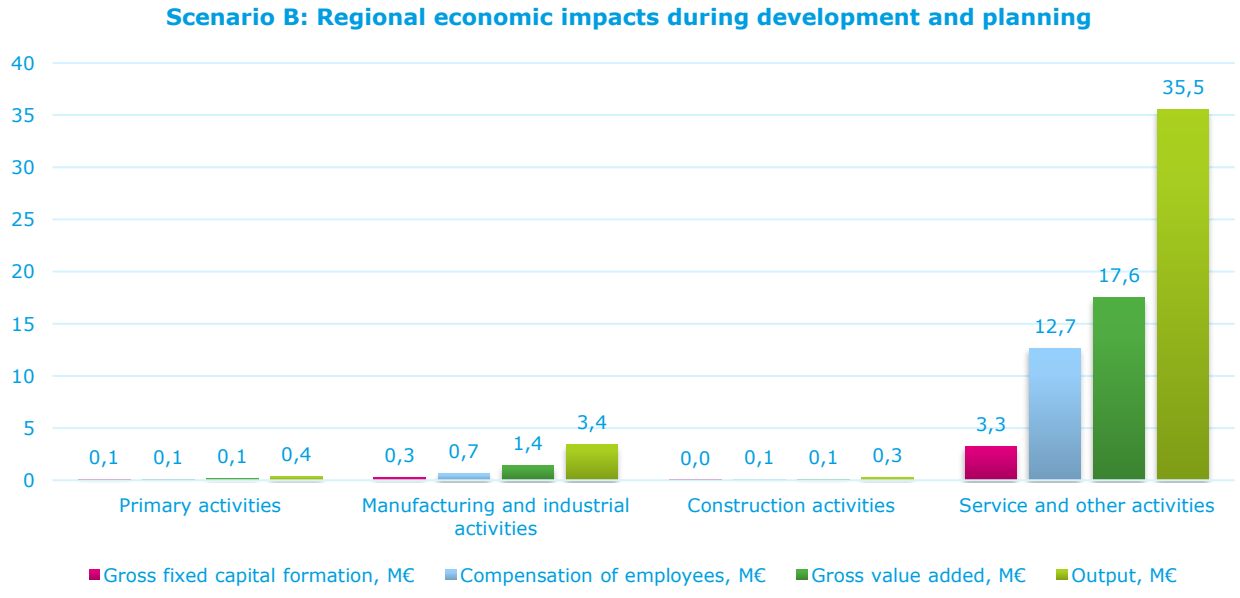

Figure 4-3. Regional economic impacts during development and planning phase by sector group

The emerging new demand will primarily target the service industry where design and other services are provided for the project (figure 4-3). In addition to design and environmental work acquired locally also some management consultancy and legal services are acquired locally. The accommodation and food service activities also see a slight rise in demand during the phase as external experts visit Åland islands frequently. Some distinct economic impacts can also be seen in the retail and wholesale trade industry, but these are mostly a result of consumption effects.

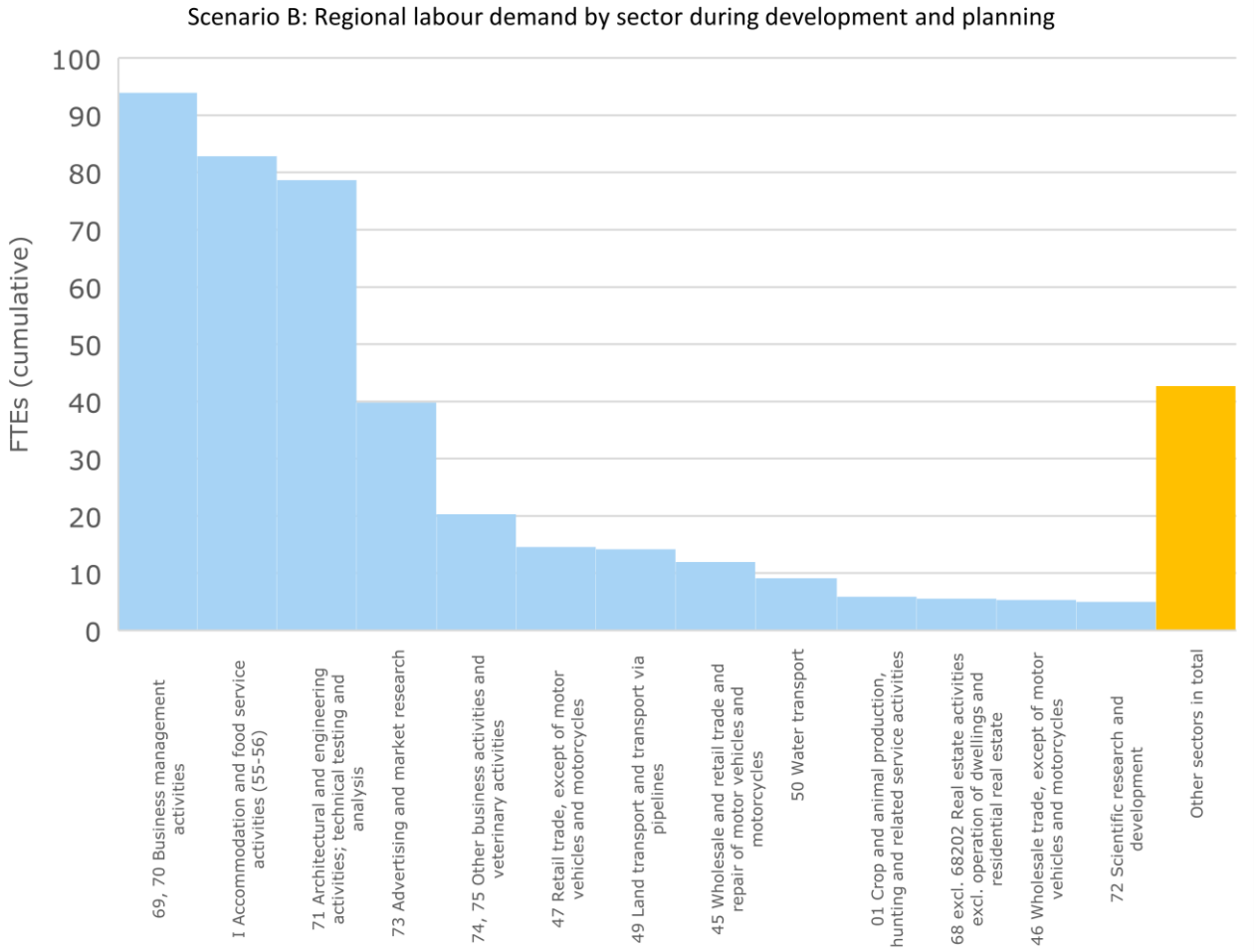

Figure 4-4. Regional labour demand during the development and planning phase by sector

The generated demand will require labor across various sectors by 435 FTEs cumulatively in total which accounts to around 72 FTEs yearly on average as the development and planning phase is expected to take 6 years. Some of the emerging labor demand will be directed towards existing operations, while others will create entirely new labor demand. Similar to the economic impacts, the most significant employment effect caused by the project will be in the service industry with its sectors labor demand making up nearly 95 % of all labor demand. Only 5 % of the total labor demand will occur in the other sectors during the development and planning phase (figure 4-4).

During the development and planning phase, all economic activities generate taxable income for both to the state and the municipalities in the region. Within the region tax revenues are generated as a result of the economic activity brought about by the investment and the purchases, totaling to approximately 8 million euros, distributed among different tax types as shown in figure 4-5.

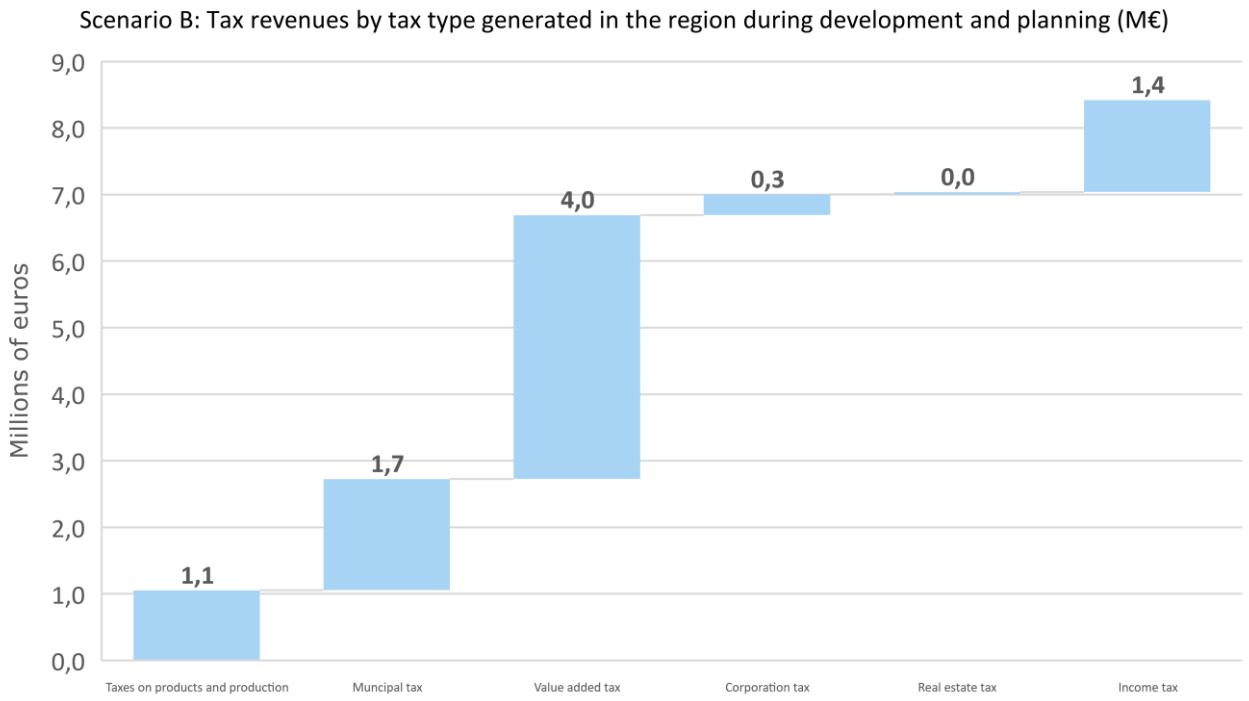

Figure 4-5. Tax revenues by tax type generated in the region during development and planning phase

Taxes have been calculated based on the economic activity taking place in Åland. In practice municipal taxes are paid according to the municipality of residence of the employees. This means that some of the calculated tax revenues may also flow to other areas in Finland, depending on how many employees commute to companies located in the municipalities of Åland.

Table 2. Regional impacts in total and on average yearly through key indicators

	Scenario A	Scenario B	Scenario C
Output in total, M€	30	40	49
Value added in total, M€	14	19	427
Municipal tax in total, M€	1	2	2
Employment in total, FTE	347	435	522
	Scenario A	**Scenario B**	**Scenario C**
Output yearly, M€	5	7	8
Value added yearly, M€	2	3	4
Municipal tax yearly, M€	0,2	0,2	0,3
Employment yearly, FTE	58	72	87

Clear differences between impacts in three evaluated scenarios exist as table 2 displays. The largest differences come up on the activity of sector 71 architectural and engineering activities, technical testing and analysis. In scenarios B and C compared to the scenario A local design services and subcontracting are used more on environmental surveys and assessments and other surveys and assessments. Additionally, slight increase can be seen in use of legal, management consultancy and related services.

4.3.2 Construction

Economic impacts occur as demand increases for other operators in Åland and elsewhere in Finland. These impacts will depend largely on whether the companies in the area can offer their services and expertise during the phase and to what extent the activity generates consumption in the region. As the phase is temporary and short term, no large structural changes will occur in the regional economy. However, as

the construction will happen gradually over a 4-year period, some changes can be visible in the regional offering and even in the economy during the time.

During the phase around 640 million euros worth of output (revenue) is generated in the region. This is a result of direct purchases and necessary subcontracting throughout the value chain. Around 43 % of the output generated is value added and around 290 million euros worth of GDP is created. In total around 4 151 FTEs will be created in Åland cumulatively during the construction phase and approximately 158 million euros of employee compensation is paid. At the same time, tax revenues of approximately 117 million euros will be generated as a result of all the activity in the value chains.

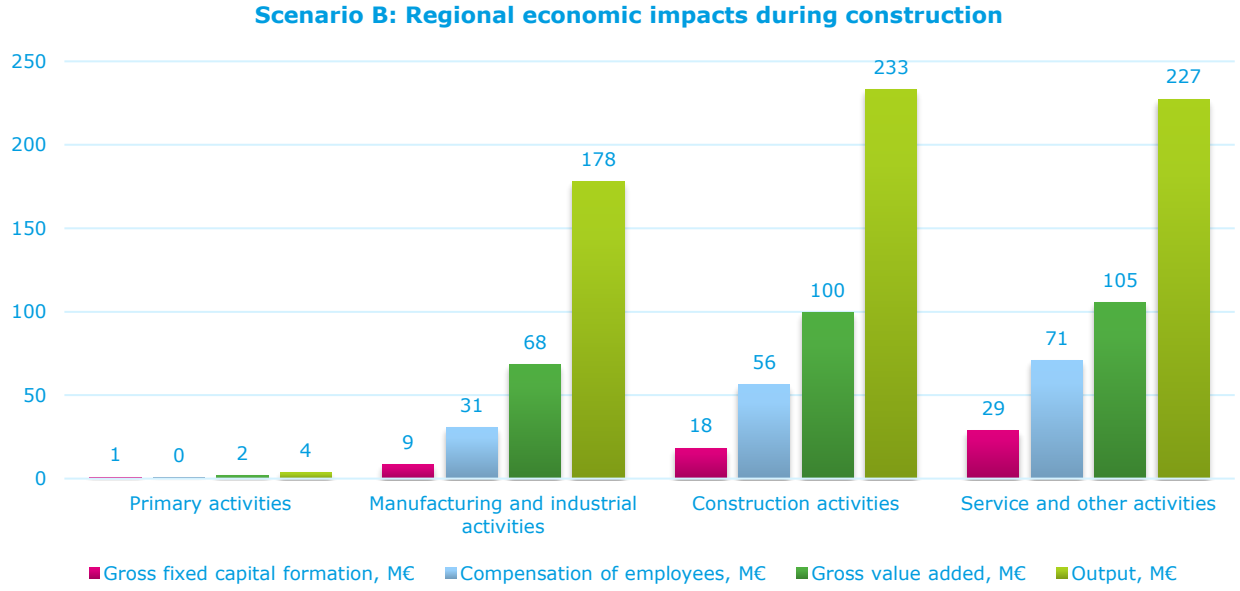

Figure 4-6. Regional economic impacts during construction phase by sector group

The emerging new demand will heavily target the construction industry, manufacturing and industrial activities as well as service and other activities (figure 4-6). Local construction companies will be utilized in building of the land properties and infrastructure. They are expected to be able to support with water construction to some extent as well. The most impacted service industries are the insurance and retail industry in addition to water transport industry that support the project in both transportation of smaller assets and personnel. Retail industry is clearly impacted as temporary housing are likely needed for workforce travelling to Åland from rest of Finland and further. In the manufacturing industry most of the impacts target sectors 33 repair and installation of machinery and equipment and sector 35 electricity, gas, steam and air conditioning supply. Services are needed for installations of new machinery and systems in the substations and other facilities and for cabling and grid connections where companies such as Kraftnät Åland are likely to participate in the works.

