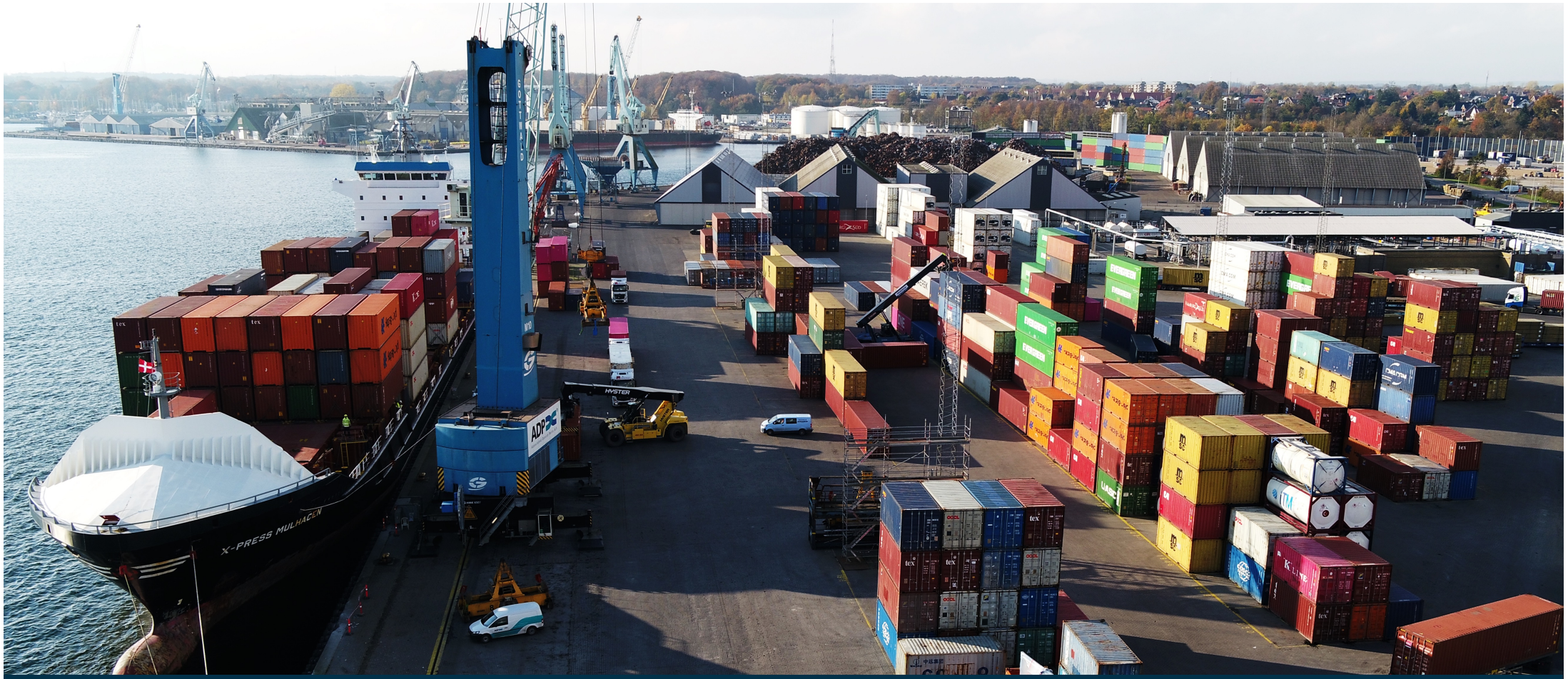



# Market Outlook of Danish Container Ports

A market report commissioned by Danish Shipping

26.11.2024

junior consult

## Supply & Demand Gap Analysis

**Junior Consult finds Denmark can fulfil future demand of container throughput without further port expansions**

- Aarhus, Fredericia and Copenhagen are projected to work with a high port density.
- Esbjerg, Aalborg and Kalundborg are expected to operate with low densities.
- By engaging in collaboration groups, it is assessed that Denmark will collectively be able to cover all future volume increases from 2023 to 2043.

## Volume Projection

**Container throughput in Danish ports is expected to grow with a CAGR of 2.2% from 2023 to 2043**

- Aarhus and Fredericia are projected to drive 82% of the future volume increase due to high efficiency, great locations, and recent performance.
- Europe and the Americas are projected to drive 81% of growth, with Europe being the main region of growth. APAC is expected to grow, but it is stagnating compared to recent years.

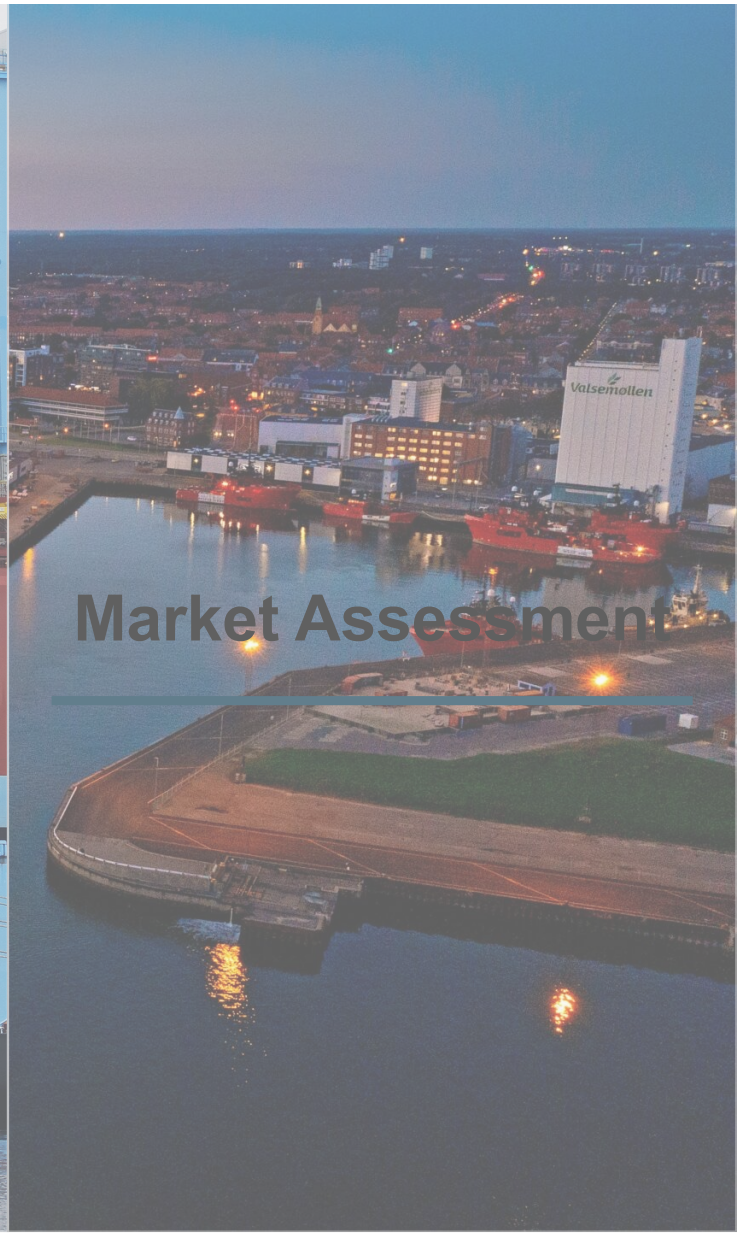
## Market Assessment

**The market for container shipping is highly competitive between ports despite clear market leaders in Aarhus, Fredericia, and Copenhagen**

- Container throughput has experienced annual growth of 2.2% over the past decade, where Aarhus and Fredericia have gained a combined market share of over 80%.
- As shipping costs have increased, cargo owners have increased their focus on price, pushing sustainability as a competing parameter for the future

## Demand & Supply Gap Analysis


## Volume Projections



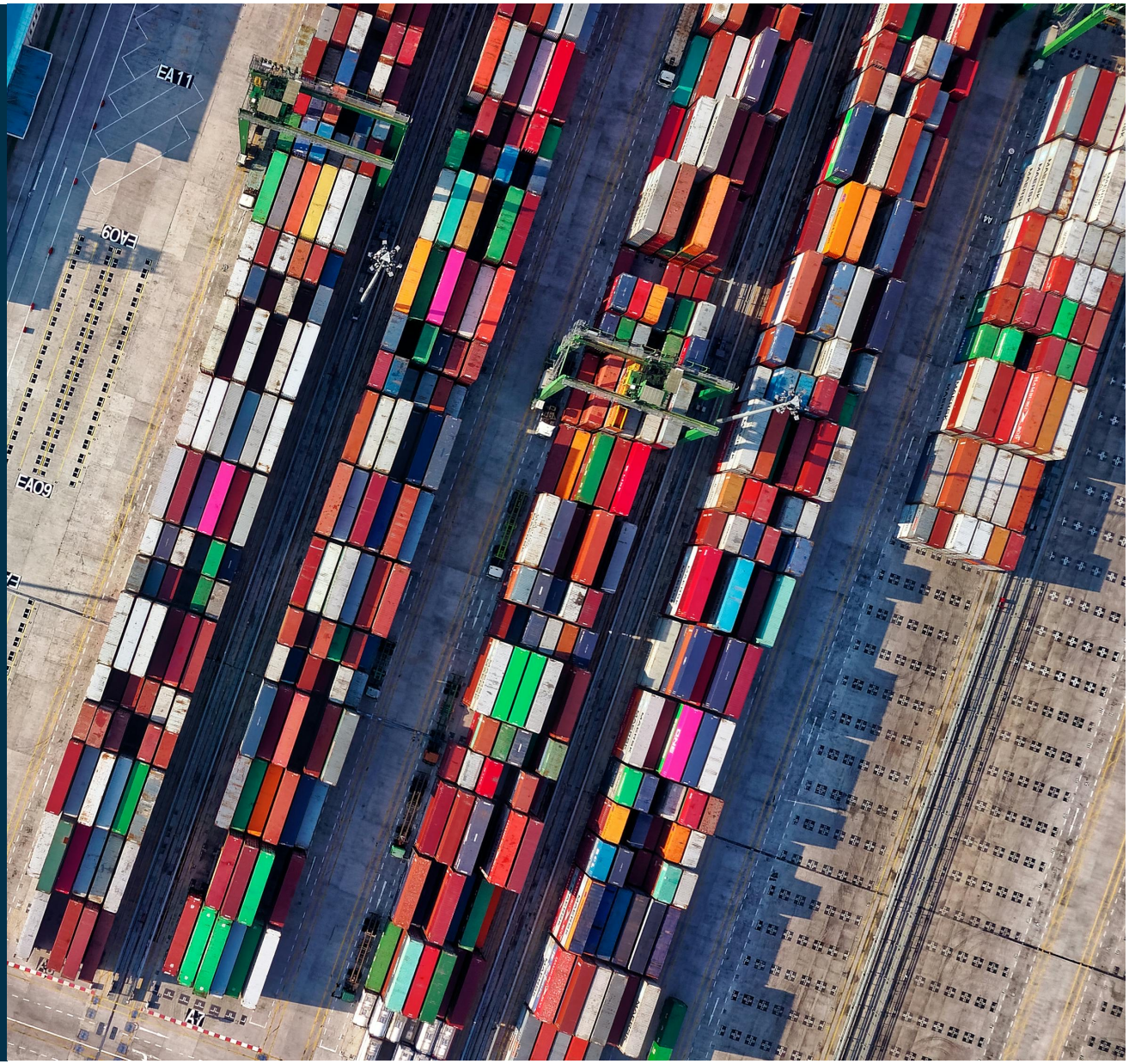

## Market Assessment

# Agenda

1 Executive summary of Gap Analysis

2 Introduction to method for gap analysis

3 Overall analysis for gaps in Denmark



# Junior Consult believes that Denmark is positioned to fulfil future demand without further port expansions

**1**
Method

- The gap analysis utilizes a density measure (TEU[1]/m$^2$) to examine whether Danish ports can handle projected volumes. An increase in the density measure implies that Danish ports must operate more efficiently to handle throughput.
- Two methods are utilized. Firstly, the increase in density (and thereby in efficiency/productivity) will be compared to the Danish productivity growth from 2003 to 2023. Secondly, the required density levels in 2043 for Danish ports will be compared to European ports. The two methods will collectively answer the question of whether Danish ports must expand further or not.

**2**
Collective Coverage

- Danish ports can collectively cover future throughput. This is strengthened by the possibility of engaging in collaboration groups.
- Mid Jutland, Northern Jutland, Southern Denmark, as well as Zealand, are assessed to collectively cover the total demand despite the high expected density in Aarhus, Fredericia and Copenhagen.
- Aarhus, Aalborg, Fredericia and Esbjerg may all be able to cover each other even though they are in different groups in this report.