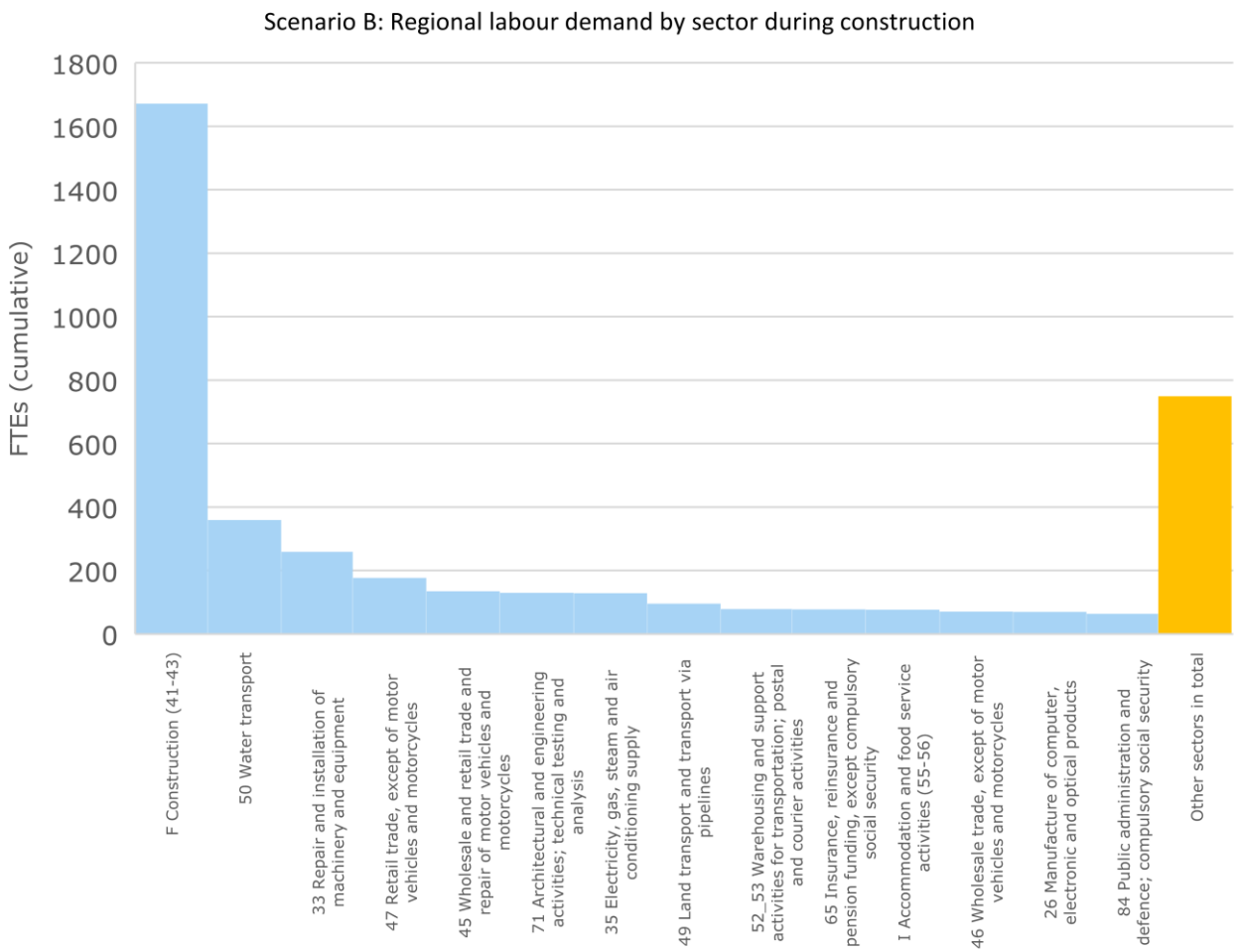

Figure 4-7. Regional labour demand during the construction phase by sector

The generated demand will require labor across various sectors by 4 151 FTEs cumulatively in total which accounts to around 1 038 FTEs yearly on average as the construction phase is expected to take 4 years. Some of the emerging labor demand will be directed towards existing operations, while others will create entirely new labor demand. Similar to the economic impacts, the most significant employment effect caused by the project will be in the service and construction industry (figure 4-7). The employment impacts are lower in the manufacturing industry as it is more capital heavy.

During the construction phase, all economic activities generate taxable income for both to the state and the municipalities in the region. Within the region tax revenues are generated as a result of the economic activity brought about by the investment and the purchases, totaling to approximately 117 million euros, distributed among different tax types as shown in figure 4-8.

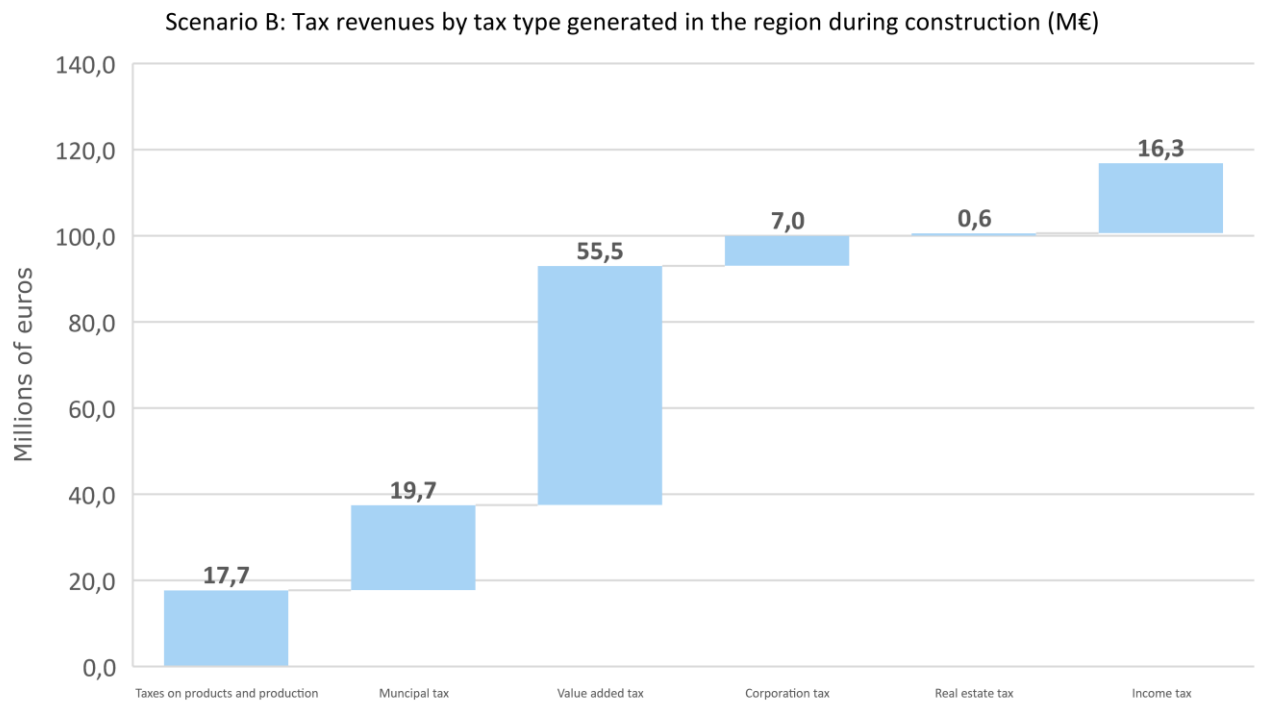

Figure 4-8. Tax revenues by tax type generated in the region during construction phase

Taxes have been calculated based on the economic activity taking place in Åland. In practice municipal taxes are paid according to the municipality of residence of the employees. This means that some of the calculated tax revenues may also flow to other areas in Finland, depending on how many employees commute to companies located in the municipalities of Åland.

Table 3. Regional impacts in total and on average yearly through key indicators

	Scenario A	Scenario B	Scenario C
Output in total, M€	335	642	1 000
Value added in total, M€	147	275	427
Municipal tax in total, M€	10	20	31
Employment in total, FTE	1 197	4 151	6 739
	Scenario A	**Scenario B**	**Scenario C**
Output yearly, M€	84	161	250
Value added yearly, M€	37	69	107
Municipal tax yearly, M€	2	5	8
Employment yearly, FTE	499	1 038	1 685

Large differences between impacts in three evaluated scenarios exist as table 3 displays. The largest differences come up on the activity of sector 33 repair and installation of machinery and equipment as well as the construction sector. In scenarios B and C compared to the scenario A local companies and workforce are expected to be able to further develop their capabilities to meet the needs of the project. At the same time local marine transport industry is needed and used more to move the resources between Åland mainland and the project site.

4.3.3 Operation

Economic impacts occur as demand increases for other operators in Åland and elsewhere in Finland. These impacts will depend largely on whether the companies in the area can offer their services and expertise during the phase and to what extent the activity generates consumption in the region. As the phase is

long term structural changes in the economy are expected to come up in the regional economy as the operation will happen quite consistently over a 25-year period.

During the phase around 913 million euros worth of output (revenue) is generated in the region. This is a result of direct purchases and necessary subcontracting throughout the value chain. Around 44 % of the output generated is value added and around 450 million euros worth of GDP is created. In total around 5 536 FTEs will be created in Åland cumulatively during the operation phase and approximately 240 million euros of employee compensation is paid. At the same time, tax revenues of approximately 150 million euros will be generated as a result of all the activity in the value chains.

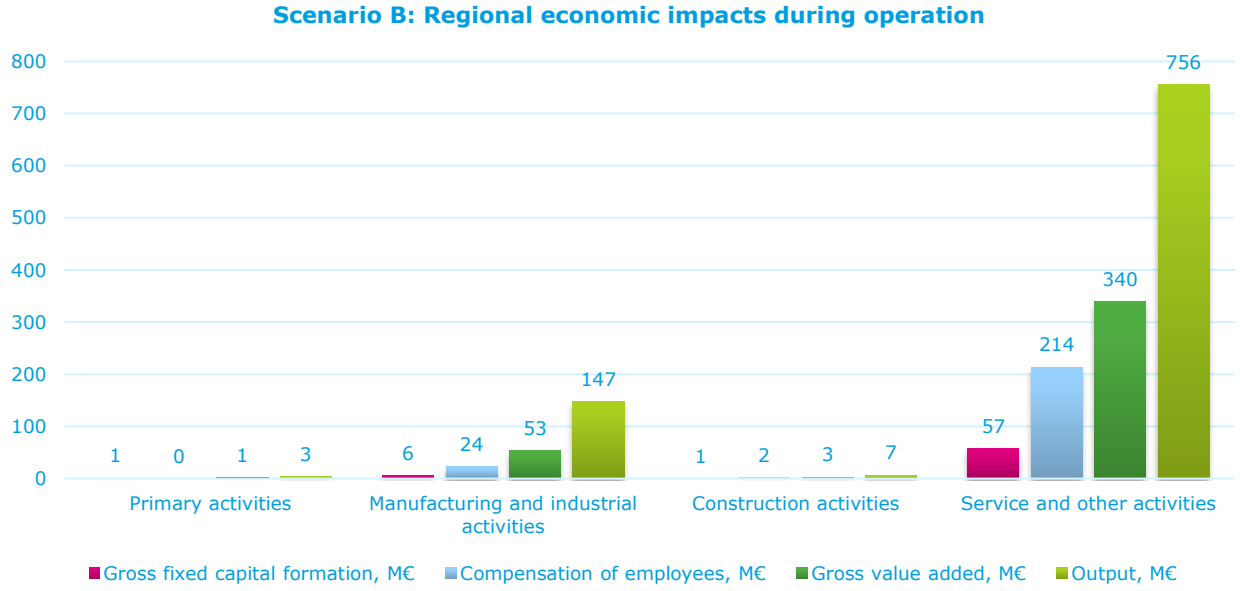

Figure 4-9. Regional economic impacts during operation phase by sector group

The emerging new demand will mainly target the service industry (figure 4-9). In addition to the local operations of Ilmatar (direct impacts) that generate steady stream of regional economic impacts (as presented in direct impacts), local companies providing services for upkeep and maintenance of the wind farm and the supporting infrastructure generate another steady stream of regional impacts. The regional economy is also steadily impacted on the insurance sector due to the project needs. However, the largest impacts during operation phase arise in the marine industry sector. Local ports and services of the sector are likely to be utilized when conducting everyday activities of the operation even though the largest physical items are still expected to be shipped from mainland Finland as in the construction phase. Additionally new and more standby services are needed in e.g., healthcare and emergency response during the operation of the wind farm. As to large rise in sectoral demand of many industries more monetary flows end up in the wholesale and retail industry also as to increased consumption within the region.

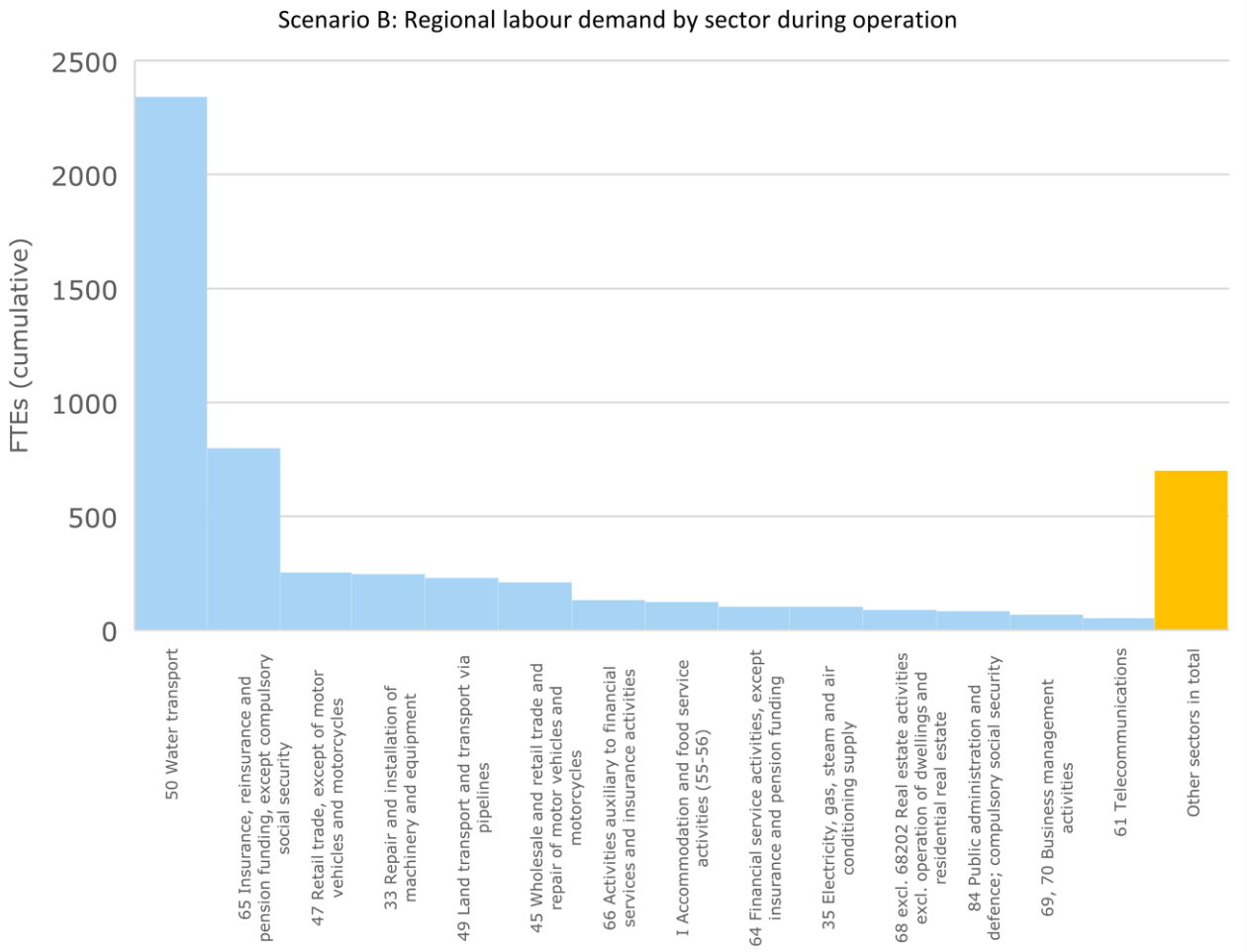

Figure 4-10. Regional labour demand during the operation phase by sector

The generated demand will require labor across various sectors by 5 536 FTEs cumulatively in total which accounts to around 221 FTEs yearly on average as the operation phase is expected to take 25 years. Some of the emerging labor demand will be directed towards existing operations, while others will create entirely new labor demand. Similar to the economic impacts, the most significant employment effect caused by the project will be in the service industry (89 % of the total labour needs) as figure 4-10 displays.

During the operation phase, all economic activities generate taxable income for both to the state and the municipalities in the region. Within the region tax revenues are generated as a result of the economic activity brought about by the product and service purchases, totaling to approximately 150 million euros, distributed among different tax types as shown in figure 4-11.