**3**
Port Coverages

- Aarhus, Fredericia and Copenhagen operate at relatively high-density levels, but it is assessed that no port expansions are needed. Although Aarhus is above its peers in density levels, collective coverage and their high efficiency make them capable of covering future demand.
- Esbjerg, Aalborg and Kalundborg all operate at very low-density levels. This indicates they can cover demand from ports that are expected to experience future demand pressure.

[1] TEU equal to 20-foot equivalent unit

# The terms “density”, “productivity”, and “efficiency” will be used interchangeably throughout the report, but they all seek to understand whether port expansions are necessary in the future

Throughout the gap analysis, the term density level will be used to examine whether Denmark can accommodate future throughput without increasing container terminal capacity in Danish ports

The density level of Danish ports will be measured as TEU/$m^2$, indicating how much throughput the ports will experience per area of container terminal.

The density measure is used to understand whether Danish ports will be required to operate more efficiently/productively in the future in relation to the capacity.

**Readers must, therefore, be aware that when the report states facts about the density level, this is done to understand the required efficiency/productivity of Danish ports in the future.**

This also implies that the use of words such as “density”, “efficiency”, and “productivity” may be used interchangeably with the sole purpose of understanding whether Danish ports can fulfil future demand by not making further port expansions other than currently planned capacity increases.

# Two methods will be applied to examine the future growth in TEU throughput of Danish ports

**Two methods are used to examine whether Danish ports are positioned to fulfil future demand**

**Method 1** — **Analysis of the Danish productivity development**

The first way to examine the future growth of Danish ports is to compare the required increase in productivity until 2043 with the historic growth rate in Danish productivity within trade and transport. A relatively high CAGR within Danish ports would imply a potential need for further expansion.

**Method 2** — **Benchmarking against effective European ports**

The second method examines the current density of large and effective European ports with the density of Danish ports. This method sheds light on whether Danish ports will be required to operate more efficiently to successfully accommodate for higher density on the ports compared to European ports.

**Applying the two methods simultaneously allows for a comprehensive and accurate evaluation of whether Danish ports can fulfil future demand only through productivity gains or whether port expansions will be a necessary strategy.**

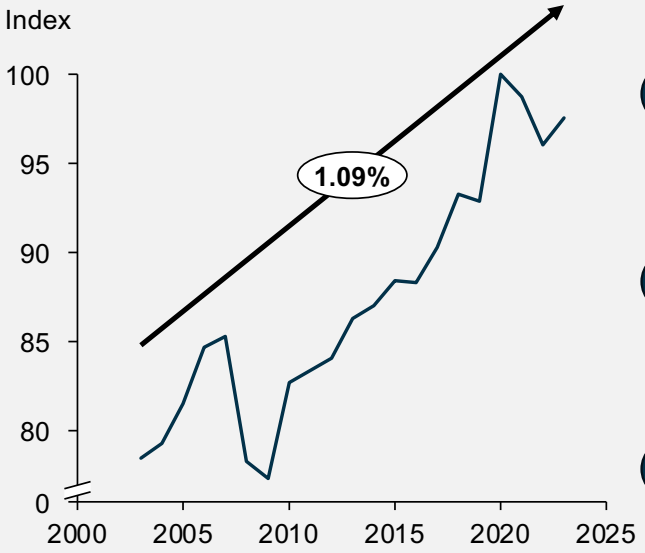
Method 1 sheds light on whether the required productivity growth in Danish ports is high or low compared to the overall Danish productivity growth. However, this method does not consider required productivity levels. Therefore, Method 2 incorporates required productivity levels to paint a nuanced picture.

# The first method seeks to compare the productivity development of Danish ports with the Danish productivity within trade and transport

## Method 1: Productivity development for Trade & Transport in Denmark

**The development in Danish productivity within trade and transport is a good indicator of whether the required productivity described in this report is achievable or whether Danish ports must expand to fulfil future demand**

### Danish productivity has increased by a rate of 1% over a 20-year-period




1. The Danish productivity development has been mapped to compare Danish port productivity development with this measure
2. The productivity data is from “Trade and Transport”, as this is the productivity measure that best captures port activities
3. Productivity is a measure of “how efficiently labour is used to produce goods and services”[1].

### Key Take Aways

The Danish productivity development has been mapped to compare the 20-year CAGR of 1.09% to the CAGR in required productivity for each Danish port.

In essence, the increase in volume can be handled by either increasing the terminal area or becoming more efficient within the port. If the density measure increases through the period, the additional throughput must be handled by achieving higher efficiency.

Source: Danmarks Statistik, Junior Consult analysis
Note: [1]Definition from Danmarks Statistik

# The second method seeks to compare the required productivity levels in 2043 for Danish ports with productivity of large and efficient European peers

## Method 2: Density levels of efficient European ports

**The productivity levels of six large and efficient ports are used to evaluate the current and required productivity levels of Danish ports**

### Benchmark Ports

| Port name | Productivity (TEU/m²) |
|---|---|
| Rotterdam | 13.50 |
| Antwerp | 3.20 |
| Gdansk | 2.27 |
| Hamburg | 1.75 |
| Bremerhaven | 1.45 |
| Goteborg | 1.14 |

### Selected peers for comparison

The following three European ports have been chosen as peers for Danish ports

1. Hamburg
2. Bremerhaven
3. Goteborg

These ports have been chosen as peers based on their size (measured in m²), throughput each year, and their implied productivity levels. Based on these criteria, the three ports are deemed the best peers for comparison.

### Key Take Aways

By comparing the current density levels of Hamburg, Bremerhaven and Goteborg with the required density levels of Danish ports, the analysis can more accurately examine whether Danish ports are currently equipped to fulfil future volume increases.

The analysis will consider the increase in density levels and the density level itself to build a more nuanced picture of the future of Danish ports and their readiness to handle volume increases.

Source: Port websites, Junior Consult analysis

# The throughput to Danish ports is projected to outgrow the planned capacity increases from 2023 to 2043

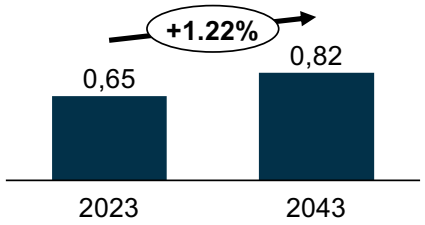
### Terminal area

**1,434 tm²** (2023) → **1,729 tm²** (2043)

### Volume ('000 TEU)

**926** (2023) → **1,424** (2043)

### Density Measure (TEU/m²)




| 20-year CAGR in Danish Productivity level | CAGR for required density level |
|---|---|
| 1.09% | 1.22% |

| Average density among selected peers | Required density level in 2043 for Denmark |
|---|---|
| 1.45 | 0.82 |

### Insights

Danish ports are projected to expand their terminal area by nearly 300,000 m². However, Junior Consult estimates that TEU throughput will increase by 500,000 TEUs over the same period. This suggests that Danish ports will need to boost productivity by 1.22% annually to accommodate the increase in density level, implying a ≈12% higher yearly productivity growth than the last 20 years.

When comparing the required density level of Danish ports in 2043 with the average density level of selected peer ports, it becomes evident that Danish ports will be operating at just above half the efficiency of these peers.

This analysis demonstrates that expansions in terminal area may not be necessary to meet future demand, as productivity improvements and collective coverage can sufficiently handle the expected growth.

Source: Junior Consult Analysis

# The sensitivity analysis indicates a low difference from the base case to the high and low scenario, respectively, implying that the analysis will solely build on the base case scenario

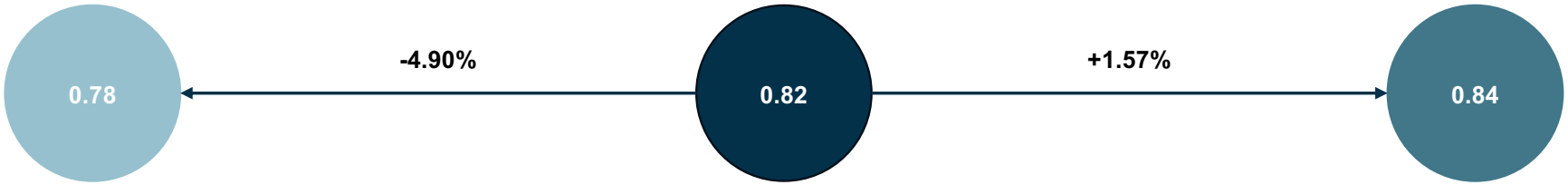
**The full gap analysis will solely build on the results from the base case in the forecasting model.**
This is deemed appropriate as the required productivity levels are not highly different in the high or low-case

**The current total density level for Denmark as of 2023 is 0.65**

**Low Case**
(Total required density level in Denmark)

**Base**
(Total required density level in Denmark)

**High**
(Total required density level in Denmark)




**As the scenario analysis indicates a low sensitivity in the required density levels, the gap analysis will solely consider the base case scenario.**

Source: Junior Consult analysis

# To examine whether Denmark must plan further port expansions, Junior Consult has split Denmark into four geographic areas that can collectively cover each other in case of demand pressure

## Solutions to volume increases

Ports can handle throughput increases in three different ways.

- **Increase the container terminal area**
- **Increase the productivity of the port**
- **Create collective coverage between Danish ports**

This section will focus on whether Denmark can cover future volume increases by ensuring collaboration between Danish ports. If some Danish ports operate at low productivity levels, Denmark may be able to cover full demand by offloading some of the traffic from high-productivity ports to low-productivity ports.

## Geographical split for collective coverage


1. Northern Jutland
2. Mid Jutland
3. Southern Denmark
4. Zealand

To accommodate future volume increases, four regions in Denmark will have to collaborate to cover future throughput increases collectively.

Source: Junior Consult analysis
Note: [1]Measured in TEU / m²

# The four geographic areas can be mapped in a matrix to examine their required growth in density levels and expected density levels in 2043 to examine the potential need for further port expansions

## Criteria for coverage between regions

The following three criteria must be met for ports to be able to cover each other.

**1 Fair hinterland distance between the ports**

The ports that are to cover each other must be within a fair distance such that shipping companies will use them in alternative routes and the end destination remains reasonably close.

**2 Excess supply**

One of the ports within a fair distance must have an excess supply indicated by a low productivity level such that they have the capacity to offload traffic from other busy ports.

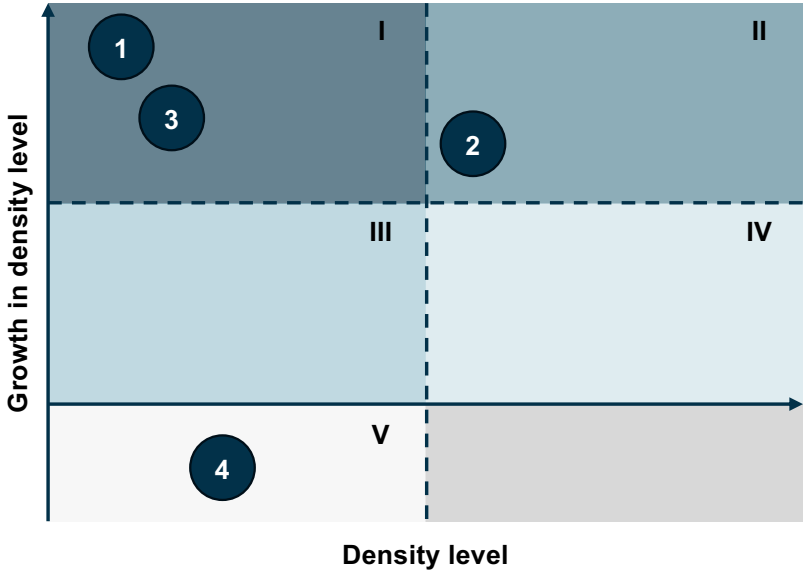
**3 Demand pressure**

One of the ports must have a demand pressure indicated by a high-density level such that the port may need offloading of their traffic.

## Geographical splits

- Benchmark levels
- 1 Northern Jutland
- 2 Mid Jutland
- 3 Southern DK
- 4 Zealand

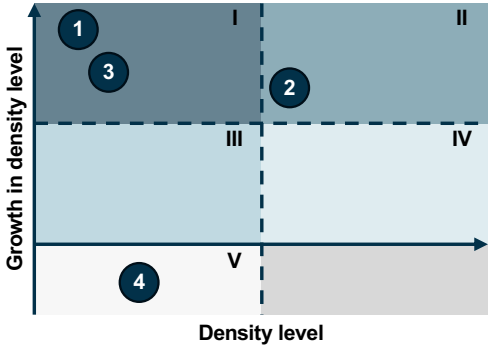
- **I** Lower density but higher growth than benchmark
- **II** Higher density and higher growth than benchmark
- **III** Lower density and lower growth than benchmark
- **IV** Higher density but lower growth than benchmark
- **V** Lower density than benchmark and negative growth




Source: Expert interview, Junior Consult analysis

# The mapping shows that collective coverage will be the key to covering future throughput increases


## Collective coverage ensures enough capacity in Danish Ports




1. All geographic areas have significantly lower density levels than benchmarks apart from Aarhus.
2. Required growth in density for Northern -, Mid -, and Southern Denmark are higher than the benchmark growth

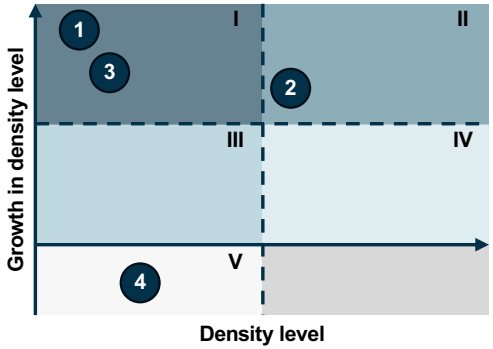
**Despite high growth, density levels are sufficiently low**
As the density levels in Norther Jutland, Southern Denmark and Zealand are significantly lower than the benchmark, the high growth is no problem.

**Despite high density and growth in Mid Jutland, Danish capacity is enough**
Collective coverage implies no need for further port expansions in Denmark as the overall port capacity is sufficient to offload demand in Mid Jutland

**Northern Jutland and Southern Denmark can cover Mid Jutland**
Mid Jutland is expected to experience high demand. However, excess supply in Northern Jutland and Southern Denmark can offload this demand pressure.[1]

Source: Junior Consult analysis
Note: [1]This is indicated by the arrows in the map depicting Denmark and the four geographic areas

# By utilizing collective coverage, Denmark will not be required to plan further port expansions to cover the future throughput




| Geographical region[1] | Density (2043) | Density growth |
|---|---|---|
| Northern Jutland | 0.20 | 4.10% |
| Mid Jutland | 1.51 | 1.90% |
| Southern Denmark | 0.39 | 2.66% |
| Zealand | 0.41 | -1.35% |
| Benchmark | 1.45 | 1.09% |

**Conclusion on gap analysis**

**3** out of **4** regions are expected to have significantly lower densities in 2043 compared to the benchmark of 1.45

**3** out of **4** regions are required to grow their productivity more than the benchmark growth of 1.09%

**Despite high growth in 3 out of 4 regions, the density levels are sufficiently low to imply no need for further port expansions.**

| Geographical region | Density (2043) | Density growth |
|---|---|---|
| Denmark | 0.82 | 1.22% |

The overall density level for Denmark in 2043 of 0.82 is well below the benchmark of 1.45. The growth is slightly higher (1.22% compared to 1.09%), but with the relatively low density**, no port expansions are needed**.

Source: Junior Consult analysis
Note:[1]See appendix for port specific deep dives


Demand & Supply
Gap Analysis
Volume Projections
MOSCOW MÆRSK
KØBENHAVN
AM
2
Market Assessment
Valsemøllen

# Agenda

1 Executive summary of volume projection

2 Forecasting model

3 Analysis of total volume expectations

4 National regions

5 Geographical regions

6 Overview of uncertainties

# Danish ports are, in total, expected to experience a stable but decaying growth rate with variations across ports and regions

## Overall Volume Projection

Denmark is projected to experience stable growth in the total throughput with an expected CAGR of 2.2% from 2024 to 2043.

Three main uncertainties have been identified:
1. Size of impact of shift in mode of transport
2. The Fehmarn Belt
3. Improved rail connectivity may lower expected throughput to Danish ports

## National regions and ports

Aarhus and Fredericia are projected to collectively drive 82% of the total throughput growth because of high efficiency, great location and recent performance.

The growth of Danish ports may vary depending on the following factors:
1. Implementation of PtX initiatives
2. More autonomy in ports
3. Green-tech

## Geographical regions

Europe and the Americas are projected to lead 81% of the total throughput growth to Danish ports. APAC is projected to see stagnating growth relative to recent years.

Regionalization is the main uncertainty when it comes to growth from specific regions. Increasing regionalization will result in Europe driving more growth than historical data shows.

**The Danish ports will experience stable growth with significant variations across ports and regions and with associated uncertainties, which require the creation of risk mitigation strategies.**

# The volume projection builds on the dynamic model, which is reached by combining the top-down and bottom-up base models

## Volume Projection Base Model

### Top-Down

The least complex method. It provides a well-balanced and transparent projection for total TEU throughput.

Total TEU throughput in Denmark is projected, then split into each port and finally geographical regions[1].

### Bottom-Up

A more complex model providing a better overview of growth in each port.

TEU is projected for each geographical region in each port. Geographical region splits are then aggregated.

## Dynamic Model

The Dynamic Model incorporates the Top-Down and Bottom-Up Base Models together with Dynamic Parameters.

Each Base Model is given a weight in the Dynamic Model.

The weighted average is impacted by each of the Dynamic Parameters.

[1] Regions are defined as the trade flow to and from countries within a geographical region

# The base model builds on historical growth and several parameters, whereas the dynamic model is an extension with additional parameters affecting projections

**The base and dynamic model build on several parameters that collectively assist the projection of future throughput**

## Base Model Parameters[1]

- **Economic Development**
- **Competition from NRP[2]**
- **Modality Effects**
- **Port Attractiveness**
- **Historic Growth**

Top-Down parameters  Bottom-Up parameters

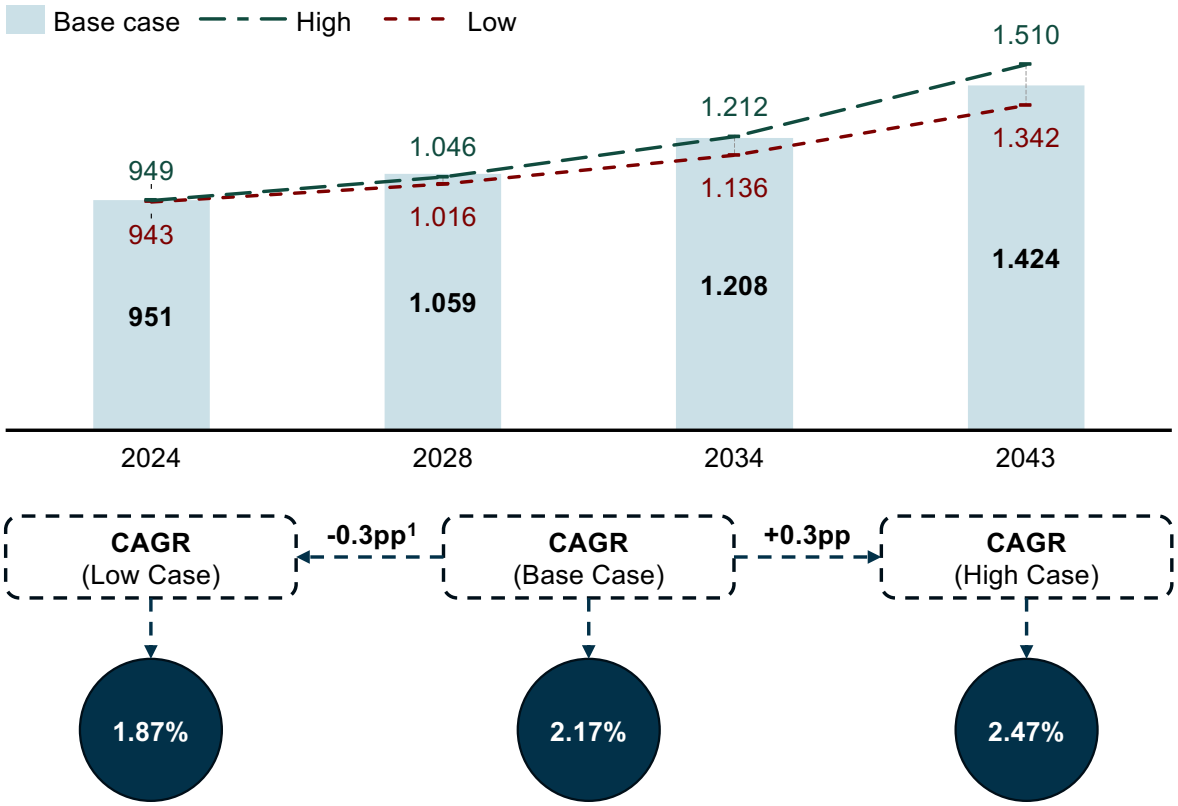
## Dynamic Model Parameters[3]

- **Trade Route Developments**
- **Technological Developments**
- **Green Technology**
- **Geopolitical Effects**

Note: [1]See appendix for deep dive on base model parameters. [2] Northern range ports. [3]See appendix for deep dive on base model parameters

# Throughput to Danish ports is expected to grow steadily over the coming 20 years with a CAGR of 2.2%

## Total volume projections for Danish ports ('000 TEU)




## Key takeaways

Junior Consult anticipates a stable growth in throughput for Danish ports in the coming 20 years. The CAGR is expected to be 2.2% throughout the period.

In the short term (2024-2028), the CAGR is expected to be 2.7%, which incidentally is the same as the CAGR for the previous 23 years but slightly higher than the growth of recent years.

In the Mid-term (2029-2034), the total throughput is expected to grow with a CAGR of 2.2% while growth in the long term (2035-2043) is anticipated to be 1,8%.

Even in the low case, the growth is expected to be 1,9%. Therefore, it seems quite certain that throughput will grow at a stable rate.

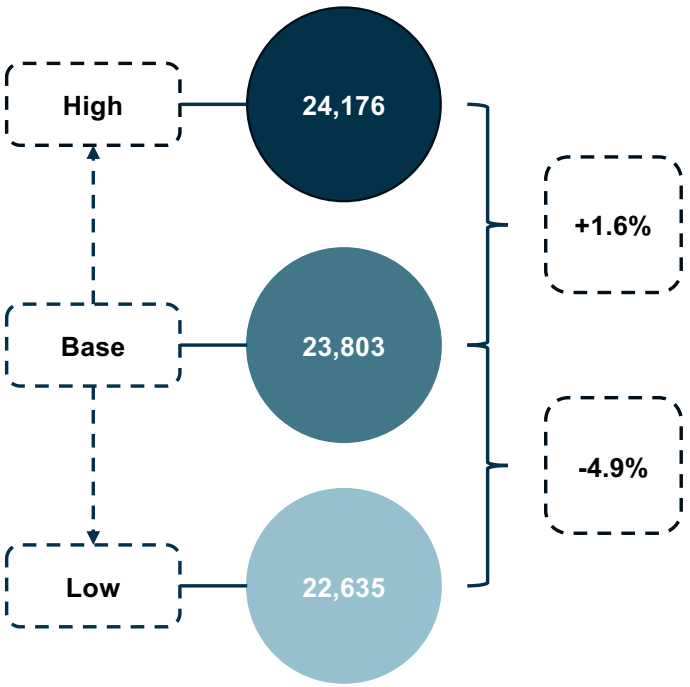
The following slide will examine the uncertainties in the forecasting model, which builds the foundation for the high and low case.