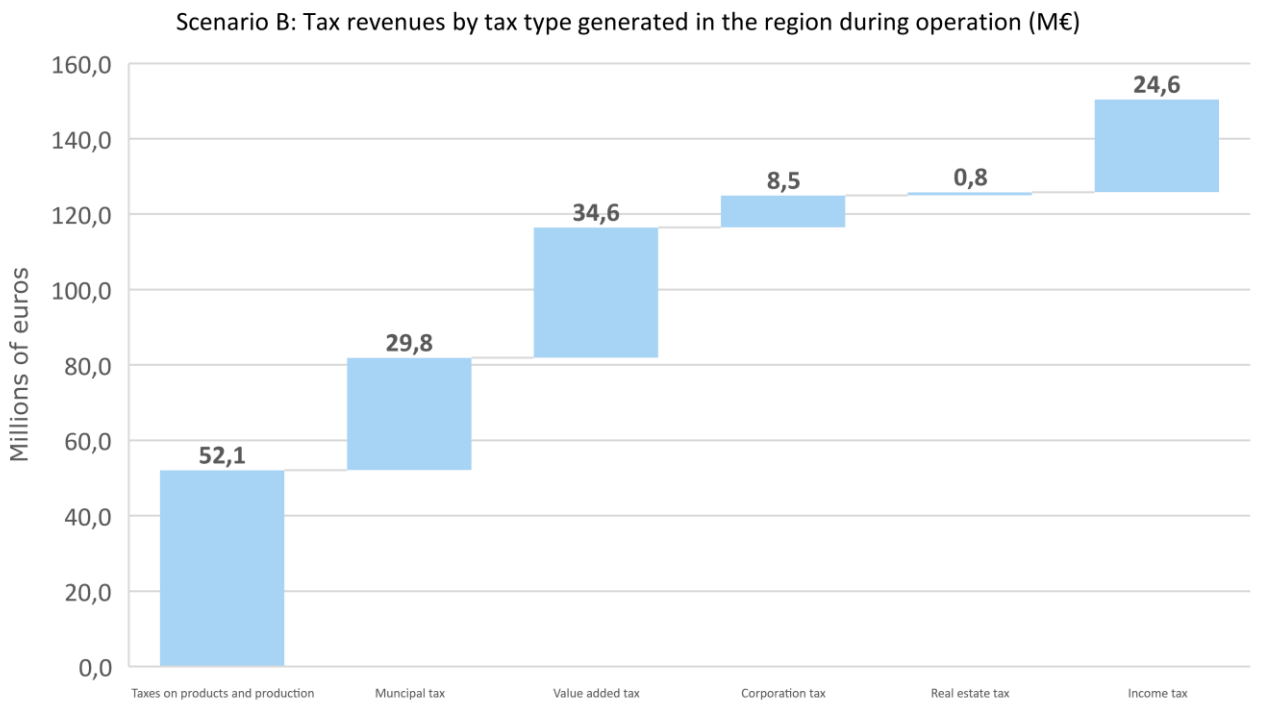

Figure 4-11. Tax revenues by tax type generated in the region during operation phase

Taxes have been calculated based on the economic activity taking place in Åland. In practice municipal taxes are paid according to the municipality of residence of the employees. This means that some of the calculated tax revenues may also flow to other areas in Finland, depending on how many employees commute to companies located in the municipalities of Åland.

Table 4. Regional impacts in total and on average yearly through key indicators

	Scenario A	Scenario B	Scenario C
Output in total, M€	732	913	1 141
Value added in total, M€	333	397	480
Municipal tax in total, M€	23	30	38
Employment in total, FTE	4 105	5 536	7 209
	Scenario A	**Scenario B**	**Scenario C**
Output yearly, M€	29	37	46
Value added yearly, M€	13	16	19
Municipal tax yearly, M€	1	1	2
Employment yearly, FTE	164	221	288

Large differences between cumulative impacts in three evaluated scenarios exist as table 4 displays. The largest differences come up on the activity of sector 33 repair and installation of machinery and equipment as well as the water transport sector. In scenarios B and C compared to the scenario A local companies and workforce are expected to be able to develop their capabilities to meet the needs of the project before the operational phase begins. This requires new specialized education and competence building to be setup in the region. At the same time the demand for services of local marine transport industry can be seen to receive a healthy and long-term boost in for years come. However, this does also require adaptation to some of the new conditions and the development of companies' service offering.

4.3.4 Repowering

The windfarm is expected to be repowered before its end of life. This is expected to extend the windfarms total lifespan to 40 years or more and would require investments in new parts in addition to very good maintenance and monitoring through the windfarm lifetime. These additional investments have not been evaluated as a part of this assessment, but they can be seen to partially reflect impacts of the construction phase.

The main impact from repowering is the continuation of the windfarm operation which has impact on both the direct impacts and the value chain level impacts due to multiplicative effects. If the repowering happens at around 20-year mark of windfarms operation and would continue the operation by 20 years, we see a 60 % rise in cumulative impacts of the operational phase. In reality these impacts may differ as to how and to what extend the windfarm is repowered. Figure 4-12 displays the continuation of cumulative regional economic and employment impacts from repowering of the wind farm.

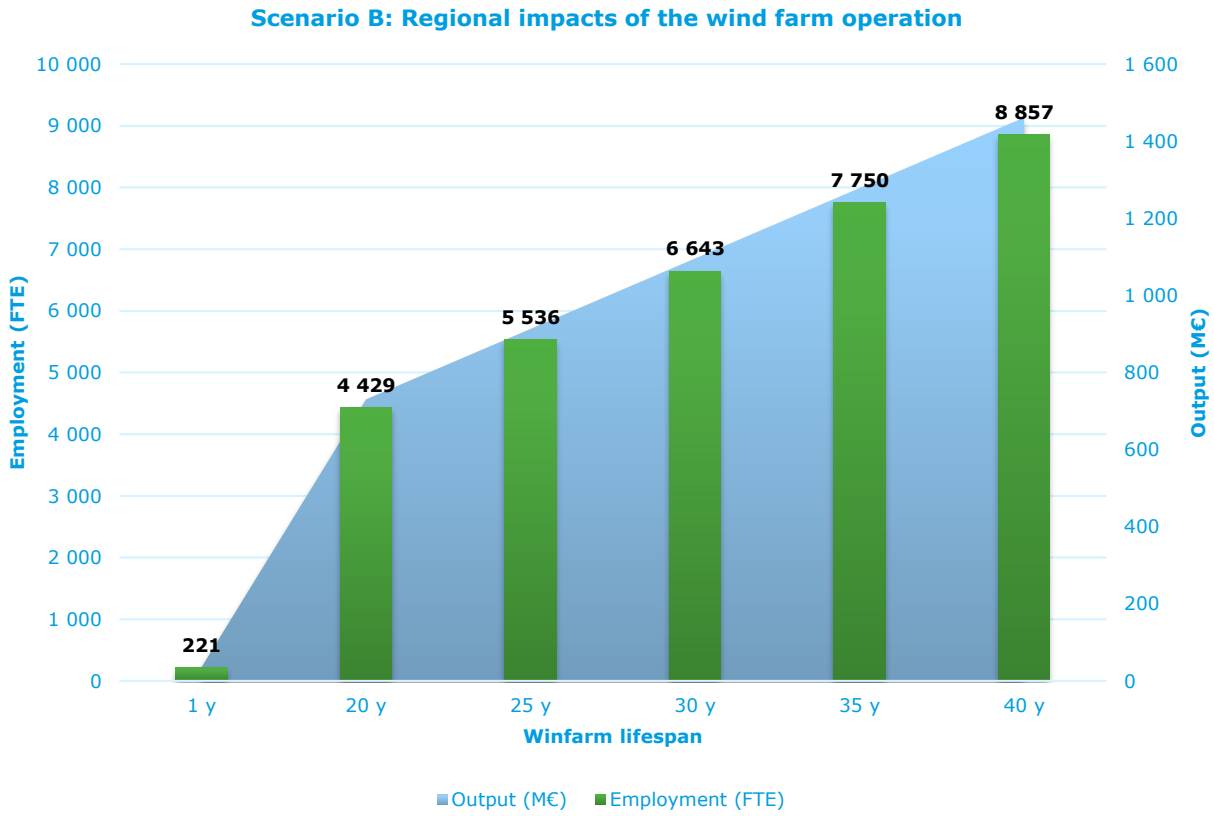

Figure 4-12. Regional impacts on output and employment during extended wind farm operational lifetime excluding direct impacts

Similarly, to the scenario B the cumulative operational phase impacts of other scenarios are estimated to grow 60 % as well throughout the windfarm lifetime if it is repowered. After the repowered wind farm meets its end of life many possibilities for the end use of farm exist such as decommissioning and sale of parts. However, this happens in very distant future and has neither been evaluated in the assessment though the activity would bring regional economic impacts as well.

4.3.5 Lifecycle impacts

The wind farm is expected to have many clear regional economic and employment impacts to the Åland islands. Cumulatively around 2-4 % of the impacts will occur during the development and planning phase, around 40-41 % during the construction phase and 55-57 % during the operation phase if the windfarms lifespan is 25 years and the direct impacts are ignored (figure 4-13). If the windfarm is repowered over 2/3 off the impacts would occur during the extended operational phase. On the other hand, if the impacts are inspected on a yearly basis on average a year of construction impacts is significantly larger than a standard year of operation or development and planning phase impacts.

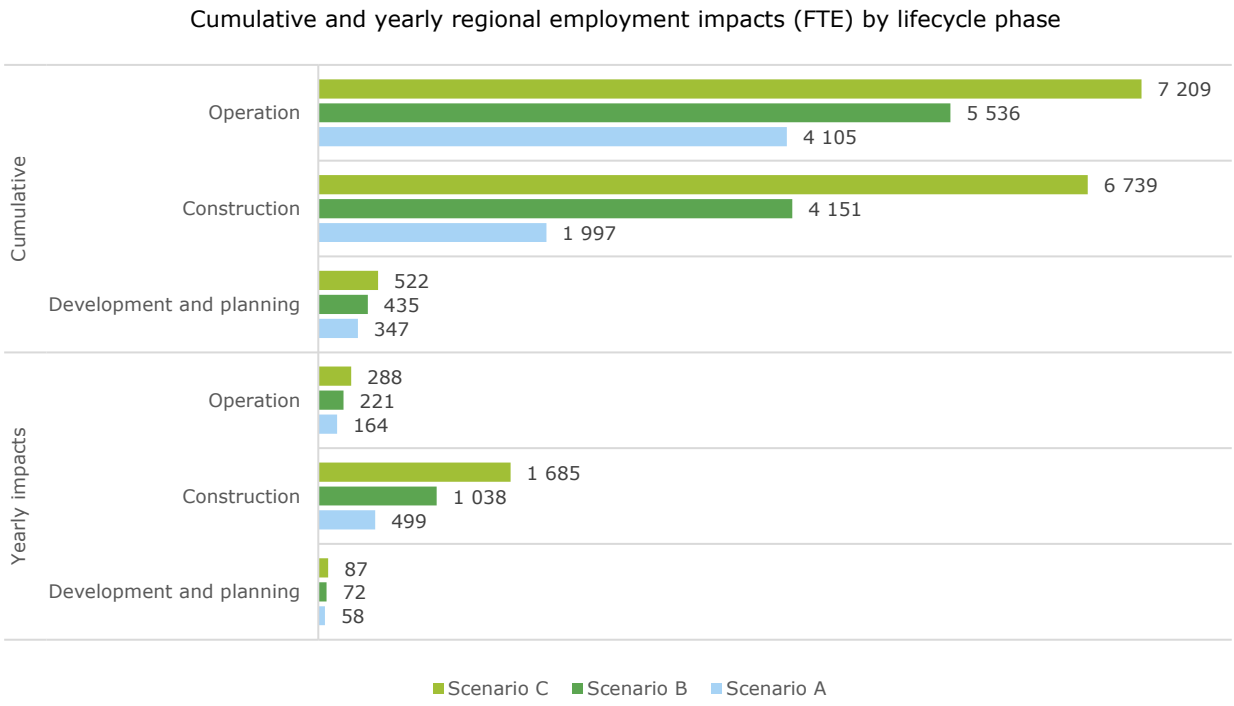

Figure 4-13. Cumulative and yearly regional employment impacts (FTE) by lifecycle phase in Åland

The major differences between employment impacts between scenarios are evident. The biggest differences during development and planning phase are identified in the sector 71 architectural and engineering activities, technical testing and analysis. Cumulatively these differences between sectoral employment demand make up 92 FTEs between scenarios A and C. The biggest differences during construction phase are identified in the sector 33 repair and installation of machinery and equipment and in the construction industry. Cumulatively these differences between sectoral employment demand make over 2 100 FTEs between scenarios A and C in the construction industry. The biggest differences during operational phase are identified in the sector 33 repair and installation of machinery and equipment and the water transport industry. Cumulatively these differences between sectoral employment demand make over 1 900 FTEs between scenarios A and C across these sectors.

4.4 Rest of Finland multiplicative impacts

4.4.1 Project development and planning

Operators in Finland are well equipped to support development and planning of the project in many parts where local expertise is not available. Economic impacts occur as demand increases for operators in Finland besides Åland. These impacts will depend largely on whether the companies in Finland can offer their services and expertise during the phase and to what extent the activity generates consumption in rest of Finland. As the phase is temporary and short term, no large structural changes will occur in the economy. However, as the development and planning will happen gradually over a 6-year period, some changes might be visible in the offering and even in the economy during the time.

During the phase around 288 million euros worth of output (revenue) is generated in rest of Finland. This is a result of direct purchases and necessary subcontracting throughout the value chain. Over half of the output generated is value added and around 152 million euros worth of GDP is created. In total around 1 966 FTEs will be created in rest of Finland cumulatively during the development and planning phase and approximately 91 million euros of employee compensation is paid. At the same time, tax revenues of approximately 71 million euros will be generated as a result of all the activity in the value chains.

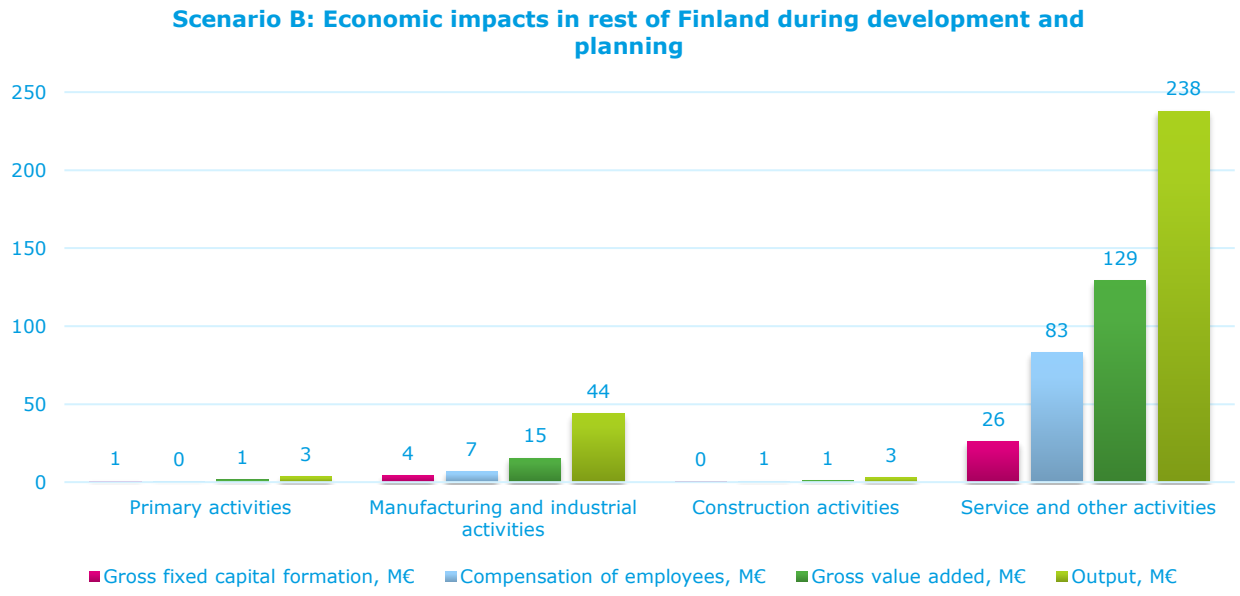

Figure 4-14. Economic impacts during development and planning phase in rest of Finland by sector group

Much like in Åland, the emerging new demand will primarily target the service industry where design and other services are provided for the project (figure 4-14). A large amount of design and environmental and geophysical assessment work is acquired from rest of Finland. Some management consultancy and legal services are acquired and also the scientific research and development sector is clearly impacted.

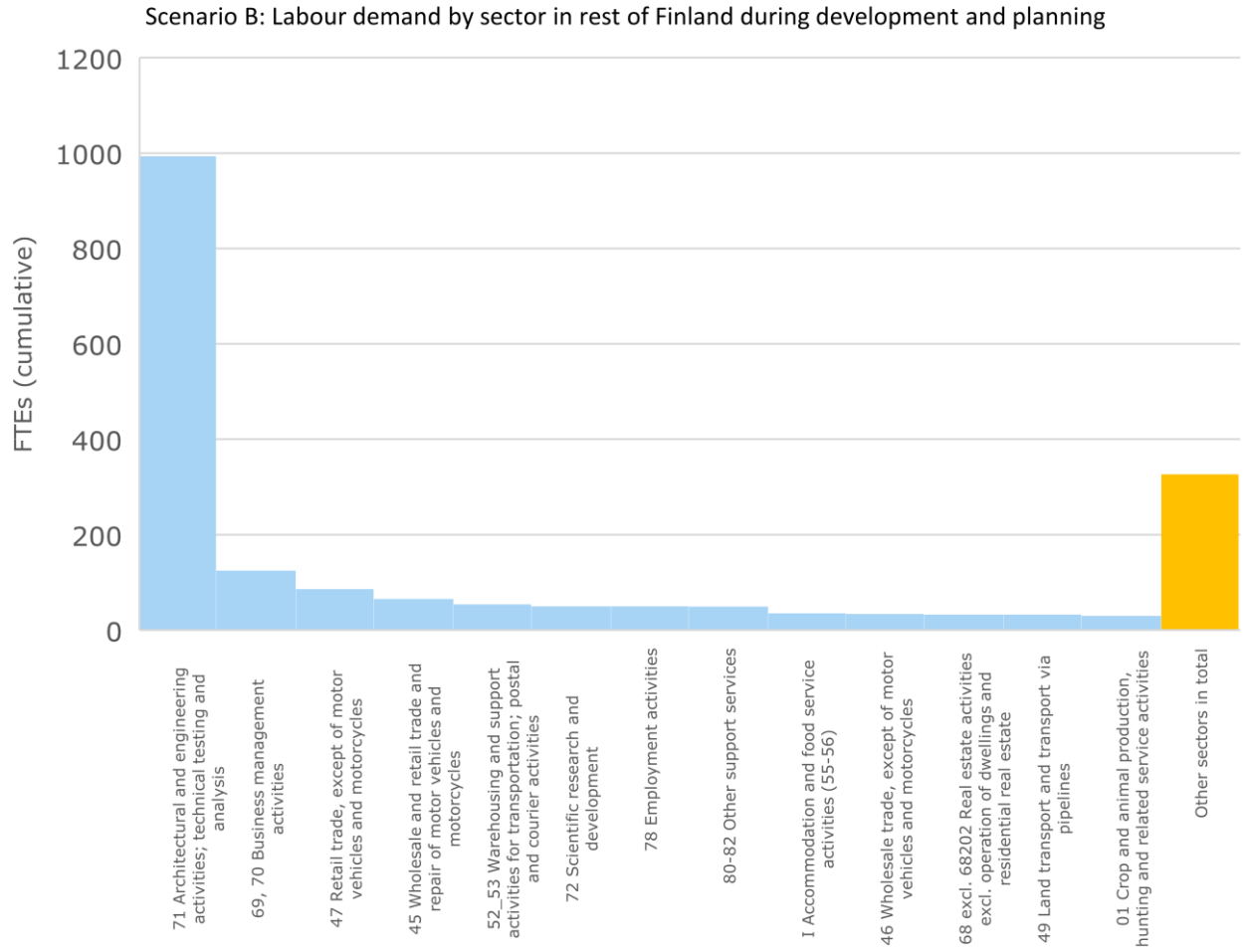

Figure 4-15. Labour demand in rest of Finland during the development and planning phase by sector

The generated demand will require labor across various sectors by 1 966 FTEs cumulatively in total which accounts to around 328 FTEs yearly on average as the development and planning phase is expected to

take 6 years. Some of the emerging labor demand will be directed towards existing operations, while others will create entirely new labor demand. Similar to the economic impacts, the most significant employment effect caused by the project will be seen in the service industry with its sectors labor demand making up over 90 % of all labor demand (figure 4-15).

During the development and planning phase, all economic activities generate taxable income for both to the state and the municipalities in Finland. Within rest of Finland tax revenues are generated as a result of the economic activity brought about by the investment and the purchases, totaling to approximately 71 million euros, distributed among different tax types as shown in figure 4-16.

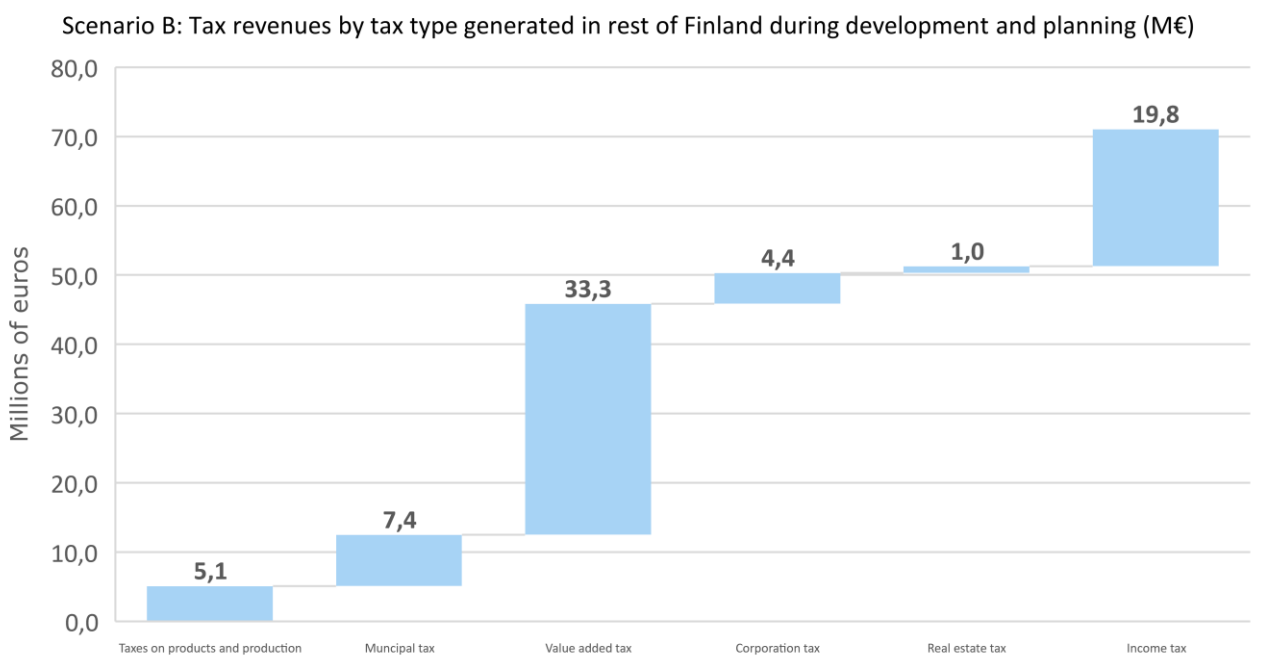

Figure 4-16. Tax revenues by tax type generated in rest of Finland during development and planning phase, in the graph income taxes (state) include the share of taxes directed to wellbeing services counties which were previously paid as a part of municipal taxes in mainland Finland

Taxes have been calculated based on the economic activity taking place in rest of Finland. In practice municipal taxes are paid according to the municipality of residence of the employees. This means that that some of the calculated tax revenues may also flow to Åland, depending on how many employees commute from Åland to companies located in rest of Finland.

Table 5. Rest of Finland impacts in total and on average yearly through key indicators

	Scenario A	Scenario B	Scenario C
Output in total, M€	293	288	282
Value added in total, M€	150	147	144
Municipal tax in total, M€	8	7	7
Employment in total, FTE	2 006	1 966	1 925
	Scenario A	**Scenario B**	**Scenario C**
Output yearly, M€	49	48	47
Value added yearly, M€	25	25	24
Municipal tax yearly, M€	1	1	1
Employment yearly, FTE	334	328	321

Interesting differences between impacts in three evaluated scenarios exist as table 5 displays. The scenario A has clearly less impacts occurring in rest of Finland than scenarios B and C. This is due to more of subcontracting and services bought from Åland in these scenarios i.e., even though the total Finnish

impacts grow the biggest growth is seen in Åland in this case. Most of the differences come up on the most heavily impacted sector which is sector 71 architectural and engineering activities, technical testing and analysis.

4.4.2 Construction

Operators in Finland are well equipped to support construction of the wind farm in many parts where local expertise is not available. Economic impacts occur as demand increases for operators in Finland besides Åland. These impacts will depend largely on whether the companies in Finland can offer their services and expertise during the phase and to what extent the activity generates consumption in rest of Finland. As the phase is temporary and short term, no large structural changes will occur in the economy. However, as the construction will happen gradually over a 4-year period, some changes might be visible in the offering and even in the economy during the time.

During the phase around 4 447 million euros worth of output (revenue) is generated in rest of Finland. This is a result of direct purchases and necessary subcontracting throughout the value chain. Around 42 % of the output generated is value added and around 1 937 million euros worth of GDP is created. In total over 22 600 FTEs will be created in rest of Finland cumulatively during the construction phase and approximately 991 million euros of employee compensation is paid. At the same time, tax revenues of approximately 875 million euros will be generated as a result of all the activity in the value chains.

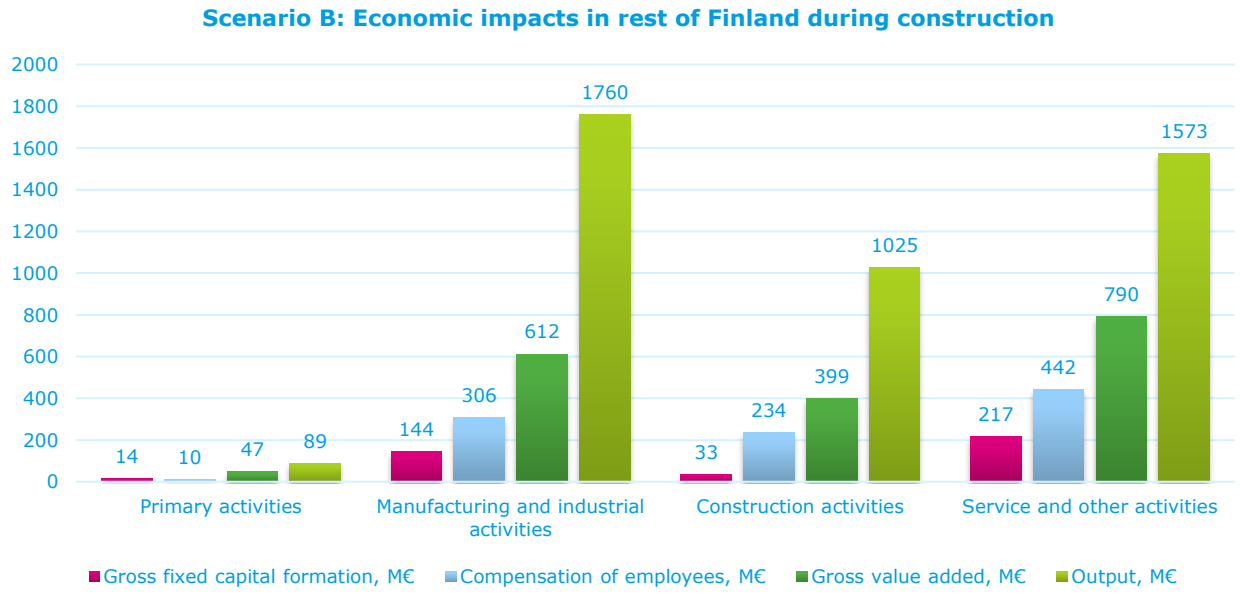

Figure 4-17. Economic impacts in rest of Finland during construction phase by sector group

The emerging new demand will heavily target the manufacturing industry, construction industry and service activities (figure 4-17). Finnish companies are able to support on some of the specialized construction and installation work and help fill out the regional needs for specialized expertise. Finnish companies are expected to provide the project with much needed physical goods such as cables, some of the larger structures and key components for the substation. The wind turbine will be purchased outside of Finland, most likely from Europe though there are some Finnish companies working within the value chains of manufacturing wind turbines. Service industry is impacted during construction especially on design services, real estate activities and in the trade industry. Many of the impacts on trade industry are a result of multiplicative impacts from both production and consumption.

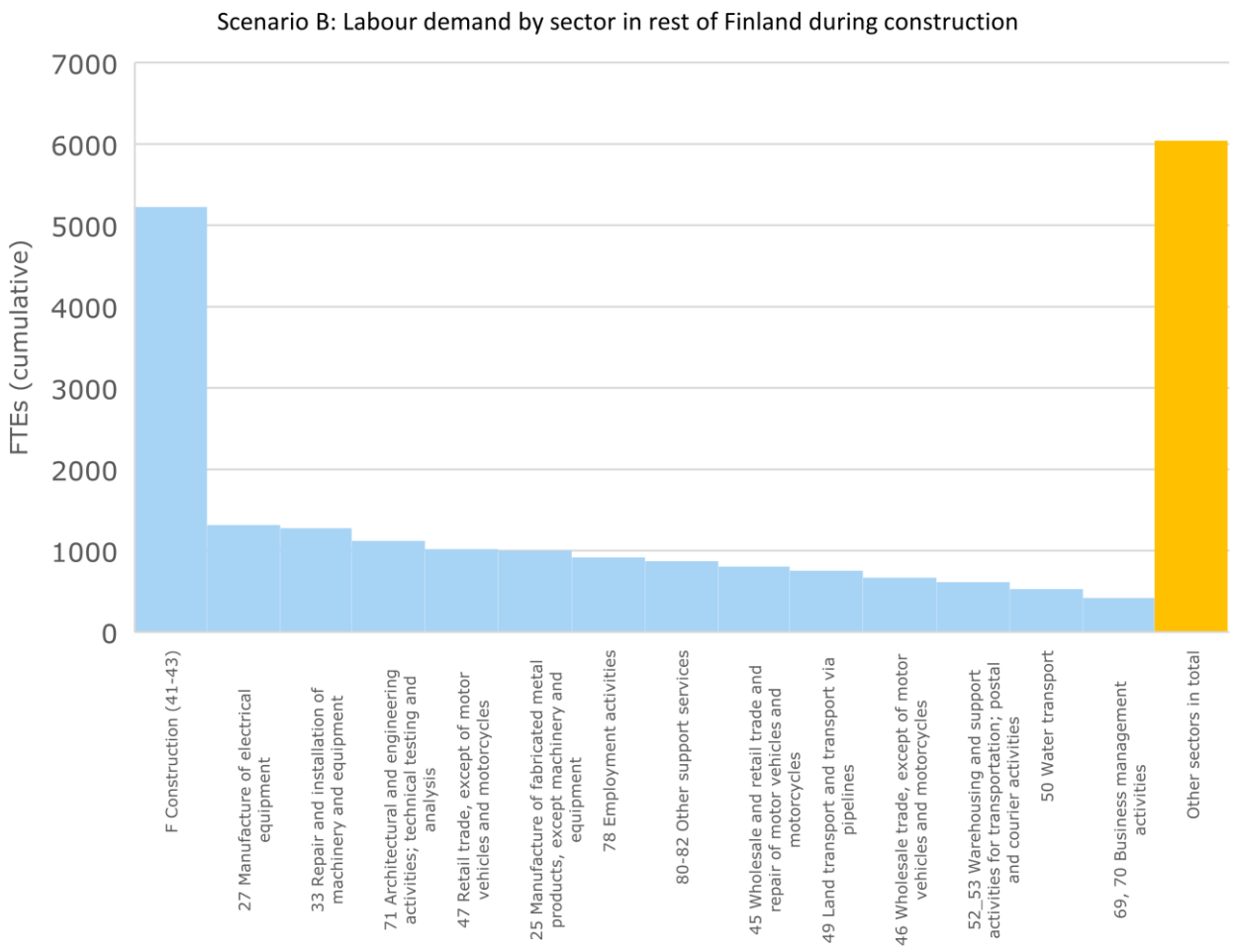

Figure 4-18. Labour demand in rest of Finland during the construction phase by sector

The generated demand will require labor across various sectors by 22 609 FTEs cumulatively in total which accounts to around 5 652 FTEs yearly on average as the construction phase is expected to take 4 years. Some of the emerging labor demand will be directed towards existing operations, while others will create entirely new labor demand. Similar to the economic impacts, the most significant employment effect caused by the project will be in the service and manufacturing industry. However, a smaller single sector group that is most impacted is the construction sector (figure 4-18).

During the construction phase, all economic activities generate taxable income for both to the state and the municipalities in Finland. Within rest of Finland tax revenues are generated as a result of the economic activity brought about by the investment and the purchases, totaling to approximately 875 million euros, distributed among different tax types as shown in figure 4-19.