Sources: Danmarks Statistik, McKinsey, Rambøll, UNCTAD, IAPH, DSV, Junior Consult Analysis
Note: [1]pp is an abbreviation for percentage points

# The total amount of throughput can either drop by 4.9% or increase by 1.6% relative to the base case

**Total volumes**
(Scenario Split)

Accumulated throughput of Danish ports from 2024 to 2043 (Measured in ´000 TEU)




**Uncertainties in forecasting model**

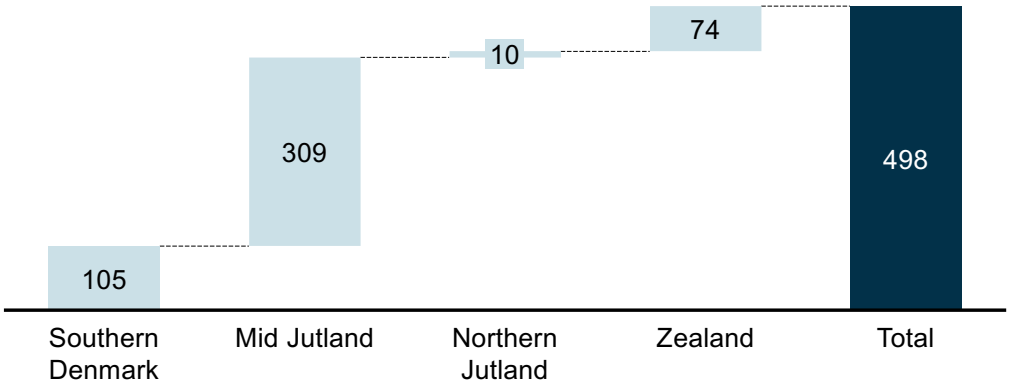
1. **Trade Route Developments**
   Trade route developments may lower trucked goods, thereby increasing port traffic.
2. **Regionalization of Supply Chains**
   Regionalization may decrease expected growth rates.
3. **Rail Connectivity**
   Rail connections may improve thereby lowering growth in high case.
4. **International Trade Volume**
   Overall trade volume may reach saturation, thereby dropping growth rates.
5. **GDP growth**
   Future GDP growth may be lower or higher for both Denmark and its trade partners.

The model's sensitivity shows that the accumulated volume may decrease by up to 4.9% from the base case or increase by up to 1.6% in the high case. Therefore, the largest risk comes from an overestimation of throughput. It is thus recommended that future throughput developments are tracked.

Sources: Junior Consult analysis

# Mid Jutland is expected to remain the market leader, but Southern Denmark and Zealand are expected to win market shares due to efficiency gains and rerouting

**Total throughput growth**
Split on national regions ('000 TEU)




**Expected market share developments**

▲ Increase ▼ Decrease ▶ Maintained ? Inconclusive

| | |
|---|---|
| Fredericia ▲ | Copenhagen ▶ |
| Kalundborg ▲ | Aalborg ▶ |
| Aarhus ▼ | Esbjerg ? |

**Growth expectation explanations**

**Increased technological efficiency in Fredericia, Kalundborg and Esbjerg**

As other ports gain efficiency, these will close the gap to Port of Aarhus, leading to changes in market shares.

**Aalborg may exceed growth expectations with a successful shuttle traffic increase**

Port of Aalborg has large potential in feeder traffic and may be able to win market shares by utilizing this potential.

**Cross-border trend makes traffic to Southern Denmark larger**

As traffic shifts from road to sea, Fredericia and Esbjerg will be expected to win market share from Aarhus.

Source: Junior Consult analysis

# The forecasting model provides accurate results when interpreted on national regions but becomes uncertain regarding conclusions on specific ports


**While forecasts on specific ports are highly uncertain, the certainty is relatively high when examining national regions**

Demand is expected to be highly centred around Southern Denmark and Mid Jutland, which includes the ports of Fredericia, Esbjerg and Aarhus. These three ports are expected to drive 83% of the total growth.

Zealand is expected to account for 15% of the total growth. Whether the growth mainly arrives at Copenhagen or Kalundborg is uncertain.

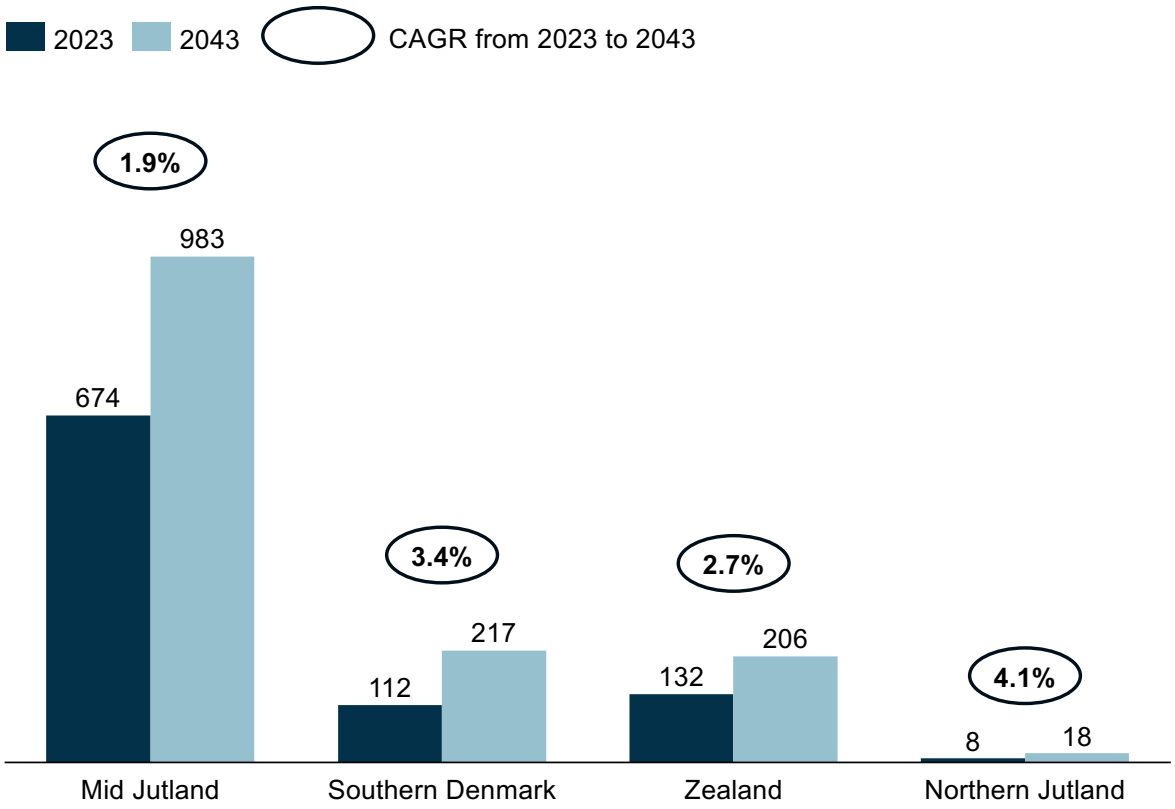
Aalborg will most likely be able to cover some traffic from Aarhus. However, due to the distances between each port, the most likely partnership is expected to be between Fredericia, Esbjerg and Aarhus.

**Southern Denmark and Mid Jutland are the two national regions expected to experience the most growth throughout the 20-year period.**

Source: Expert interview, Junior Consult analysis

# While a large share of growth comes from Mid Jutland, the CAGR is the lowest of all examined geographic areas due to saturation and efficiency gains of other ports

**Growth expectations for each region** ('000 TEU)




**Key takeaways**

As the forecasting period stretches over 20 years, forecasting throughput for specific ports is highly uncertain. However, the results provide a foundation for understanding basic movements in expected market dynamics for the future.

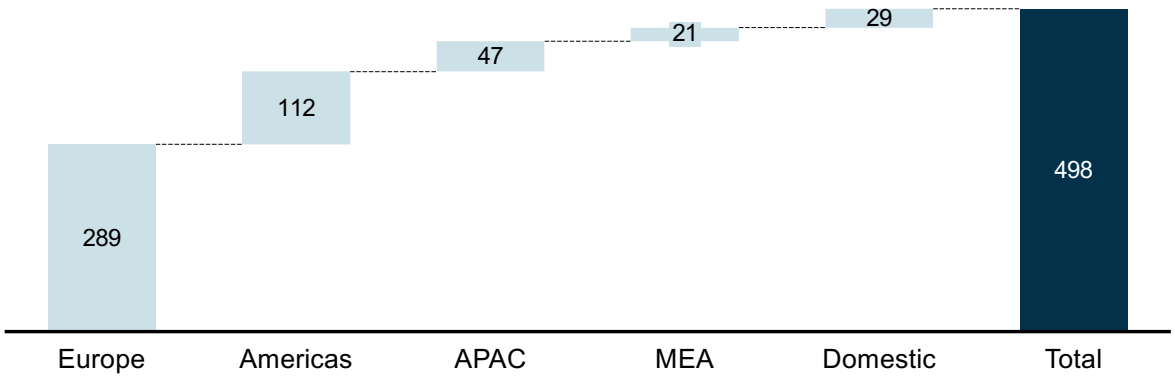
Except for Port of Aarhus and Port of Copenhagen, the remaining ports are expected to outgrow the total market. This is mainly because Aarhus greatly influences the overall market CAGR.

While it may be difficult to determine the growth rates for each specific port, the forecasting results are a good foundation for understanding which national regions will drive future growth.

Sources: Junior Consult analysis

# The throughput growth is projected to mainly come from Europe and the Americas, with Europe driving approximately 57% of the growth

**Total Throughput growth split on regions ('000 TEU)**




**Europe and Americas to drive 81% of the total throughput growth**

Regionalization is expected to boost throughput from Europe as supply chains concentrate within a single region.

Americas is expected to drive approximately 23% of total growth. One explanation is that large international trade companies, such as medical firms, are located in the Americas.

**Key takeaways**

Europe will be a large driver of growth in Danish ports. In fact, Europe is expected to account for 58% of the total growth. This is mainly due to the regionalization of supply chains, which implies more trade from Europe for Denmark.

The trade growth from the Pacific (APAC) is expected to stabilize in conjunction with the slowed economic development in China. The region will drive approximately 9% of the total growth, a drop from previous years. This is mainly due to Suez Canal problems and the expectation that APAC products will, to a higher degree be transported to Denmark by shuttle, in which case the goods will be noted as throughput from Europe.

Americas are expected to lead transcontinental growth due to an expected strengthening of trade lanes across the Atlantic.

Sources: World Economic Forum, McKinsey & Company, Junior Consult analysis

# Five trends[1] makes the forecasting model uncertain and will shape the future shipping market in Denmark

| | Shift in mode of transport | Autonomous Ports | Regionalization of Supply chains | Fehmarn Tunnel | Green Tech |
|---|---|---|---|---|---|
| Explanation | EU-wide regulations, such as ETS and ETS2, will shift transport modes from road to short sea and rail | Technological development in ports can help improve ports' efficiency, decision-making, and competitive value proposition | Companies are increasingly focusing on nearshoring as a reaction to recent developments | A fixed link between Germany and Zealand completed in 2029 | Green Tech includes PtX[2], CCUS[3], shore power systems, and electrification of ports |
| Effect | Will affect total TEU volumes through Danish ports, primarily in Southern Jutland | Can impact individual ports' competitiveness positively | Mostly affecting inbound and outbound geographical regions' volumes | Can affect total TEU volumes in ports on Zealand | Has the possibility to affect specific ports' competitiveness |
| Challenges | It is unclear how much of the road transport will be transported by rail and ship | Adopting high technological solutions requires that ports acquire both hardware and software, which comes with multiple challenges. | Uncertainty around the degree of nearshoring versus improving supply resilience through integrated networks, multi-sourcing and better planning | Reports and data show ambiguous expected effects on sea freight in Danish ports | Electrification of ports is expected to be a hygiene factor, where PtX and CCUS might pose a competitive advantage |
| Size of effect |  |  |  |  |  |

Low High

Sources: Junior Consult analysis
Note: [1]See appendix for deep dives. [2]Power to X. [3]Carbon capture, utilization, and storage

## Demand & Supply Gap Analysis


## Volume Projections


## Market Assessment

# Agenda

1 Executive summary of Market Assessment

2 Historic market growth

3 Competition analysis

4 Trends & Technological Advancements

5 Overview of Danish ports

# Danish Ports must compete on key winning criteria, embrace trends and overcome barriers to expand capacity and drive future growth

**Historic market growth**

- Throughput has significantly increased over the past decade, with a CAGR of 2% from 2014 to 2023. Moreover, Aarhus and Fredericia have experienced the highest growth rates in container throughput since 2010.
- Throughput in Danish ports is primarily shipped from other European ports, while APAC and Americas have increased their share of total throughput over the past decade.

**Competition analysis**

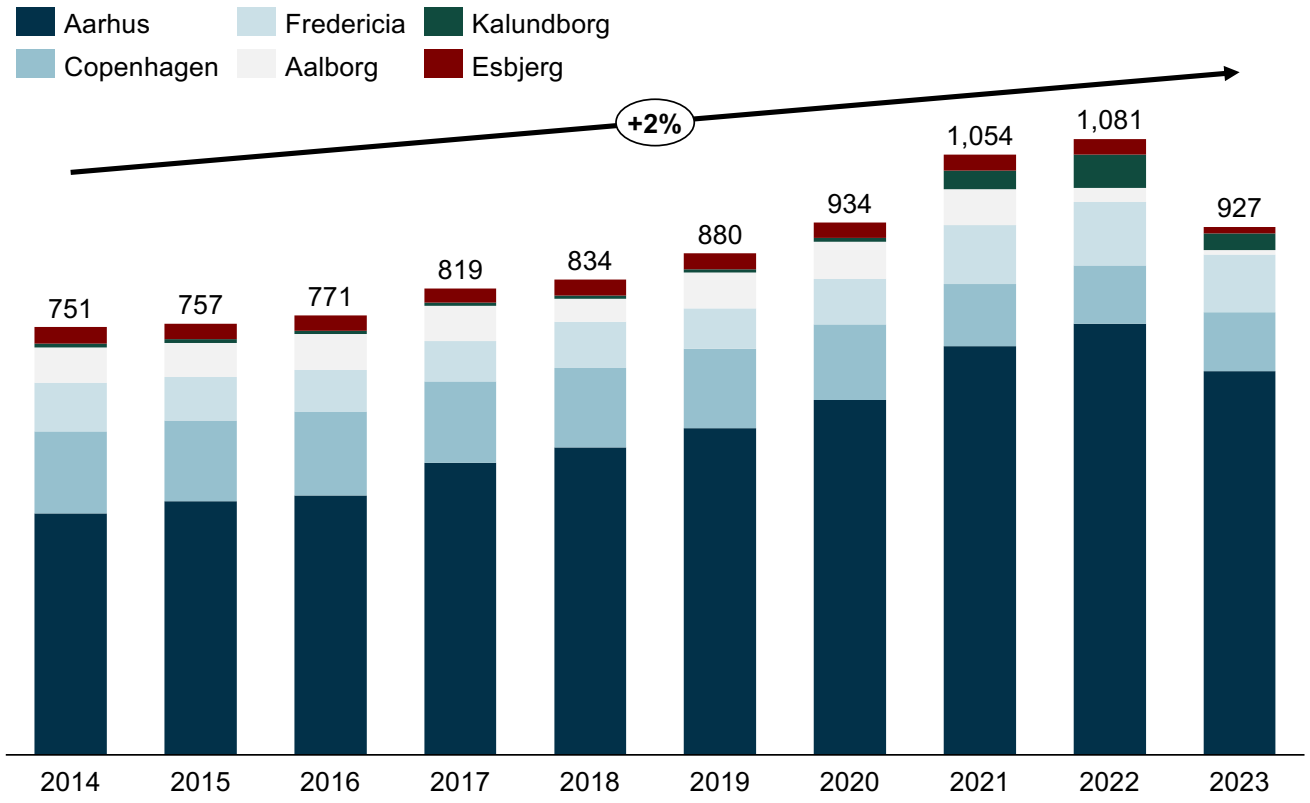
- Danish ports primarily compete on price, time, sustainability, and connectivity. As shipping costs have risen, the focus on price has increased when planning shipping routes.
- Aarhus, Fredericia, and Copenhagen remain market leaders due to strong connectivity and efficient logistics, which also results in competitive prices and shorter transit times.
- Danish ports compete indirectly with other types of modality. Modality types' performance on key parameters is close, indicating a highly competitive market for container shipping.

**Trends & Technology advancements**

- Three key trends will shape the competitive landscape within shipping: sustainability, technology & automation, and dynamic trade flows.
- These trends affect Danish ports differently, where sustainability has the strongest impact. Danish ports must address these trends to remain competitive.

# Throughput in Danish ports is highly concentrated around six ports, with Aarhus being the clear market leader

**Throughput of containers** (1000 TEU[1])




**Key take-aways**

**Throughput is distributed across six ports,** which account for **95% to 97.5% of total container throughput** from 2014 to 2022.

The container market experienced a steady growth from 2014 to 2019 with a CAGR of 3%, followed by a significant increase to a CAGR of 7% from 2019 to 2022.

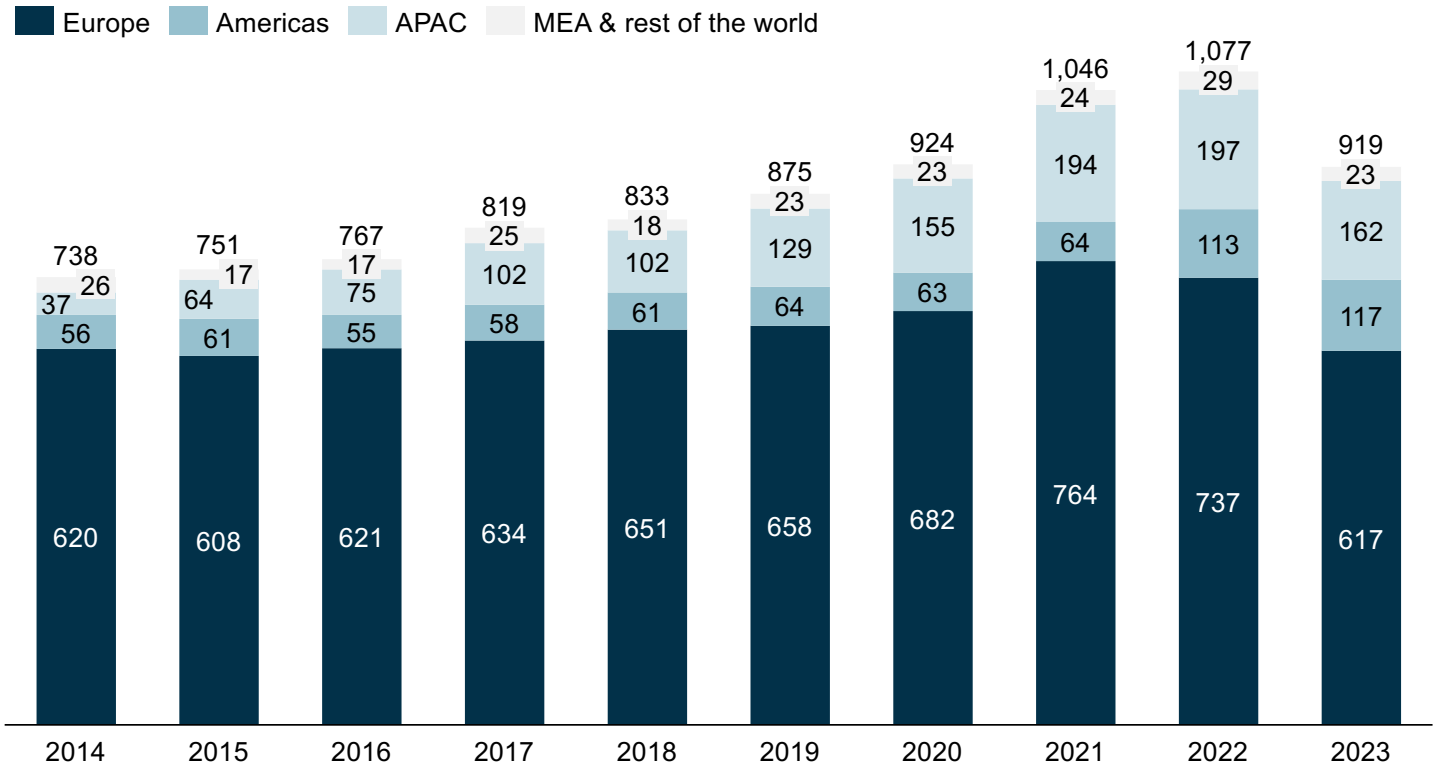
In the last eight years, Aarhus has remained a market leader and increased their market share by 24% from 56%-70%, while Copenhagen has lost 51% of its market share

Kalundborg has experienced strong growth, with a CAGR of 31%, and increasing market share from 0.9% to 5.5%

Source: Danmarks Statistik (SKIB49)

# Despite increases in shipments directly from APAC, the throughput in Danish ports is focused on Europe and shuttle traffic from NRP

**Throughput of containers by previous port** ('000 TEU)




**Key take-aways**

**The majority of trade has consistently been shipped to or from Europe**. This is partly intercontinental from European countries and shuttle traffic from the rest of the world through NRP.

With increasing production and high GDP growth, APAC has continuously increased its throughput share.

MEA have the highest growth in throughput share but remains a low contributor to aggregate throughput.

Source: Danmarks Statistik (SKIB50), Junior Consult analysis
Note: Totals do not match the total throughput because the "missing data" category has been omitted.

# As shipping costs increase, price remains the essential parameter for winning trade flows, pushing sustainability as a critical future parameter

| Competition parameter | Description | Importance | Trend | Quotes |
|---|---|---|---|---|
| **Total price** | The price of different transportation modes. | ● | → | *"The price is the primary criterion for the cargo owner, while other aspects are secondary"* **- Global industry expert** |
| **Sustainability** | Includes environmental and climate aspects such as CO2 emissions and air pollutants. | ◔ | ↑ | *"Although shipping costs have increased, sustainability remains a criterion for future shipping routes* **- Global logistics director** |
| **Time** | The total time for the cargo to reach the destination. | ◕ | ↓ | *"Time remains a key metric, but decreases in importance as logistic departments plan shipments on longer horizons"* **- Global logistics director** |
| **Connectivity** | Degree of a port's connection to other ports and the catchment area size | ◕ | → | *"Hinterland & maritime connectivity is a fundamental criterion when competing for trade routes"* **- Port executive** |

● High importance
○ Low importance
↑ Increasing importance
→ Constant importance
↓ Decreasing importance

## Key Take Aways

**Cargo owners and freight forwarders have price as the primary concern** when planning shipping routes. Importance only increased after shipping costs rose.

CO2 emissions remain a crucial aspect for shipping in the future, but **shipping lines and freight forwarders currently prioritize price.**

**As short-sea usage is preferred to trucking,** cargo owners are planning longer transit times, meaning time decreases in importance

**Strong maritime and hinterland connectivity** in terms of frequent routes and proximity to destinations **is a fundamental factor for ports to remain competitive**

Sources: Expert interviews. Junior Consult analysis

# Aarhus and Fredericia are market leaders in throughput mainly due to strong performance on connectivity and efficient logistics, which results in competitive prices and shorter transit time

| Port | | Connectivity[1] | Sustainability | Efficiency[2] |
|---|---|---|---|---|
| AARHUS HAVN PORT OF AARHUS | Port of Aarhus | 9.33 |  | 12.7 |
| ADPC | Port of Fredericia | 8.6 |  | -- |
| CMP COPENHAGEN MALMÖ PORT | Port of Copenhagen | 2.67 |  | 16.4 |
| PORT OF AALBORG gate to great | Port of Aalborg | 1.1 |  | 13.7 |
| KALUNDBORG HAVN | Port of Kalundborg | 1 |  | -- |
| ESBJERG HAVN | Port Esbjerg | 0.8 |  | 14.1 |

Market leading ports

 Strong sustainability commitment

 Weak sustainability commitment

## Key Take Aways

**Aarhus remains market leader with a 70% market share**. This is sustained through **strong maritime connectivity, offering frequent routes at competitive prices** relative to other ports.

**Through investments in infrastructure and an efficient dry port, Fredericia is bridging the gap**, making it a market follower with a 10% market share in 2023.

Copenhagen, Aarhus, and Kalundborg **are frontrunners on sustainability, believing it will be a key purchasing criterion in the future.**

Sources: Expert interviews, APM Terminals, CMP, Maritime Traffic, Junior Consult analysis
Note: Cargo owners choose routes based on prices from shipping lines. Therefore, port fees are not considered for port comparison. [1]Connectivity is measured as port calls per week (monthly avg.). [2]Efficiency is measured as avg. time between arrival and departure

# Danish ports also compete against other types of modality. Minor variations across modalities indicate a highly competitive landscape

**Case study: Shipment of a 40-foot container from Shanghai to Herning[1]**

| Trade route[2] | Full price | CO2 emissions (Index) | Transit time |
|---|---|---|---|
| Mainliner to Danish port | 55.750 DKK | 83 | 49 days |
| Shuttle from NRP to Danish port | 55.600 DKK | 87 | 47 days |
| Truck from NRP | 54.500 DKK | 100 | 42 days |

Winning modality

**Key take-aways**

Cargo owners and freight forwarders can choose between multiple trade routes, **ensuring strong competition between different modalities.**

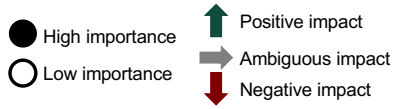
Intercontinental traffic **moves towards multimodal transportation**, **as carriers can reduce transit time** with shuttles from NRP.

The **choice of trade route is highly dependent on the end destination,** with shuttle and truck from NRP as the two most flexible options.