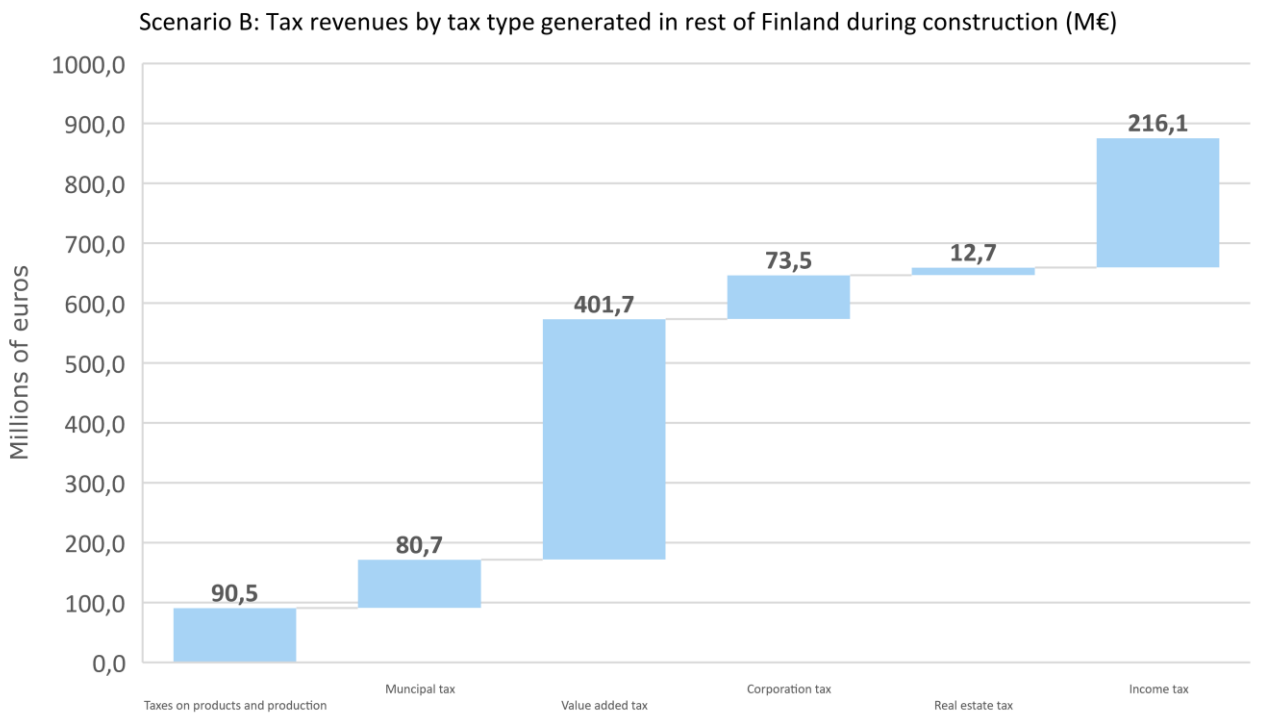

Figure 4-19. Tax revenues by tax type generated in rest of Finland during construction phase, in the graph income taxes (state) include the share of taxes directed to wellbeing services counties which were previously paid as a part of municipal taxes in mainland Finland

Taxes have been calculated based on the economic activity taking place in rest of Finland. In practice municipal taxes are paid according to the municipality of residence of the employees. This means that that some of the calculated tax revenues may also flow to Åland, depending on how many employees commute from Åland to companies located in rest of Finland.

Table 6. Rest of Finland impacts in total and on average yearly through key indicators

	Scenario A	Scenario B	Scenario C
Output in total, M€	2 638	4 447	5 794
Value added in total, M€	1 098	1 847	2 362
Municipal tax in total, M€	47	81	104
Employment in total, FTE	12 901	22 609	29 153
	Scenario A	**Scenario B**	**Scenario C**
Output yearly, M€	659	1 112	1 448
Value added yearly, M€	274	462	590
Municipal tax yearly, M€	12	20	26
Employment yearly, FTE	3 225	5 652	7 288

Large differences between impacts in three evaluated scenarios exist both yearly and cumulatively as table 6 displays. The largest differences come up on the activity of sector 25 manufacture of fabricated metal products, except machinery and equipment, sector 33 repair and installation of machinery and equipment, sector 71 architectural and engineering activities; technical testing and analysis as well as in the construction sector. In scenarios B and C compared to the scenario A Finnish companies and workforce are expected to be able to further develop their capabilities to meet many of the product and service needs of the project. At the same time many other industries across Finland are impacted due to multiplicative impacts of consumption brough about by increased employee compensation and consumption.

4.4.3 Operation

Operators in Finland are well equipped to support operation of the wind farm in many parts where local expertise is not available. Economic impacts occur as demand increases for operators in Finland besides Åland. These impacts will depend largely on whether the companies in Finland can offer their services and expertise during the phase and to what extent the activity generates consumption in rest of Finland. As the phase is long term structural changes in the economy are expected to come up in the economy as the operation will happen quite consistently over a 25-year period.

During the phase around 2 763 million euros worth of output (revenue) is generated in rest of Finland. This is a result of direct purchases and necessary subcontracting throughout the value chain. Around 45 % of the output generated is value added and around 1 350 million euros worth of GDP is created. In total around 13 733 FTEs will be created in rest of Finland cumulatively during the operation phase and approximately 627 million euros of employee compensation is paid. At the same time, tax revenues of approximately 560 million euros will be generated as a result of all the activity in the value chains.

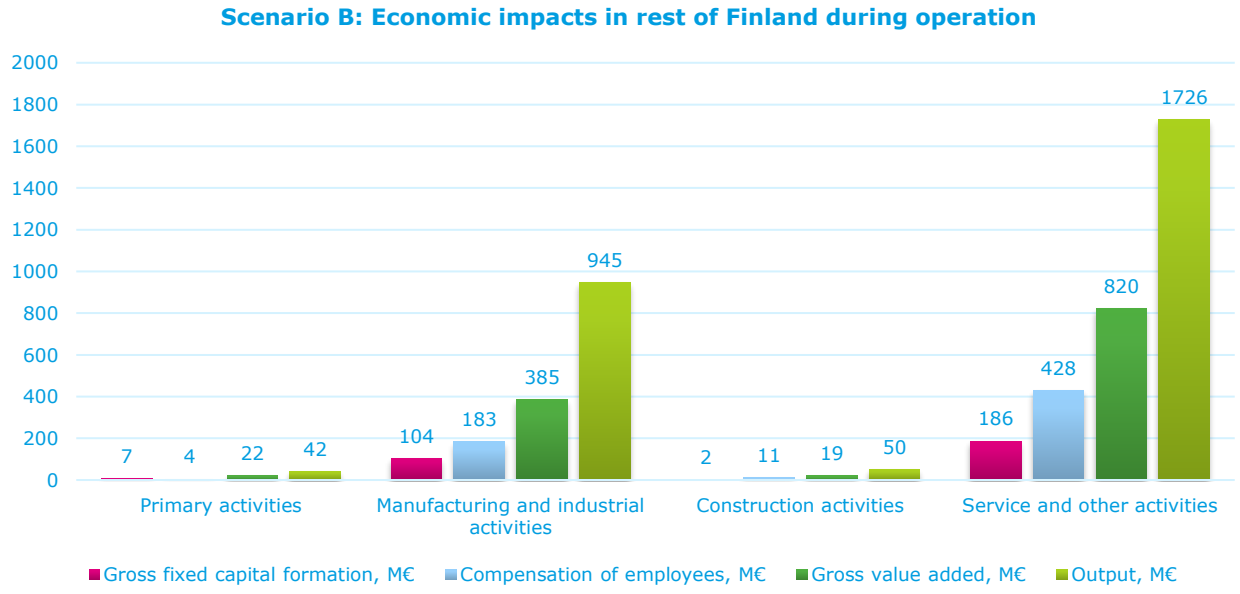

Figure 4-20. Economic impacts in rest of Finland during operation phase by sector group

The emerging new demand will mostly target the service industry (figure 4-20). Some of the impacts arise in the manufacturing industry as well due to steady needs of some spare parts and equipment. However, most of the manufacturing industry impacts come up in sector 35 electricity, gas, steam and air conditioning supply that provides services for the upkeep of the grid network and sector 33 repair and installation of machinery and equipment that supports the operation and maintenance of the wind farm as well as the adjacent substations and other facilities. The largest impacts in the service industry can be seen on the water transport industry that supports the operation of the wind farm by moving both personnel and goods between mainland Finland and Åland, the project site and further. Clear economic impacts can also be seen in the trading sector, insurance sector and real estate activities. As to large rise in sectoral demand of many industries more monetary flows end up also in the wholesale and retail industry also as to increased consumption within Finland.

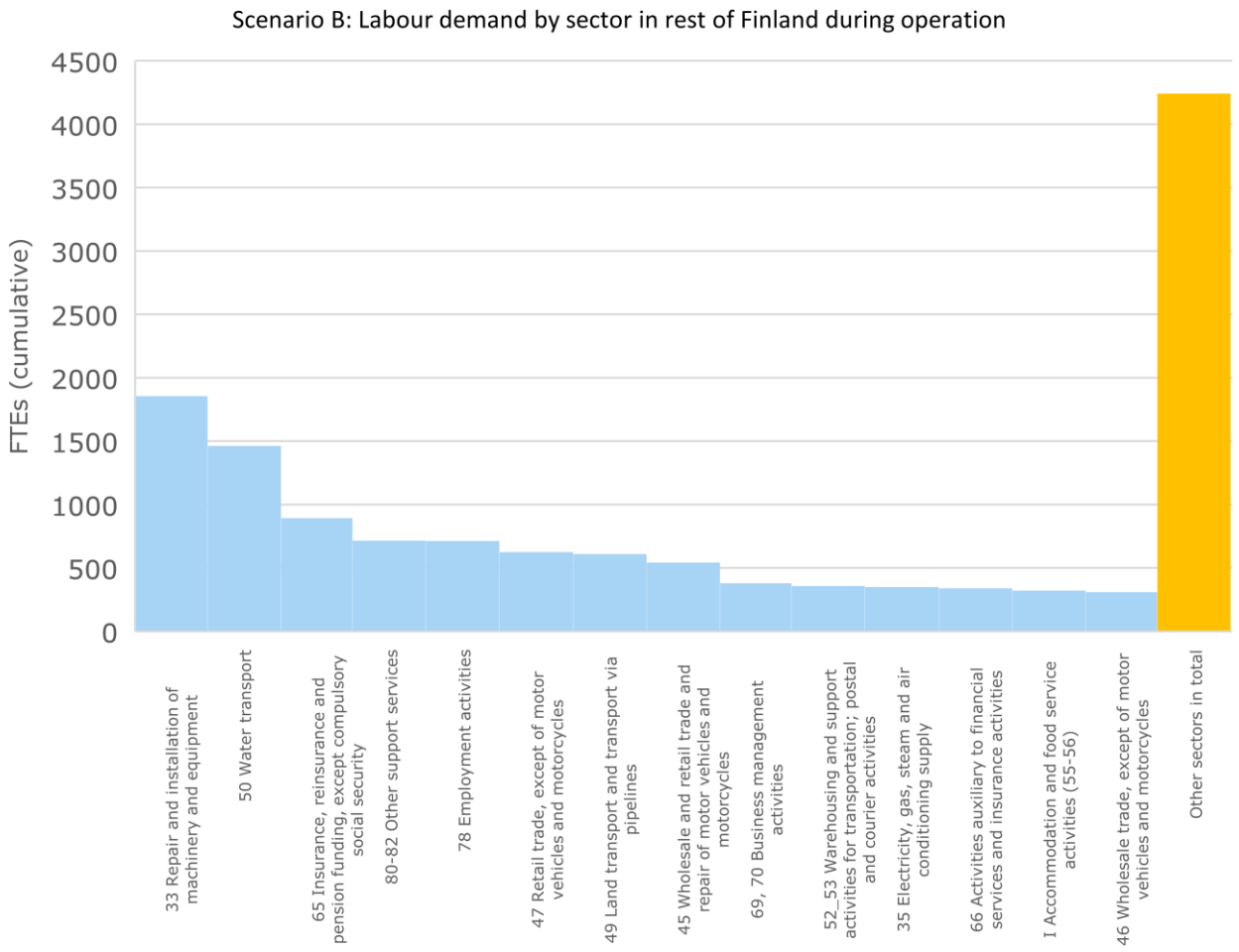

Figure 4-21. Labour demand in rest of Finland during the operation phase by sector

The generated demand will require labor across various sectors by 13 733 FTEs cumulatively in total which accounts to around 549 FTEs yearly on average as the operation phase is expected to take 25 years. Some of the emerging labor demand will be directed towards existing operations, while others will create entirely new labor demand. Similar to the economic impacts, the most significant employment effect caused by the project will be in the service industry, approx. 70 % of the total labour needs, and the manufacturing industry and related activities, approx. 26 % of the total labour needs (figure 4-21).

During the operation phase, all economic activities generate taxable income for both to the state and the municipalities in Finland. Within rest of Finland tax revenues are generated as a result of the economic activity brought about by the product and service purchases, totaling to approximately 560 million euros, distributed among different tax types as shown in figure 4-22.

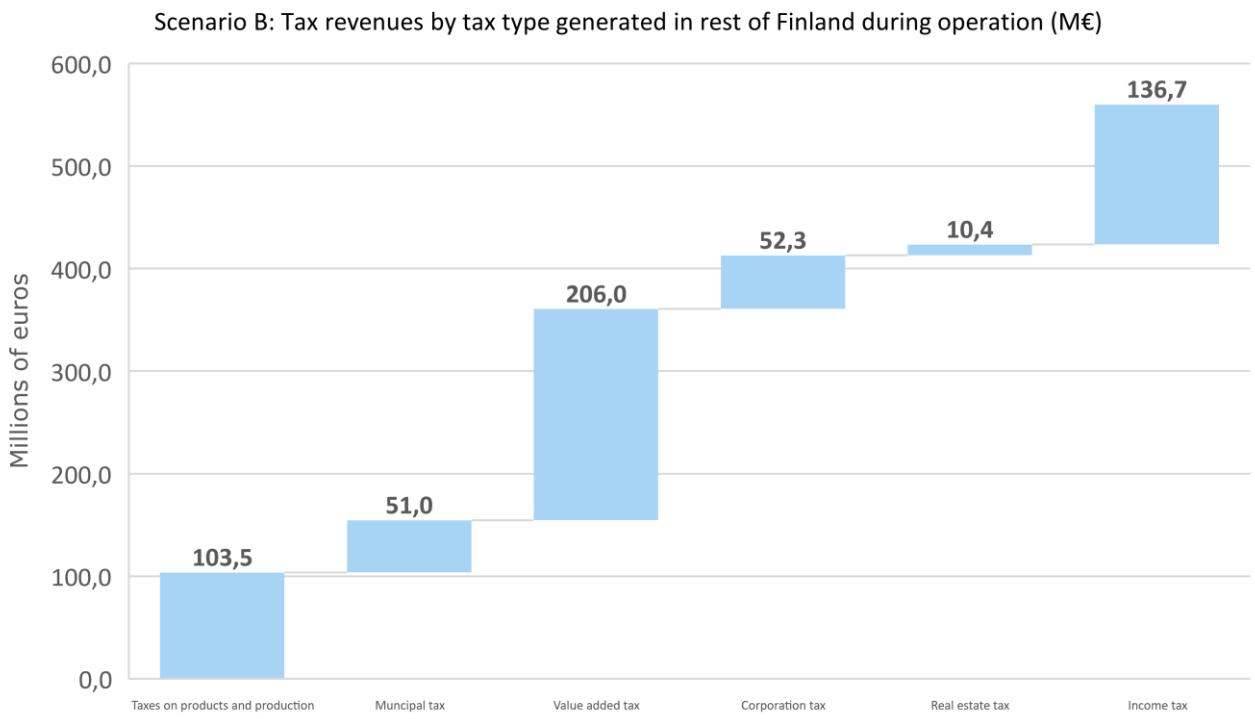

Figure 4-22. Tax revenues by tax type generated in rest of Finland during operation phase, , in the graph income taxes (state) include the share of taxes directed to wellbeing services counties which were previously paid as a part of municipal taxes in mainland Finland

Taxes have been calculated based on the economic activity taking place in rest of Finland. In practice municipal taxes are paid according to the municipality of residence of the employees. This means that that some of the calculated tax revenues may also flow to Åland, depending on how many employees commute from Åland to companies located in rest of Finland.