Source: Expert interview, Junoior Consult analysis
Note: [1]Shanghai to Herning is chosen as a representative route. [2]See appendix for deep-dives on price, emissions and transit time comparison between trade-routes.

# Three main trends will shape the competitive landscape in the future. Danish ports must address these trends to remain relevant and competent business partners for shipping lines and logistics companies

| Trends | Key elements | Implications | Importance | Impact on Danish ports |
|---|---|---|---|---|
|  **Sustainability** | • Regulatory changes<br>• PtX[1] & CCUS[2]<br>• CO2 reductions through new technology | As multimodal transportation has lower CO2 emissions, regulators and cargo owners push more traffic towards short-sea and push standards for greener ports |  |  |
|  **Technology and automation** | • AI, Automation & Digitalization<br>• 3D Printing<br>• IoT, Digital Twin & Blockchain | The rapid development of AI and automated processes can provide significant productivity and expenditure gains. The gap between leaders and laggards will increase if ports do not implement new technologies |  |  |
|  **Dynamic trade flows** | • Flexibility and resilience in supply chains<br>• Nearshoring<br>• India and MEA economic development | The geopolitical situation continues to set high standards for logistics. The development of flexible trade flows and nearshoring will result in more volatile throughput |  |  |



# Growing demand for sustainability actions from shipping lines, cargo owners, and regulators forces Danish ports to continue their investments in green technology

| | Regulatory changes | PtX & CCUS industry growth | CO2 reductions through green technology |
|---|---|---|---|
| Trend | • The EU transport policy aims to minimize cargo transportation on roads due to higher emissions.<br>• Policy changes will include a fuel tax. | • PtX and CCUS will play an essential role in the green transformation of both shipping and other industries.<br>• As Denmark positions itself as a hub for green tech, PtX facilities will be developed and constructed in Denmark. | • As global emphasis on sustainability intensifies, the pressure to reduce emissions increases as businesses monitor their scope three emissions.<br>• Ports must continue implementing their initiatives to electrify operations and thereby generate customer value. |
| Implication | • Shuttle ships will gain a competitive advantage on trucking from NRP.<br>• This will increase the area of cargo destination where shuttle shipments are economically optimal. | • The increased usage of equipment and materials will be shipped primarily through Danish ports, increasing the throughput.<br>• This will allow ports to supply green methanol for cargo ships, making improved sustainability possible. | • Shipping lines and cargo owners will demand access to shore power systems and green fuels as necessary requirements for choosing a specific port.<br>• Danish ports must continue implementing green technologies to remain front-runner against other modality types. |
| Impact |  |  |  |
| Importance |  |  |  |

Source: Expert interviews, Junior Consult Analysis

# Danish ports must integrate recently developed technologies to increase productivity and remain competitive

| | AI, automation and digitalization | 3D printing | IoT, digital twin, and blockchain |
|---|---|---|---|
| Trend | • The development of automation technology and AI continue to transform businesses. The nature of container terminal operations means process automation has high productivity potential. | • Scaling of 3D printing has the potential to revolutionize global logistics. Using 3D printing, supply chain networks will be smaller, meaning a decreased demand for cargo shipping.<br>• 3D printing will only be used for R&D and product testing in the foreseeable future. | • Digital twin and blockchain have strong potential in the shipping industry.<br>• Implementation of the technology will increase transparency and traceability in the industry, resulting in efficient planning and operations, leading to lower transportation costs and lead times. |
| Implication | • McKinsey estimates that ports can reach up to 35% productivity gains and cut expenditures by up to 55%.<br>• Ports must handle the biggest challenge of acquiring the necessary capabilities to implement automation processes. | • 3D printing will impact throughput negatively, but the likelihood and magnitude of scaling is low. | • Use of the technology requires collaboration and data sharing between actors in the value chain.<br>• The implementation has not succeeded yet, despite efforts from industry behemoths such as Maersk and IBM. |
| Impact |  |  |  |
| Importance |  |  |  |

Source: McKinsey, BCG, Junior Consult analysis

# Unpredictable market conditions pressure trade flows and force companies to invest in and focus on resilient and flexible supply chains. Danish ports must build resilience to remain competitive

**Flexible and resilient supply chains**

**Nearshoring**

**India and MEA economic development**

| | Flexible and resilient supply chains | Nearshoring | India and MEA economic development |
|---|---|---|---|
| Trend | • As geopolitical effects continue to affect trade routes, companies' supply chain priorities have shifted.<br>• Executives are valuing the resilience and flexibility of their supply chains higher | • In a time of uncertain geopolitical conditions, companies are building resilience in their supply chains<br>• Companies are looking into moving production facilities closer to end consumers, thereby reducing the supply chain. | • The MEA region and India will see economic growth in the coming decades.<br>• India's economy is projected to grow by a CAGR of 6% over the next five years, according to Jefferies, surpassing economies like Japan and Germany. |
| Implication | • With an increased focus on flexible and resilient supply chains, Danish ports must deliver reliable service to remain competitive and win market shares | • Potential nearshoring will lead to changing trade routes where rail and truck may be the optimal modality, resulting in lower throughput.<br>• A significant nearshoring movement seems infeasible due to insufficient land and labor supply, resulting in low likelihood and impact | • The growth will boost container flows to Danish ports from India and the MEA region, potentially leading to the establishment of new shipping routes and increasing demand pressure on Danish ports' ability to accommodate calls. |
| Impact |  |  |  |
| Importance |  |  |  |

Sources: BCG, Bain, Expert interviews, Forbes, Junior Consult Analysis

# The major Danish industry ports are developing at a different pace, where Fredericia invests heavily to catch Aarhus, while Copenhagen and Kalundborg are directly competing for throughput

| | AARHUS HAVN PORT OF AARHUS | CMP COPENHAGEN MALMÖ PORT | PORT OF AALBORG gate to great | ADPC | KALUNDBORG HAVN | ESBJERG HAVN |
|---|---|---|---|---|---|---|
| **Technology advancements** | Operating STS cranes, but will be less of advantage in the future[1] | New STS container cranes and hybrid straddle carriers | Inland Port that concentrates on shuttle traffic | Investment in STS cranes and fully electrified terminals | Electrification of equipment | No container-specific advancement, as strategic focus is on other types of cargo |
| **Expansion plans** | Plans to develop dry port outside of Aarhus. Expansion plans are postponed till 2025 | Relocating their container terminal to Ydre Nordhavn by 2025 | Development of a railway north of Aalborg and investments in Liebherr Mobile Crane | New container terminal scheduled for completion in 2025 | Investments are planned for an expansion to 330,000 $m^2$ terminal area | Deepening of fairway from 10,5m to 12,5m to be able to call larger vessels |
| **Crucial routes** | Maersk has discontinued its mainliner route between Asia and Aarhus focusing on shuttles through Bremerhaven | Have lost majority of their Maersk routes to Kalundborg | Loss of the Royal arctic Lines' Greenland route in 2022 | Focus on shuttle ships from NRP | Strong partnership with Maersk on shuttle routes from NRP | No current crucial routes for containers |

Note: [1]Other ports are seen to invest in advanced cranes.
Sources: Beskyt havmiljøet, Expert interviews, Junior Consult analysis

# Appendix Gap Analysis

1 Port of Aalborg

2 Port of Aarhus

3 Port of Copenhagen

4 Port of Fredericia

5 Port of Kalundborg

6 Port of Esbjerg

# Port of Aalborg has seen an 87% decline in container throughput in the recent two years but has the potential to capture shuttle traffic to nearby companies

PORT OF AALBORG
gate to great

## Container Terminal Area

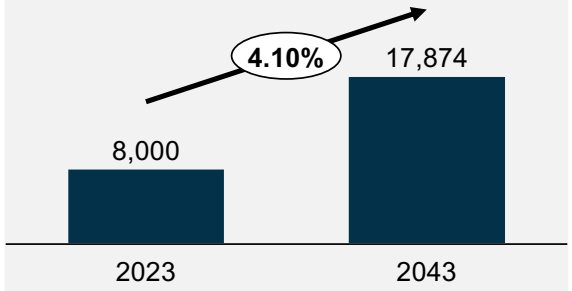
**89 tm²**
(Terminal Area 2023)

**89 tm²**
(Planned Terminal Area 2043)

Port of Aalborg has not publicly announced expansion plans for its container terminal area

## Projections

### Volume Projections (TEU)




### Density Measure (TEU/m²)

Port of Aalborg will have to slightly increase its density level from 0.09 TEU/m² to 0.20 over the next 20 years to fulfil projected demand

**0.09** → **0.20**

## Insights

Volumes are expected to increase by 123% between 2023 to 2043. This forecast is, however, associated with some uncertainties.

1. Port of Aalborg has experienced an 87% decline in container volumes over the past two years, primarily due to the conclusion of its 50-year partnership with Royal Arctic Lines.

2. Due to the many production companies in Aalborg, one expert stated in an interview that Aalborg has a large potential for shuttle traffic.

Current density levels are notably low, mainly due to the significant volume decline in recent years, leaving the terminal area oversized for reduced activity. Therefore, there is no need for efficiency gains.

Sources: Expert interview, Shippingwatch, Port of Aalborg and Junior Consult analysis

# Port of Aalborg can accommodate the estimated growth without expanding the port due to low current density levels

PORT OF AALBORG
gate to great

## Method 1: Is the growth in required density realistic?

20-year CAGR[1] in Danish Productivity levels

**1.09%**

CAGR[2] for required density level

**4.10%**

Port of Aalborg is set to grow more in the coming 20 years than Danish productivity has in the recent 20-year period.

## Method 2: Is the required density level realistic?

Average density among selected peers

**1.45**

Required density level in 2043 for Aalborg

**0.20**

The required density level for the port of Aalborg is significantly lower than the three European peers, implying no need for further expansion.

## Key Take Aways

The analysis presents two seemingly contradictory conclusions:

1. The first method shows that the port of Aalborg must increase productivity by 4.10% each year by acquiring labour resources or improving efficiency.
2. The second method indicates that the required capacity for 2043 is significantly below that of the peer group, suggesting that there is ample capacity to accommodate growth in TEU volumes.

Based on the two methods and Port of Aalborg's TEU throughput in recent years, **Junior Consult sees no justification for expanding the port.**

Note: [1]CAGR is calculated from 2003 to 2023. [2] CAGR is calculated as the growth in productivity level to fulfil demand in the period from 2023 to 2043

# Port of Aarhus must increase its productivity in the coming years but can utilize the potential dry port to cope with potential demand pressure

AARHUS HAVN
PORT OF AARHUS

## Container Terminal Area

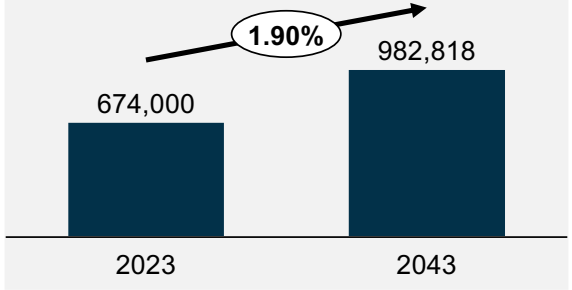
**650 tm²**
(Terminal Area 2023)

**650 tm²**
(Planned Terminal Area 2043)

Port of Aarhus currently has no publicly announced plans to expand the container terminal after the discontinuation of the recent expansion plan[1]

## Projections

### Volume Projections (TEU)




### Density Measure (TEU/m²)

Port of Aarhus will have to increase its density from 1.04 TEU/m² to 1.51 over the next 20 years to fulfil projected demand


## Insights

Container volumes in the port of Aarhus are projected to grow by 46% throughout the next 20 years, corresponding to a CAGR of 1.90%.

As negotiations for expansion plans have been paused until 2025, their efficiency must increase to fulfil the projected demand because of the expectation that density levels will rise.

Port of Aarhus plans to build a dry port that is not included in the current terminal area, which will enhance its capacity to handle increased volumes.

Sources: Port of Aarhus, Expert interview
Note: [1]As the expansion plan negotiations are postponed to 2025, the expansion is not considered in this report

# No further expansions are needed for Aarhus to fulfil demand, but collective coverage may be beneficial in case of larger-than-expected demand

AARHUS HAVN
PORT OF AARHUS

## Method 1: Is the growth in required density realistic?

20-year CAGR[1] in Danish productivity levels

**1.09%**

CAGR[2] for required density level

**1.90%**

Port of Aarhus is set to grow by a CAGR of more than double in the coming 20 years than the Danish productivity has done in the most recent 20-year period.