Table 7. Rest of Finland impacts in total and on average yearly through key indicators

	Scenario A	Scenario B	Scenario C
Output in total, M€	2 687	2 763	2 814
Value added in total, M€	1 213	1 246	1 269
Municipal tax in total, M€	49	51	52
Employment in total, FTE	13 163	13 733	14 146
	Scenario A	**Scenario B**	**Scenario C**
Output yearly, M€	107	111	113
Value added yearly, M€	49	50	51
Municipal tax yearly, M€	2	2	2
Employment yearly, FTE	527	549	566

Quite small differences between cumulative and yearly impacts in three evaluated scenarios exist as table 7 displays. This is due to many of the tasks expected to be able to be done more in Åland between scenarios. Also, in every scenario some expertise is needed from outside of Finland as well. There are no large differences between distinct sectoral changes in the scenarios as some of the sectors in rest of Finland see slight rise in impacts and some decline in impacts due to local companies in Åland being able to provide the needed services. Overall new specialized education and competence is needed in all of Finland to support all the offshore wind project planned to the territorial waters and EEZ in Finland.

4.4.4 Repowering

The windfarm is expected to be repowered before its end of life. This is expected to extend the windfarms total lifespan to 40 years or more and would require investments in new parts in addition to very good maintenance and monitoring through the windfarm lifetime. These additional investments have not been evaluated as a part of this assessment, but they can be seen to partially reflect impacts of the construction phase.

The main impact from repowering is the continuation of the windfarm operation which has impact on both the direct impacts and the value chain level impacts due to multiplicative effects. If the repowering happens at around 20-year mark of windfarms operation and would continue the operation by 20 years, we see a 60 % rise in cumulative impacts of the operational phase. In reality these impacts may differ as to how and to what extend the windfarm is repowered. Figure 4-23 displays the continuation of cumulative economic and employment impacts in rest of Finland from repowering of the wind farm.

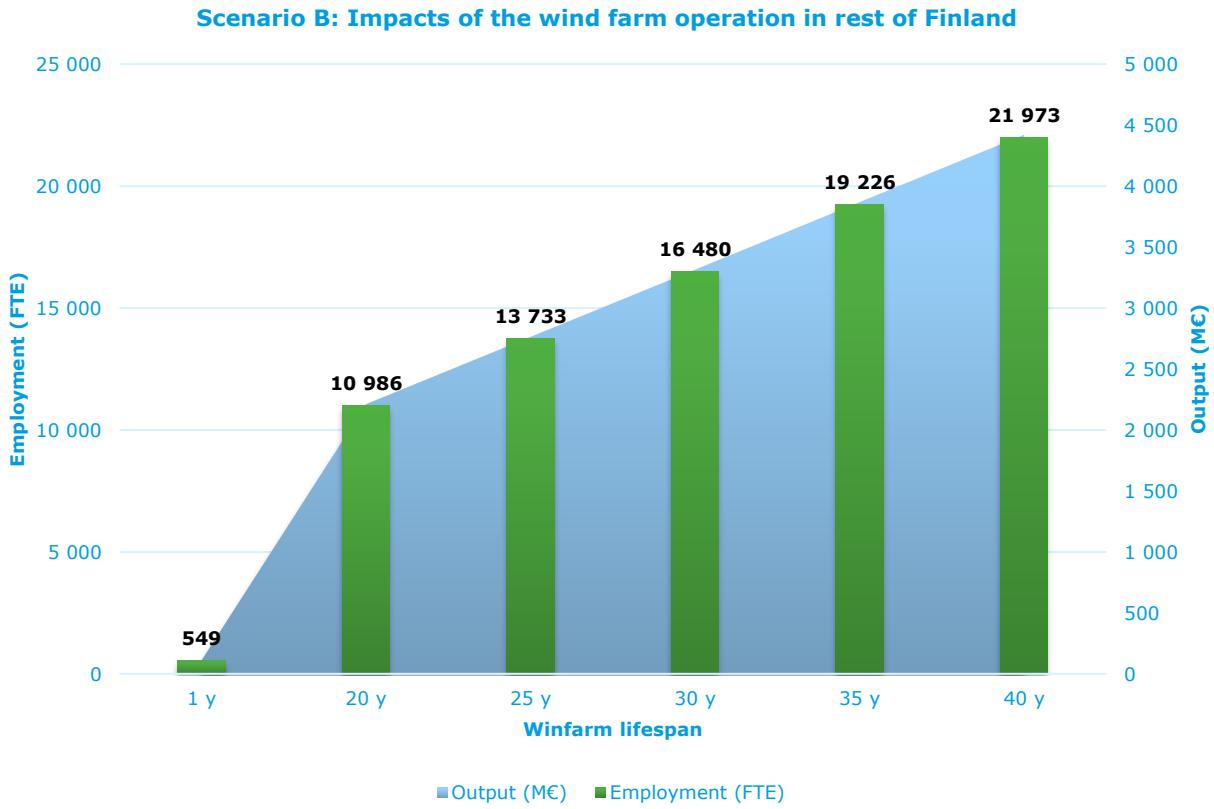

Figure 4-23. Regional impacts on output and employment during extended wind farm operational lifetime

Similarly, to the scenario B the cumulative operational phase impacts of other scenarios are estimated to grow 60 % as well throughout the windfarm lifetime if it is repowered. After the repowered wind farm meets its end of life many possibilities for the end use of farm exist such as decommissioning and sale of parts. However, this happens in very distant future and has neither been evaluated in the assessment though the activity would bring regional economic impacts as well.

4.4.5 Lifecycle impacts

The wind farm is expected to have many clear economic and employment impacts on rest of Finland. These impacts are clearly higher in rest of Finland than in Åland as more products and services required to make the project happen are available in the market. In rest of Finland cumulatively around 3-5 % of the impacts will occur during the development and planning phase, around 78-79 % during the construction phase and 17-18 % during the operation phase if the windfarms lifespan is 25 years (figure 4-24). Clearly the weight on Finnish impacts is more on construction phase impacts than operational phase impacts. This is due to some of the physical goods required in construction phase being available in the Finnish markets that are not available in Åland. However, if the windfarm is repowered 43-59 % off the impacts would occur during the extended operational phase. On the other hand, if the impacts are

inspected on a yearly basis on average a year of construction impacts is significantly larger than a standard year of operation or development and planning phase impacts.

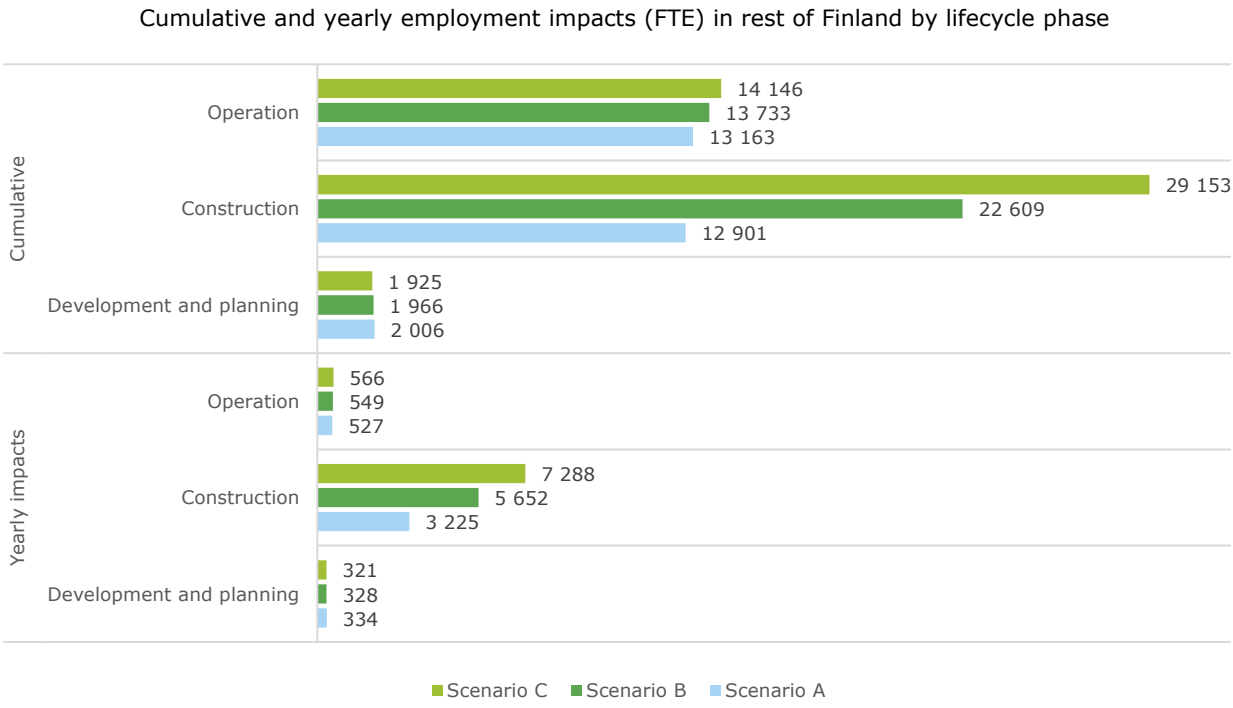

Figure 4-24. Cumulative and yearly regional employment impacts (FTE) by lifecycle phase in rest of Finland

The major differences between employment impacts in between scenarios are large only in the construction phase when examining the rest of Finland impacts. The biggest differences during the phase are identified in the construction industry (F), sector 33 repair and installation of machinery and equipment and in the construction industry and in the activity of sector 25 manufacture of fabricated metal products, except machinery and equipment as well as sector 71 architectural and engineering activities; technical testing and analysis. Cumulatively these differences on the four sectors employment demand make difference of over 6 000 FTEs in total between scenarios A and C.

5. ANALYSIS

5.1 Analysis of impacts overall

The planned wind farm project would have a massive economic impact both on regional and national scale (see attachment 1). The cumulative employment impacts across the lifetime of the project make up 6 449 – 14 469 FTEs regionally and 28 070 – 45 225 FTEs in rest of Finland. Yearly this corresponds to employment demand of 185-414 FTEs on average regionally across the project lifetime. If the direct employment impacts are also considered this corresponds to 194-431 FTEs yearly on average in Åland. In terms of economic impacts, the most probable scenario B will cause 763-million-euro impact on the GDP of Åland cumulatively or 22 million euros yearly on average, as a result multiplicative impacts, which is around 2 % of the current GDP of Åland. If considering the direct impacts also the yearly impact on GDP will be massive due to the sale of electricity. On the other hand, the cumulative impacts on Finnish GDP from rest of Finland impacts make up around 1-2 % of Finnish GDP though the yearly impact is quite small due to the size of the national economy.

The economic impacts to come from the project are very large and reflect the current economy. This means that as technology and market develop some tasks might become less labour intensive and the employment impacts smaller. At the same time new expertise need to be built both locally and nationally to serve the quickly growing offshore wind market. Both Finland and Åland have a massive opportunity to set themselves up strong within the value chains of offshore windfarm projects, after all the presented large impacts reflect only the impacts arising from realization of Stormskär and Väderskär project. This does require a forward-looking mindset and development of companies' product and service offerings even before the construction of the first new offshore wind projects begin.

5.2 Analysis of gaps

The results outline clear needs for products and services to be acquired from multiple sectors. Some of the most impacted sectors are the construction industry, repair and installation services, marine industry (water transportation) and the technical designs testing and analysis sector. If looking at the current economy of Åland we can see that Åland is very well fit to serve the project and the only sector lacking in required number of employees is the repair and installation of machinery and equipment sector during the construction phase (figure 5-1). To meet the temporary labour needs new experts need to be either trained locally or brought in from rest or outside of Finland.

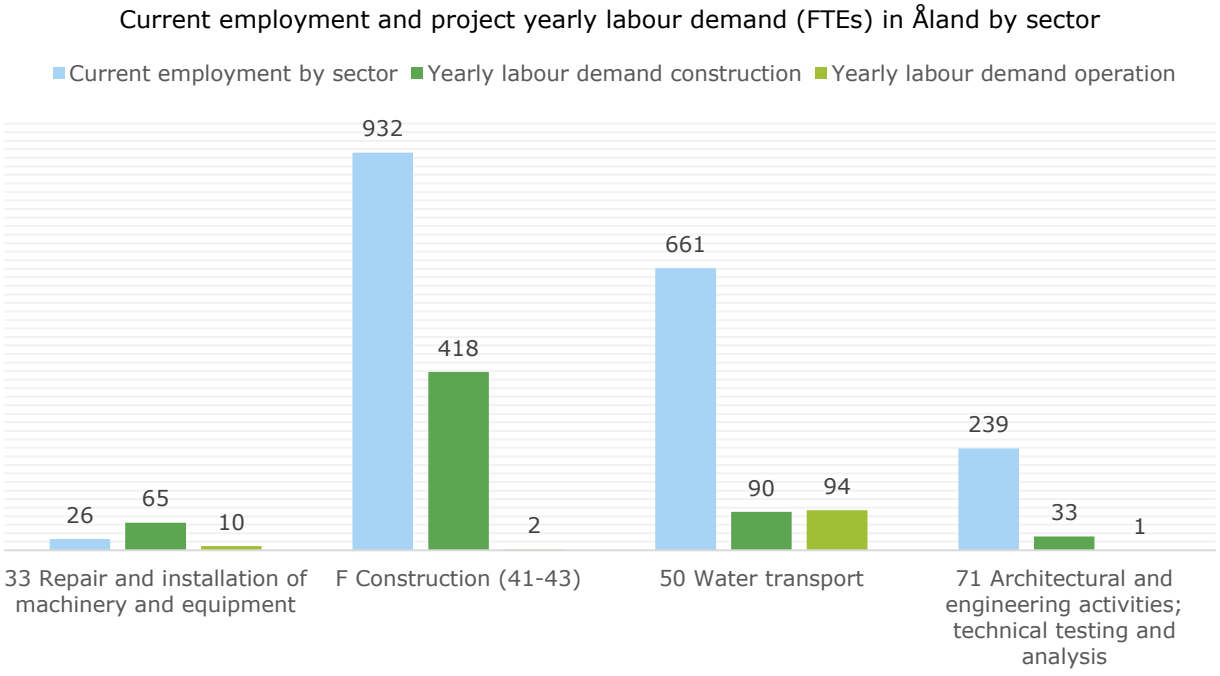

Figure 5-1. Current employment and project yearly labour needs (FTEs) on average by sector in Åland (Scenario B)

In reality all sectors do need to develop their offering the meet the new future needs, but the current situation gives a good indication on the availability of skilled workforce. It is also good to note that the current employment serves the current needs and if for example the spike in yearly labour demand of 418 FTEs come up in construction industry in Åland, which is approximately 45 % of current employment, some resources need to be pulled out of other planned projects if new workforce is not brought in and trained.