## Method 2: Is the required density level realistic?

Average density among selected peers

**1.45**

Required density level in 2043 for Aarhus

**1.51**

Port of Aarhus will experience a required density level slightly higher than the peer group's average, indicating there may need to be an expansion.

## Key Take Aways

The analysis shows that the Port of Aarhus is projected to grow significantly faster than the Danish productivity level, a trend consistent with recent years. To meet this growth, the Port of Aarhus must enhance productivity through improved efficiency or increasing labour capacity.

Regarding the required density levels in 2043, the Port of Aarhus is slightly above the peer group, however, it is still lower than Rotterdam, Antwerp and Gdansk. Since the Port of Aarhus is the most efficient port in Denmark, **Junior Consult does not anticipate the need for major capacity expansions.** However, the development of the dry port can help prevent potential bottlenecks.

Source: Junior Consult analysis
Note: [1]CAGR is calculated from 2003 to 2023. [2]CAGR is calculated as the growth in productivity level to fulfil demand in the period from 2023 to 2043

# Copenhagen will have to increase its productivity in the coming years, as no expansion plans have been announced

## Container Terminal Area

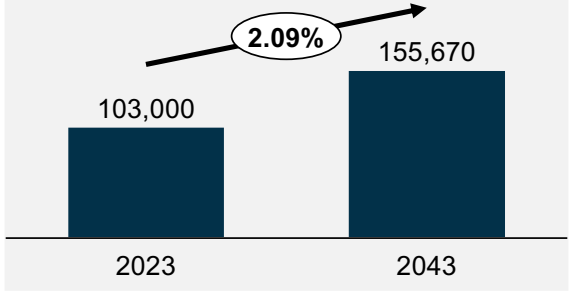
**140 tm²**
(Terminal Area 2023)

**140 tm²**
(Planned Terminal Area 2043)

While Port of Copenhagen plans to open a new container terminal, the total area remains the same, as the old terminal will be used for other activities

## Projections

### Volume Projections (TEU)




### Density Measure (TEU/m²)

Port of Copenhagen must increase its density level from 0.74 TEU/m² to 1.11 over the next 20 years to fulfil projected demand


## Insights

The Port of Copenhagen is estimated to increase container volumes by a CAGR of 2.09% throughout the next 20 years corresponding to an increase of 52,670 TEU.

As no expansion plans have been made for Port of Copenhagen, their efficiency must increase to fulfil the projected demand and accommodate for higher density.

Port of Copenhagen has seen decreasing container volumes since 2016 from 148,000 to 103,000 TEU.

Sources: Interview with Port of Copenhagen, Junior Consult analysis

# As Port of Copenhagen has previously handled more throughput than projected for 2043, the port is expected to cover the increasing demand successfully

## Method 1: Is the growth in required density realistic?

20-year CAGR[1] in Danish productivity levels

**1.09%**

CAGR[2] for required density level

**2.09%**

Port of Copenhagen is set to grow more in the coming 20 years than Danish productivity has in the recent 20-year period.

## Method 2: Is the required density level realistic?

Average density among selected peers

**1.45**

Required density level in 2043 for Copenhagen

**1.11**

The required density level for port of Copenhagen is estimated at around 3/4 of the peer group's current density level.

## Key Take Aways

The analysis projects that the Port of Copenhagen will experience higher growth relative to the Danish productivity level, though its' required density remains around 25% below that of its peer group.

This suggests that the Port of Copenhagen will need to boost productivity through increased labour capacity or improved efficiency. However, the analysis also indicates that this can be achieved within the currently planned capacity, supported by the fact that the port handled approximately 40% more TEU volumes in 2018 compared to 2023.

**Thus, it is not recommended to expand the terminal area of Port of Copenhagen.**

Source: Junior Consult analysis
Note: [1]CAGR is calculated from 2003 to 2023. [2]CAGR is calculated as the growth in productivity level to fulfil demand in the period from 2023 to 2043

# Despite a large capacity increase, Fredericia will be required to operate more efficiently in the future because of stable projected growth

## Container Terminal Area

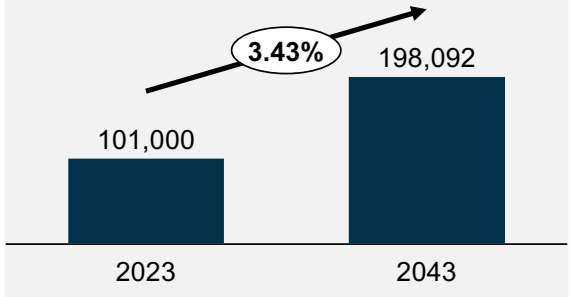
**80 tm²**
(Terminal Area 2023)

**150 tm²**
(Planned Terminal Area 2043)

Port of Fredericia has planned to increase its container terminal area from 80 tm² to 150 tm². No additional expansions have been announced

## Projections

### Volume Projections (TEU)




### Density Measure (TEU/m²)

Port of Fredericia need to increase their efficiency to follow the projected demand


## Insights

Port of Fredericia has planned a capacity increase such that the total area increases from 80 tm² to 150 tm². However, the rise in TEU volumes is relatively higher than the increase in area, meaning Port of Fredericia must increase its efficiency to fulfil demand.

Compared to other Danish ports, the density level is relatively high, indicating that they are required to operate more efficiently than most other ports.

Fredericia is projected to experience high growth from 2023 to 2043 due to efficiency gains from technological advancements as well as market share gains from rerouting that will most likely go to Fredericia or Esbjerg.

Sources: Expert interview, Dansk Industri, Interview med ADP, Junior Consult analysis

# Fredericia will be able to fulfil future demand because of its relatively low-density level and its opportunity to utilize the dry port in case of high demand pressure

## Method 1: Is the growth in required density realistic?

20-year CAGR[1] in Danish productivity levels

**1.09%**

CAGR[2] for required density level

**0.23%**

Port of Fredericia is set to see a drop in density in the coming years because of its planned port expansion.

## Method 2: Is the required density level realistic?

Average density among selected peers

**1.45**

Required density level in 2043 for Fredericia

**1.32**

The required density level in Fredericia is close to the current density level of the peer group.

## Key Take Aways

Junior Consult's analysis indicates that Port of Fredericia will require higher efficiency than other Danish ports.

This is deemed possible for two reasons.

Port of Fredericia will still require a lower density level in 2043 than the peer group and require a lower productivity growth than the Danish 20-year average.

Further, Port of Fredericia is connected to a large dry port with multimodal transport and logistics facilities.

**Junior Consult do not find reason for further expansions.**

Source: Expert interview, Junior Consult analysis
Note: [1] CAGR is calculated from 2003 to 2023. [2] CAGR is calculated as the growth in productivity level to fulfil demand in the period from 2023 to 2043

# While Port of Kalundborg has no planned capacity increases, it can utilize its area at Ny Vesthavn to accommodate large potential traffic

## Container Terminal Area

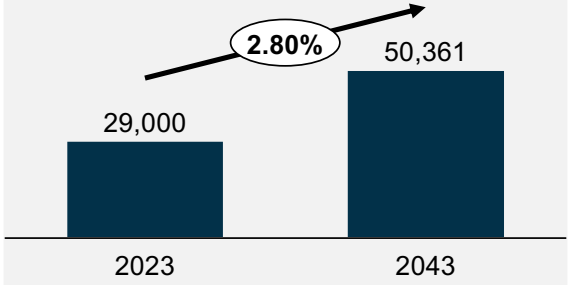
**75 tm²**
(Terminal Area 2023)

**300 tm²**
(Planned Terminal Area 2043)

Port of Kalundborg may be able to utilize the area at Ny Vesthavn to handle future container throughput

## Projections

### Volume Projections (TEU)




### Density Measure (TEU/m²)

Because of the increase in container terminal area, Kalundborg will not have to operate more efficiently in the future


## Insights

Port of Kalundborg has no publicly announced port expansion plans. However, they have a large area at Ny Vesthavn of 330 tm², which they will presumably be able to utilize in case of volume increases.

In this analysis, it is assumed that the total area will reach 300 tm² in 2043. This implies that Kalundborg will not have to operate more efficiently to meet future throughput levels.

Based on the above, Port of Kalundborg is expected to be able to meet future demand confidently.

Sources: APM Terminals, Port of Kalundborg

# With no unforeseen increases in throughput until 2043, Kalundborg should be able to handle future volume increases

## Method 1: Is the growth in required density realistic?

20-year CAGR[1] in Danish productivity levels

**1.09%**

CAGR[2] for required density level

**-4.09%**

Kalundborg is expected to see a relatively large drop in density levels in the next 20 years.

## Method 2: Is the required density level realistic?

Average density among selected peers

**1.45**

Required density level in 2043 for Kalundborg

**0.17**

The required density level for port of Kalundborg is significantly lower than the three European peers implying no need for further expansion.

## Key Take Aways

Method 1 indicates that the required density level of Port of Kalundborg will drop in the coming 20 years. The reason is that the capacity increase more than offsets the expected future volume increases.

Method 2 clearly indicates that the required density level is significantly lower than the peers. The density level drops from 0.39 to 0.17 from 2023 to 2043 as an additional 300 $tm^2$ from Ny Vesthavn has been added.

If Port of Kalundborg can maintain the current density level at 0.39 for the increased capacity, the port will be able to handle 116,000.
**Consequently, with current conditions, the port should be able to meet future demand.**

Source: Expert interviews, Junior Consult analysis
Note: [1] CAGR is calculated from 2003 to 2023. [2] CAGR is calculated as the growth in productivity level to fulfill demand in the period from 2023 to 2043

# Esbjerg operates its port with a flexible model that allows it to utilize the port area for different activities

ESBJERG HAVN

## Container Terminal Area

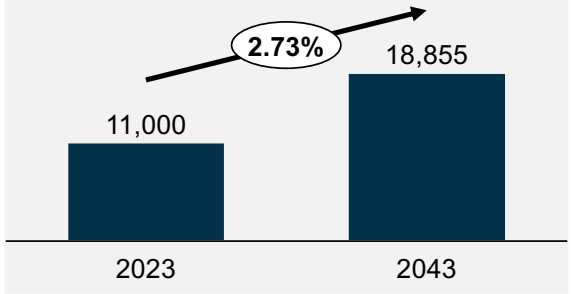
**400 tm²**
(Terminal Area 2023)

**400 tm²**
(Planned Terminal Area 2043)

Port of Esbjerg applies a flexible model in which their total area of 400 tm² can be used for different purposes when necessary

## Projections

### Volume Projections (TEU)




### Density Measure (TEU/m²)

Port of Esbjerg will have to slightly increase its density from 0.03 TEU/m² to 0.05 over the next 20 years


## Insights

The size of the container terminal in Esbjerg is difficult to determine accurately. The total port area is 400 tm², but the port operates with a flexible model that allows them to utilize the area differently depending on their needs.

Under the assumption that 100% of the area is utilized as a container terminal, the productivity levels are very small moving from 0.03 to 0.05 between 2023 and 2043.

Volumes are projected to increase with a CAGR of 2.73% over the next 20 years.

Source: Port of Esbjerg, Expert interviews, and Junior Consult analysis

# Port of Esbjerg is expected to confidently be able to handle future throughput because of its low required productivity level

ESBJERG HAVN

## Method 1: Is the growth in required density realistic?

20-year CAGR[1] in Danish productivity levels

**1.09%**

CAGR[2] for required density level

**2.73%**

Port of Esbjerg is set to grow by 1.64 percentage points more in the coming 20 years than the Danish productivity has done in the most recent 20-year period.

## Method 2: Is the required density level realistic?

Average density among selected peers

**1.45**

Required density level in 2043 for Esbjerg

**0.05**

The required productivity level for port of Esbjerg is significantly lower than the three European peers implying no need for further expansion.

## Key Take Aways

The analysis shows that Esbjerg can fulfil future volume increases even though the productivity may grow more than the Danish productivity. This conclusion is especially evident when comparing the required density level with the average density of peers. Esbjerg is required to operate with a density of 0.05 compared to the peer average of 1.45.

The reason for the low-density level is the size of the container terminal. The total area is set to 400 tm2. This may be slightly misleading as Esbjerg operates with a flexible model that allows them to utilize the port area for the needed purpose.