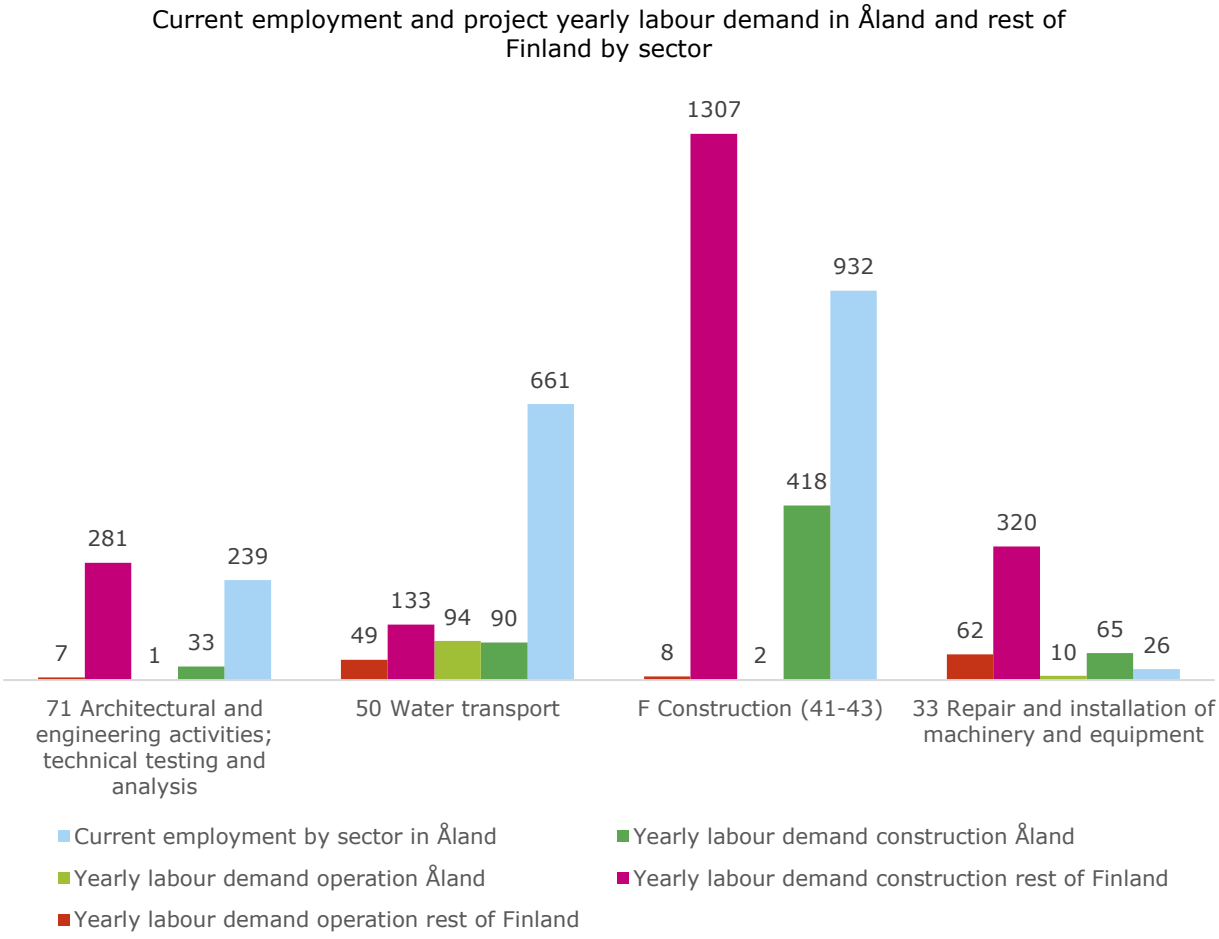

Figure 5-2. Current employment in Åland and project yearly labour needs on average by sector in Åland and rest of Finland (Scenario B)

If Åland was extremely ambitious in development of activities to support the wind farm construction and operation it can achieve greater regional impacts as scenario C outlined. However, if the ambition level was even higher some of the Finnish impacts could be obtained locally. If done so it is good to remember the limits and massive labour needs of the project. Figure 5-2 displays clearly that if all Finnish construction and installation work was to be done by experts from Åland the current capacity would fall well short. The attraction of new workforce to the region would and will in turn need more housing and streamlining process of relocating to Åland which requires consideration of language barriers, possession of properties and many other factors.

5.3 Analysis of impacts on Finnish economy

The results display that mainland Finland ("rest of Finland") is the recipient of most of the impacts as competence, services and production needed to support project accomplishment mostly exist already on the mainland though some new competencies need to be built and strengthened still. A multi-billion investment in Finland is always a big positive boost to the economy that impacts many actors in various sectors within the extended value chains. The biggest impacts will be seen on the construction industry, installation and repair (maintenance) services and in water transportation during construction. Ports in south-western Finland are the most likely ports to be used when hauling larger parts of the windmills to the project area on the sea. During operation the focus is mostly on expert maintenance services and water transportation. In development and planning phase (and throughout the project lifetime) technical

design and permitting services, surveys and other consultancy services are needed. With heavy focus on utilizing Finnish experts' new competences can be built that can be used later in supporting projects across Europe and globally if done right. Boost can be also seen in already active scientific research and development sector in Finland which is very advanced in the field and especially on ice research.

Overall, the biggest economic potential is in the construction and operation phase of offshore wind farm project. More impacts than estimated can be achieved if Finnish expertise and market develops quick. Few of the potential highlights where more economic impacts could be achieved are stronger positioning in service and operation of offshore wind farms (operational phase) and the manufacturing of resilient long lasting foundation structures suitable to Baltic Sea and other arctic environments (construction phase). Some potential exists also in production of smaller maintenance vessels and low-maintenance offshore bases that can be used to support the upkeep of operation of large wind farms.

5.4 Analysis of impacts on Åland economy

Åland will have big regional economic impacts for years to come if the assessed project is carried out. These impacts are heavily dependent on how much local expertise can be strengthened and utilized. This in turn requires inputs from both the investor and the region (the government, the companies and the education system). Though the results display most of the impacts to realize in the construction sector and installation services during construction phase and in the maintenance services, insurance sector and water transportation industry in the operating phase the multiplicative impacts spread out even more impacts throughout the economy (see figure 5-3 and attachments 2-4). It can be seen that for example the slight decline in marine industry activities (employment and turnover) in Åland can be somewhat negated as a result of the project if the market reacts and develops its offering and current maritime transportation connections.

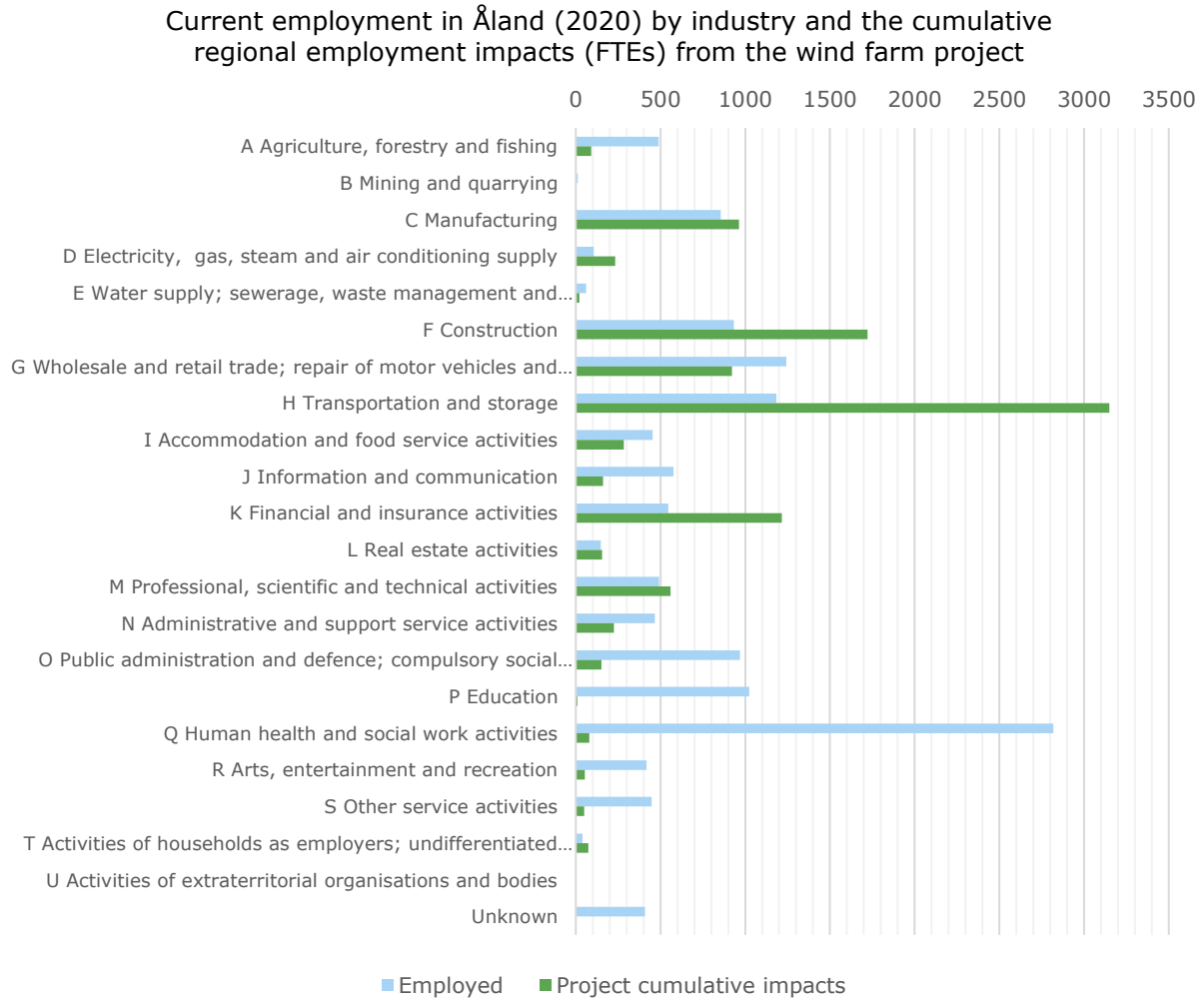

Figure 5-3. Employed persons by industry in Åland (2020) and the cumulative regional employment impacts (FTEs) of scenario B

New services are not only needed to support the project but also for the new workforce who relocate to Åland either temporarily or permanently. This means new housing might be needed both close to the project area (northern Åland) and in residential clusters such as Mariehamn. The existing properties near the project area might therefore see a rise in property values as commonly new jobs and industries create increase property values nearby. Overall, it has been found in a Danish study that offshore wind farms in distance have very little impact on property values on nearby shores (Jensen et al., 2018). Therefore, the impacts on property values are very dependent on where supporting mainland operations are setup. Many of the new workers are likely to bring their families with them who do also need services, jobs, kindergartens and schooling that are not directly estimated in the assessment. This means both that the impacts (employment, GDP, taxes…) are potentially larger but also that the stress for the local system grows which means new officials are needed for education, healthcare, administrative and other positions. What this also means is that population of Åland most likely grows and more so the share of population in working age will grow.

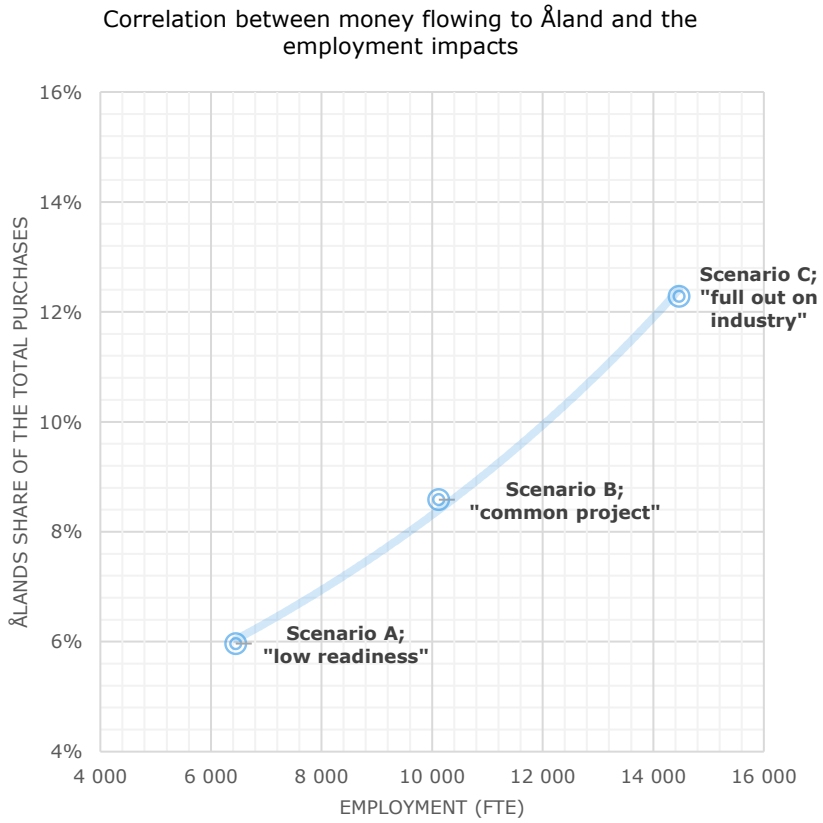

Figure 5-4. Correlation between money flowing to Åland (share of purchases) and the employment impacts (FTEs) between scenarios A, B and C

It is evident that more money flowing to Åland leads into more employment impacts, more market development and more taxes. The correlation is clear when looking at the differences in impacts by scenario (figure 5-4). Overall positive impacts can be seen across multiple industries. Key to capturing these impacts is readiness of Åland. Currently we can see that the readiness is at the stage just shy of scenario A. However, as the project develops the market has to and will naturally react. This will move the impacts closer towards the scenario B but to achieve the "co-operation project" results some inputs are needed from the government itself as the results clearly display a need of new resources in e.g., repair, installation and maintenance services. Moving further in order to achieve the scenario C results the region has to move deeper into more of a co-development setting where the anticipated employment and other regional development needs are perceived and discussed years in advance. Inherently, it is a two-way stream and clear commitment is needed from project developer as well.

Building of the offshore wind farm brings about additional possibilities that are not currently estimated to happen in Åland if the project is carried out. One of the biggest opportunities is the service and operation of wind turbines itself that is expected to be coordinated and carried out from and outside of mainland Finland. However, there is a good possibility that a service operator could set up a subsidiary in the region

in right conditions which can be promoted by making governmental practices and investment conditions clearer in the region. This in turn would localize more impacts than assessed to Åland.

Many other more uncertain potential impacts that could occur as a follow up of building the wind farm exist as well. These include development of completely new business operations and deep expertise for the regional market in emerging and growing subsectors such as electromagnetics, robotics as well as development of new maintenance methods by using e.g., drones (for wind farms and other facilities) among other fields. One other possibility that applies for Åland as it does for Finland is ice where Åland has a long-standing history operating on. The conditions in Baltic Sea are quite unique and offer learning opportunities on e.g., the potential offshore wind production that could become of use in other similar "arctic conditions". There is potential to develop deep knowhow on both operating underwater and in extremely high altitudes in varying difficult conditions whether it is by person or by remotely operated technological unit such as drone. New business could additionally be built on wind research and on industrial tourism in future. These are some of the possibilities that might realize in future if the wind farm project is executed but have not been estimated quantitatively in the assessment.

As has been earlier outlined to succeed the project needs inputs and actions from all three the government of Åland, the industry and Ilmatar. Some steps are integral in order to make the project happen and to regionalize the impacts and some are steps that may enable even more impacts to be captured locally. **Some of the key steps that officials and local companies have to take into account are**

- Make sure there is enough and skilled staff to oversee the official side of permitting and other procedures along the project timeline
- Invest in education proactively to have more local experts and workforce participating in project
- Make sure there are not too many barriers for new people relocating to Åland either permanently or temporarily
- Be aware that relocating workforce are likely to bring their families with and need variety of basic services
- Make the taxation and governmental procedures clearer for current and future investors
- Make sure enough temporary housing exists during construction and permanent housing during the operation phase
- Infrastructure needs to be strengthened in the northern Åland to support moving of products and personnel
- Encourage the further development of marine transport connections between Åland and Helsinki, Turku and Stockholm
- Make it attractive for key subcontractors (e.g., turbine maintenance) to set up Åland local offices and operation in order to capture more clear regional impacts
- Build on the new special capabilities to be developed locally and consider what other potential business avenues they may open for Åland in future

Ilmatar can and has to support the region in order to maximize the regional impacts. **Some of the key steps that the Ilmatar has to do are**

- Have a transparent and constant dialogue with the officials about the project status, needs and potential impacts
- Map out the local experts, subcontractors and other companies and communicate your needs well in advance
- Try to opt for local and Finnish partnerships and subcontracting when and if possible
- Support the regional education system to make sure enough local experts exist at different project phases
- Formulate ideas on what other activities besides offshore wind production could be built around new operation by local companies and be open to new ideas of synergies
- Consider the locals and keep them well informed over the project steps, actions and impacts

The completed assessment and suggestions have been done based on current knowledge, economy and its gaps. Therefore, it is pivotal to understand the timeline of the project and that major part of the project and investments will realize well in the future. During the time regional and Finnish economy, market and procedures can and will develop. Hence, when looking back the assessed impacts should be reflected in relation to the current situation.

6. CONCLUSIONS

The construction of the planned offshore wind farm project as per co-operation project will have significant economic impacts both regionally and nationally. If realized, the project will generate over 9 billion euros of new output in the Finnish economy as a result of multiplicative effect during the project lifetime and create a total demand of over 48 000 FTEs of labor. If also the direct impacts are considered new turnover generated significantly exceeds this and employment impacts draw even closer to 50 000 FTEs even if the wind farm is not repowered. If repowered the cumulative employment impacts will rise by about 20 % and economic impacts even more. Additionally, the project would enhance regional vitality, bring up new economic opportunities and significantly increase the amount of renewable energy produced in Finland.

During the development and planning phase and the construction phase, new turnover of over 680 million euros will be generated in Åland, of which the value-added is approximately 295 million euros. The businesses within the project value chains will invest approximately 60 million euros in new equipment, machinery, facilities, and properties in the region during this period to ensure they can offer competitive and up-to-date products and services to other stakeholders in the changing economic situation. Simultaneously, the economic activity resulting from the development, planning and construction of the offshore wind farm will create new demand for labor regionally, amounting to over 4 580 FTEs of labor demand, and to over 24 500 FTEs of labor demand elsewhere in Finland. Tax revenues will also accumulate during this period, totaling to over 1 070 million euros overall in Finland, consisting of value-added taxes, product and production taxes, corporate taxes, property taxes, municipal taxes, and income taxes. However, only few percent of these taxes accumulated is paid to Åland municipalities.

During the production phase, there will be numerous positive economic impacts on the region and the entire Finland. Over the course of the production, the offshore wind farm will, through multiplicative effects, generate an annual labor demand of over 19 200 FTEs across Finland, of which nearly 30 % (over 5 500 FTEs) will be seen in Åland islands. Simultaneously, employee compensations paid will amount to over 860 million euros, and tax revenues will reach approximately 710 million euros in Finland due to the multiplicative effects. Some of these taxes will be directly allocated to municipalities where economic activities arise from the value chains of the offshore wind farm's operations. However, the majority of the taxes will be paid to the Finnish state, similar to the development and planning and the construction phase. The direct impacts during operation will significantly boost the total regional economic impacts and an annual employment need of 9-17 FTEs is also generated as a result of Ilmatars own operation in Åland.

The quantitative results have only considered the demand effects of the projects on the regional economy without addressing whether the demand will be met by existing jobs or new jobs. Moreover, other displacement effects have not been accounted for in the modeling. Depending on the industry and the amount and type of demand, it may not be possible to fulfill all new demand with regional, or even national, products, services and labour. In the assessment, this was taken into consideration based on the best available information, utilizing the current offerings of companies operating in Finland, sector-specific demand for products and services, and supply at both regional and national levels. Therefore, the assessment scenarios considered constraints related to the availability of skilled labor, as well as the supply of necessary products and services, using regional accounting, national economic accounting, and statistics from the customs authority at different regional levels. It is also possible that the projects will accelerate the development of entirely new industrial activities and services in Finland and Åland. This possibility was qualitatively discussed in the assessment. However, the realization of certain larger opportunities would likely require the execution of multiple other offshore wind farm projects planned for the Baltic Sea.

The evaluation involves several uncertainties, and a key factor in realizing the estimated economic impacts is how the centers of expertise, clusters and singular companies operating in Åland and elsewhere in Finland can adapt and develop their activities so that they have competitive products and services available as the construction of the offshore wind farm begins to come reality. During production, it is also crucial that local companies respond to the changing demand and are able to develop their operations in the right direction in a timely manner. It is important to maintain close communication on this matter between Ilmatar, regional administrative bodies and the local municipalities. Additionally, many new regional impacts could be achieved by attracting wind turbine service and other companies working within offshore wind value chains to set up operation in the region. This in turn would require early openness about future suppliers from Ilmatar and clear efforts from the region to attract the service companies.

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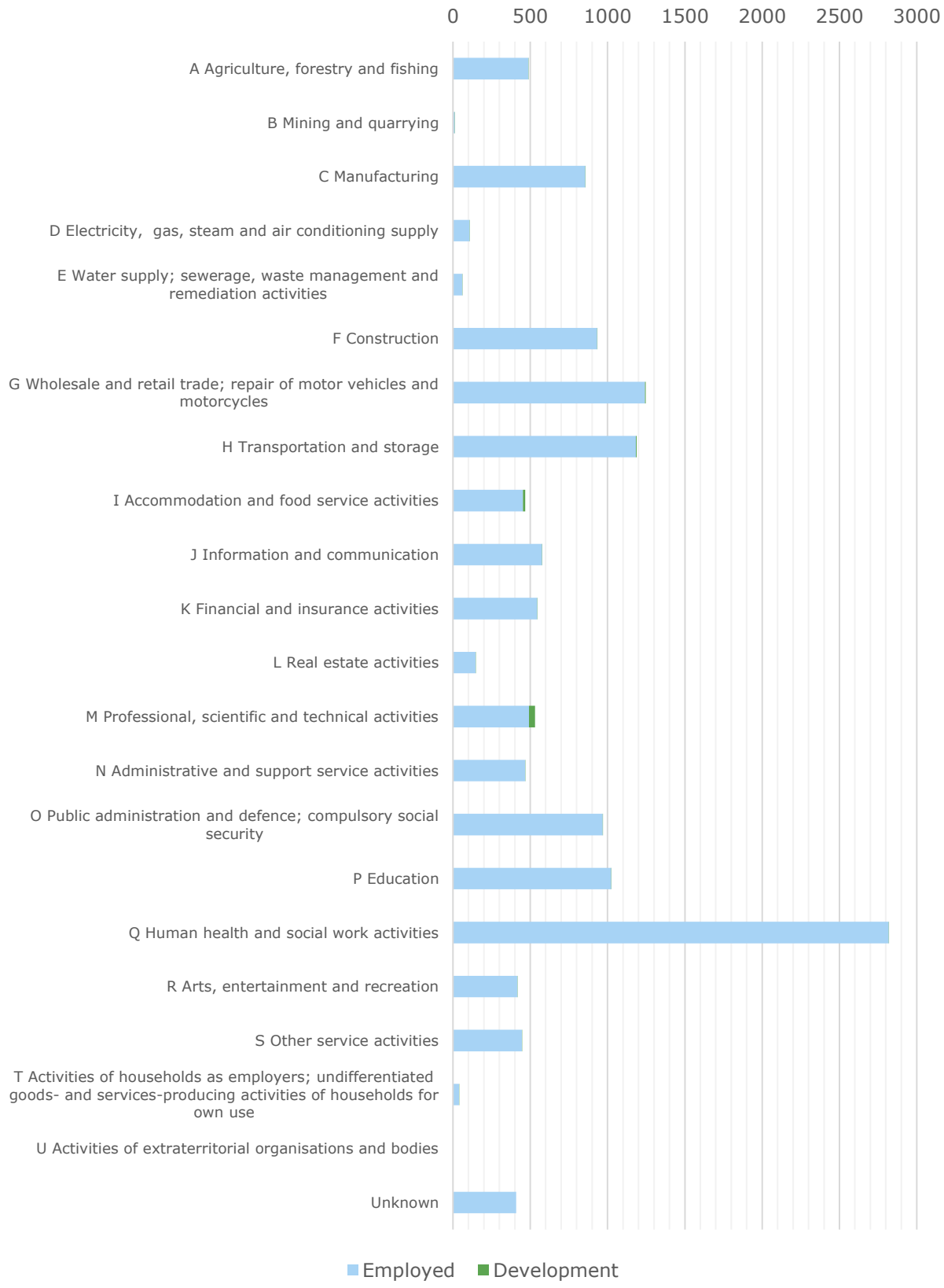
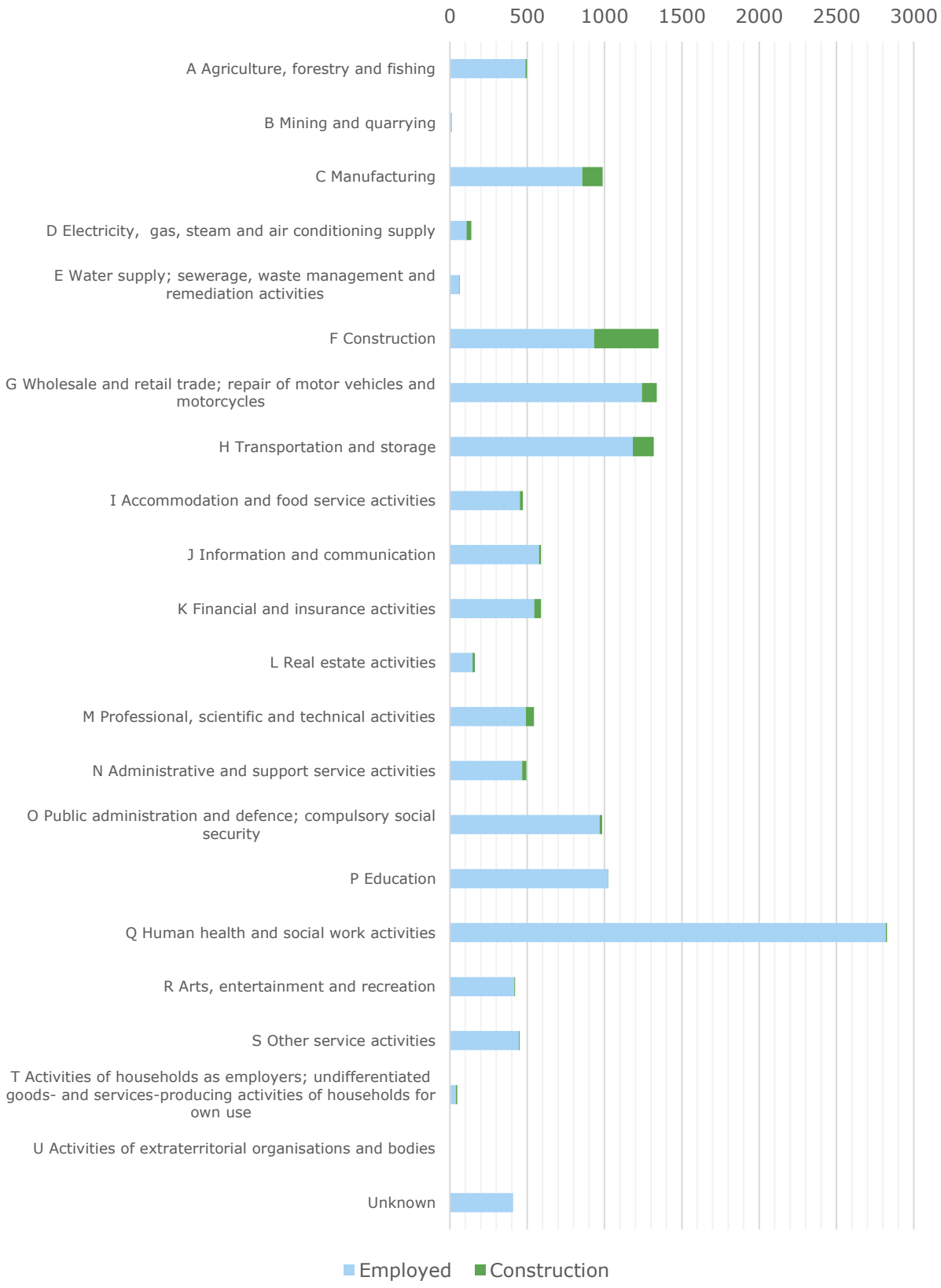
8. ATTACHMENTS

	Scenario A			Scenario B			Scenario C		
	Development and planning	Construction	Operation	Development and planning	Construction	Operation	Development and planning	Construction	Operation
Åland cumulative impacts									
Output in total, M€	30	335	732	40	642	913	49	1 000	1 141
Value added in total, M€	14	147	333	19	275	397	24	427	480
Municipal tax in total, M€	1	10	23	2	20	30	2	31	38
Employment in total, FTE	347	1 997	4 105	435	4 151	5 536	522	6 739	7 209
Rest of Finland cumulative impacts									
Output in total, M€	293	2 638	2 687	288	4 447	2 763	282	5 794	2 814
Value added in total, M€	150	1 098	1 213	147	1 847	1 246	144	2 362	1 269
Municipal tax in total, M€	8	47	49	7	81	51	7	104	52
Employment in total, FTE	2 006	12 901	13 163	1 966	22 609	13 733	1 925	29 153	14 146
Åland average yearly impacts									
Output in total, M€	5	84	29	7	161	37	8	250	46
Value added in total, M€	2	37	13	3	69	16	4	107	19
Municipal tax in total, M€	0,2	2	1	0,3	5	1	0,3	8	2
Employment in total, FTE	58	499	164	72	1 038	221	87	1 685	288
Rest of Finland average yearly impacts									
Output in total, M€	49	659	107	48	1 112	111	47	1 448	113
Value added in total, M€	25	274	49	25	462	50	24	590	51
Municipal tax in total, M€	1	12	2	1	20	2	1	26	2
Employment in total, FTE	334	3 225	527	328	5 652	549	321	7 288	566

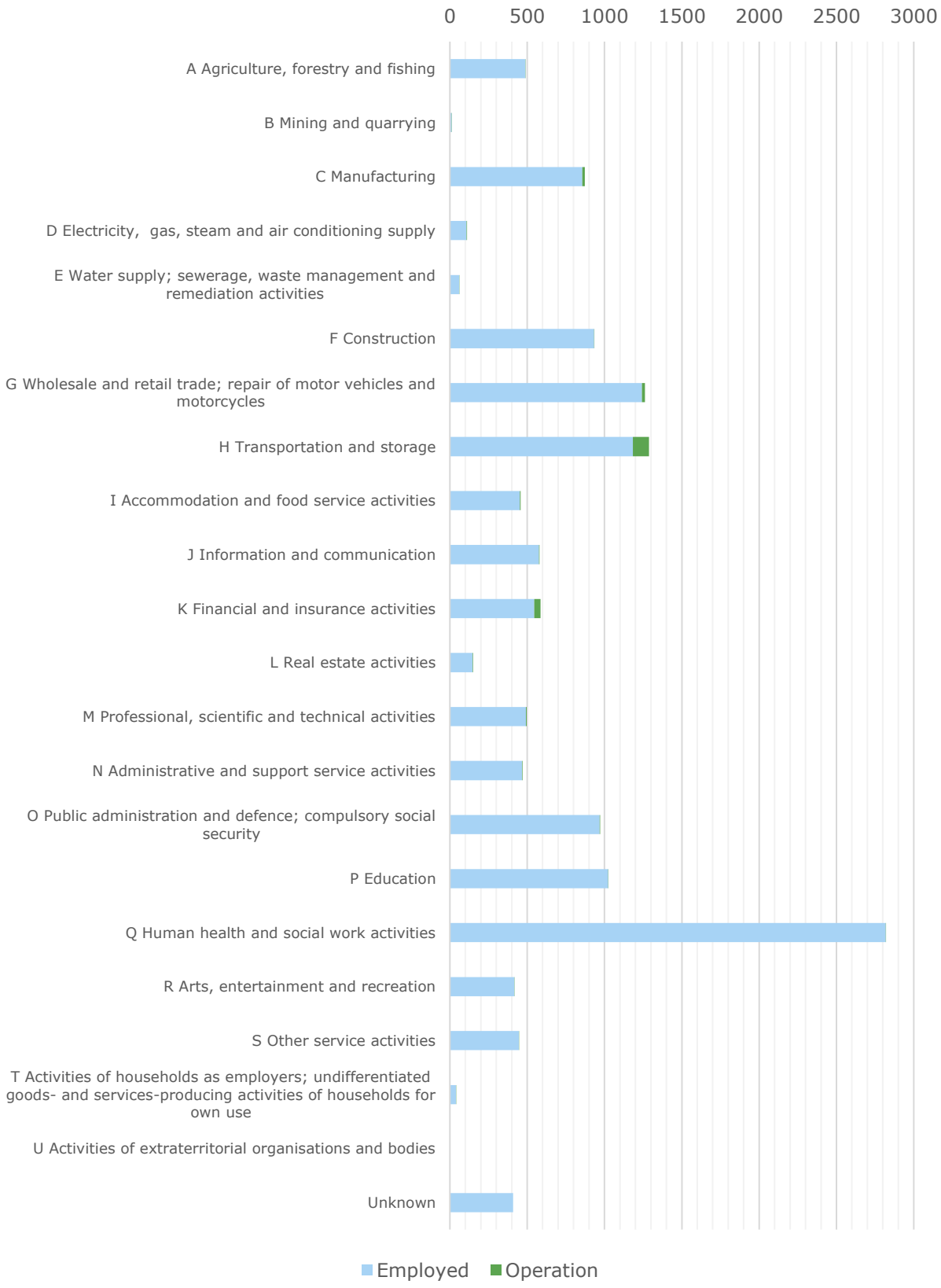
Attachment. 1 Regional and rest of Finland impacts in total and on average yearly through key indicators



Attachment 2. Employed persons by industry in Åland (2020) and the average yearly regional employment impacts (FTEs) of the development and planning phase in scenario B



Attachment 3. Employed persons by industry in Åland (2020) and the average yearly regional employment impacts (FTEs) of the construction phase in scenario B



Attachment 4. Employed persons by industry in Åland (2020) and the average yearly regional employment impacts (FTEs) of the operation phase in scenario B