**Junior Consult finds no problems for Esbjerg in covering future demand if current conditions remain.**

Source: Expert interviews, Junior Consult analysis
Note: [1] CAGR is calculated from 2003 to 2023. [2] CAGR is calculated as the growth in productivity level to fulfil demand in the period from 2023 to 2043

# Appendix Volume Projection

1 **Base model parameters**

2 **Dynamic model parameters**

3 Deep dive: **Shift in mode of transport**

4 Deep dive: **The Fehmarn tunnel**

5 Deep dive: **Green tech**

6 Deep dive: **Autonomous ports**

7 Deep dive: **Regionalization of supply chains**

# Port competitiveness impacts the ability to capture market shares and can be gauged by, among others, terminal effectiveness, maritime and hinterland connectivity, and peripheral services

| Factors | Drivers | Trend | Time horizon | Importance |
|---|---|---|---|---|
| Economic Development | GDP growth (Denmark)<br>GDP growth (Trade Partners)<br>Consumer sentiment<br>International trade volumes | Economic development is essential for the growth in TEU volumes. This is true for domestic as well as international economic development. | TEU throughput in Danish ports is highly correlated with economic development. Therefore, the basis of the projection is built upon economic growth along with historical development in throughput | |
| Competition from NRP | Goteborg<br>Bremerhaven<br>Hamburg<br>Rotterdam<br>Gdansk | The impact of competition from neighboring ports depends on whether Danish ports or their competitors (NRP) will enhance their competitiveness more effectively. This is anticipated to affect TEU volumes negatively. | Mid-/long-term negative effect<br>5 years 10 years 20 years | |
| Modality Effects | Rail Connectivity<br>Road Connectivity | Infrastructure investments in the EU expanding the rail network through the TEN-T policy are assessed to have a slightly negative impact on ports' throughput. | Mid-/long-term positive effect<br>5 years 10 years 20 years | |
| Port Attractiveness | Terminal Efficiency<br>Maritime Connectivity<br>Hinterland Connectivity<br>Activity in Near Vicinity<br>Berth performance | Port attractiveness is expected to impact Danish ports differently. Current investments in Danish ports revolve around improving efficiency, connectivity, and multimodal transportation, and increasing storage capacity. | Differential effect<br>5 years 10 years 20 years | Low High |

# Technological advancements and changing market dynamics could alter winning criteria for ports – calling for investments in new areas such as PtX and CCUS

| Factors | Drivers | Trend | Time horizon | Importance |
|---|---|---|---|---|
| Trade Route Developments | India Growth Impact<br>Regionalization of Value Chains<br>Rerouting Road to Sea | Despite some contradictions in the impact of trade route developments, it is estimated to affect volumes positively. A growing Indian economy and the shift from cross-border trucking to sea routes are expected to more than offset the negative impact of regionalization of supply chains. | Mid-/long-term positive effect<br>5 years 10 years 20 years | |
| Technological advancements | IoT, Digital Twin & Blockchain<br>3D Printing<br>AI, Automation & Digitalization | Technological advancements in logistics are progressing rapidly and will enhance all operational aspects of port operations, leading to reduced costs and shorter lead times. Emerging technologies emphasize automation, safety, efficiency, communication, and improved decision-making. | Short-/mid-term positive effect<br>5 years 10 years 20 years | |
| Green Technology | PtX<br>CCUS[1] | Green technologies such as PtX and CCUS are rapidly developing, with substantial investments and numerous projects planned. These innovations will contribute to making sea transportation more environmentally friendly, which is expected to have a modest positive impact on volumes. | Mid-/long-term positive effect<br>5 years 10 years 20 years | |
| Geopolitical Effects | Global Level of Conflict<br>Suez Canal & The Gulf of Aden | Geopolitics impacts global trade patterns and trade routes. Current trends in the geopolitical landscape, such as protectionism, sanctions, wars, and increased uncertainty, are expected to have a short- to mid-term negative impact. | Short-/mid-term negative effect<br>5 years 10 years 20 years | Low High |

Note: [1]Carborn Capture, Utilization and Storage

# EU-wide regulations incentivize more shuttle-ship transportation relative to road transportation through emission allowances and focusing on more efficient intermodal transportation

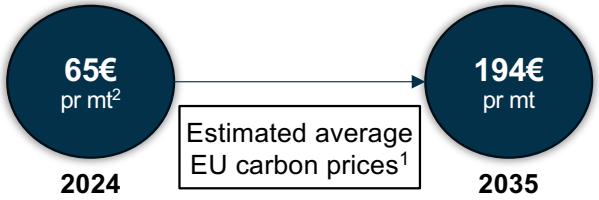
## Combining transport modes and shift from road transport

The EU is introducing new proposals under its 'Greening Freight Package,' aimed at **enhancing the efficiency and competitiveness of intermodal transport.** One key initiative is simplifying and improving access for trucks to pick up freight from terminals after the main leg of the journey has been completed by sea or rail.

The EU has set a target to shift medium-distance freight journeys from road to either rail or waterborne transportation. Medium distance is described as more than 300 km.
2030: 30% of road transportation
2050: >50% of road transportation

## EU Emissions Trading System

The EU is introducing ETS2 to address road transport emissions in a way that is similar to the original ETS.




The introduction of ETS2 is expected to benefit short-sea transportation, as CO2 emissions per container transported by road are significantly higher than sea freight.

## EU rail

The share of rail freight fell from 18.6% in 2018 to 17.1% in 2022[1]. However, the EU is committed to improving rail connectivity through the TEN-T policy. The TEN-T will consist of three layers, the core network, the extended network, and the comprehensive network, completed in 2030, 2040 and 2050, respectively.

An improved rail network will have a negative impact on sea freight. However, it is estimated that in the 20-year forecast period, it will only have a slightly negative impact.

**The EU is increasing pressure on the transport sector to shift from road to rail and short-sea shipping while promoting more efficient intermodal transport. These regulatory trends are driving growth in throughput at Danish ports.**

Sources: European Commission, Statista, Junior Consult analysis
Note: [1]BloombergNEF May 2024 estimates. [2]Per metric tonne

# The Fehmarn tunnel may generate spillover benefits for Port of Kalundborg and Copenhagen. However, projections show ambiguous results

## The Fehmarn belt tunnel

The Fehmarn belt tunnel is the largest infrastructure project in Denmark's history.
The tunnel will connect Puttgarden in Germany to Rødbyhavn in Denmark, shortening the road and rail connection between Scandinavia and the rest of Europe.

The tunnel is vital to connecting Scandinavia to the rest of Europe on the TEN-T and consists of a 4-lane highway, 2-lane electrified rail, and emergency lanes.

The project is estimated to be completed by **2029.**

## Impact on Danish ports

Reports show ambiguous results related to future cargo through the tunnel.

Rail and road transport is expected to increase, but whether this cargo would otherwise have been sea freight cannot be concluded.

The tunnel will reduce road and rail cargo from Copenhagen over Storebælt.

CBRE expects that the fixed link will strengthen the Danish industrial and logistics sectors in the area. This could potentially have some spillover effects on Port of Kalundborg and Copenhagen due to multi-modal transport solutions.

Sources: Femern A/S, Transportministeriet, CBRE

# PtX offers a pathway to reduce emissions in heavy transportation, presenting a strategic opportunity for Danish ports

## PtX & CCUS[1]

Power-to-X is a technology for producing fossil fuel alternatives and storing energy. Danish ports are key to the transition away from fossil fuels, with green fuel bunkering offering a significant opportunity to differentiate and enhance the value proposition. Additionally, CCUS presents a promising path for decarbonization, where Danish ports can play a critical role in transporting, utilizing, and storing captured carbon.

PtX and CCUS require substantial storage, distribution, and production infrastructure, which could strain **capacity** and pose **safety** challenges.

PtX & CCUS are associated with **uncertainties**, making it essential for ports to stay informed on evolving trends in alternative fuels.

**Legislation** is still under development, leaving ports without a clear regulatory framework for implementation.

## Green ports

Ports can limit their environmental footprint by electrifying equipment, such as cranes, vehicles, and tugboats.
At the same time, ports can implement shore power systems to improve their environmental profile further by offering power supply to ships calling the port.

Port electrification and shore power systems are expected to become standard operational requirements, viewed as a hygiene rather than a motivational factor.

Transitioning from fossil fuels to electricity for all equipment and providing shore power will necessitate significant upgrades to the port's electrical grid infrastructure.

## Key take away

Prioritizing electrification to become a green port should be an objective for all Danish ports to secure future competitiveness.

Implementing PtX and CCUS in ports can open new revenue streams while enhancing the ports' overall value proposition. However, these initiatives have significant challenges and uncertainties that must be carefully managed.

Through expert interviews and market reports **Junior Consult does not believe PtX and CCUS will have a significant impact on TEU volumes** because of a slow transition in the maritime sector and customers' willingness to pay a premium for transported goods.

Sources: Green Power Denmark, Danske Havne, COWI, McKinsey & Company, Expert interviews, Junior Consult analysis
Note: [1] Carbon Capture, Utilization, and Storage

# Technological solutions present an opportunity to enhance port performance and significantly improve competitiveness significantly

## Autonomous ports: Port 4.0

To become a winning port, price, time, reliability, and sustainability are all important factors. Technology offers improvements in all these areas. Automation and digitalization can boost efficiency, reducing costs, lead times, and increasing capacity. However, overcoming key challenges is essential. Automation, interconnectivity, and data processing form the foundation of future Port 4.0.

### Automation

Automating operations and processes allows ports to enhance utilization rates, maintain continuous 24/7 operations with reduced processing times, and minimize human error.

Operations efficiency

- Improve utilization of resources and time
- Predictive maintenance to decrease downtime

### Interconnectivity

Ports are a complex network of both people and organizations. Interconnectivity helps distribute data and connect operations and improves tracking, reliability, and decision-making.

Data-driven decisions

- Improve decision-making
- Real time planning
- Planning of storage and logistic planning

### Data collection and Processing

Data is crucial for advancing port technology. At the same time, it supports data-driven decision-making, predictive maintenance, and comprehensive reporting.

Supply chain integration

- Tracking
- Reliability
- Reporting

## Key takeaways

The logistics sectorgenerally relies heavily on efficient processes to handle large volumes of cargo 24/7.

Technological development presents big opportunities to optimize operations at ports which can result in cost-savings and improve lead times and customer experience.

**This will improve sea transport relative to other modes of transport,** incentivizing logistic companies to take sea routes instead of road or rail.

However, Adopting high technological solutions requires that ports acquire both hardware and software, which comes with multiple challenges.

Sources: Mckinsey & Company, Research article: “Port 4.0: a conceptual model for smart port digitalization”, Junior Consult Analyses

# Despite the potential gains from technological adoptions, the challenges associated with the adaptation make it doubtful whether it will be a significant part of future competition

**IOT**
Internet of Things is the interconnection of physical objects with software and communication protocols that enable the exchange of data.

**Big data analytics**
Big data analytics refers to the systematic processing and analysis of large amounts of data to draw valuable insights.

**Robotics and automation**
Automating tasks and enabling 24/7 operations. Examples include automated stacking cranes and vehicles.

**5G network**
To enable digitalization and automation, devices and different port areas must be connected to exchange data. The latest technology is 5G.

**Blockchain & Digital twins**
Blockchain is a way to share and verify information, which has different use cases on ports such as smart contracts. Digital twin is a simulation process aiming to improve efficiency, safety, and resource allocation.

## Challenges

Acquiring **competencies** needed for the development and operations of autonomous ports can be very challenging. Securing tech talent is a challenging task in many industries.

Upgrading ports' digital infrastructure and integrating advanced technologies requires **high capital expenditures.**

Ensuring **interoperability** of advanced technologies without conflicts can be challenging.

Cyber attacks have become more common in recent years, and as ports are critical infrastructure, **cyber security** needs to be a priority.

Sources: Deloitte, World Economic forum, and Junior Consult analysis

# While supply chain regionalization comes with uncertainties, Danish ports must adapt to address the evolving demands

## Regionalization

Resilience, risk management, and indecency have been important topics in supply chains after Covid-19. More companies are accelerating efforts to strengthen their supply network, including localizing supply, more multi-sourcing, and inventory planning. A survey by Kearney reveals that while many companies are concentrating on regionalizing their supply chains, only about a quarter intend to regionalize their operations fully.

**92%**
Are regionalizing their manufacturing footprint

**28%**
Aim to have nearly all in-region-for-region operations by 2030

## Danish ports key focus areas

### Resilience

As customers demand greater supply chain resilience, ports must enhance flexibility to meet customer expectations and keep lead times down.

1. Multimodal offerings
2. Improved infrastructure
3. Hinterland and storage

### Shortened routes

Shifting to nearshoring shortens routes and increases the use of shuttle ships. Regulatory challenges and environmental concerns also drive nearshoring.

1. Prepare for more shuttle-traffic

### Planning

More companies are adopting advanced planning and scheduling systems. The core of these systems is end-to-end visibility and high-quality data.

1. Offering tracking and reporting data
2. Prediction of cyclical movements

## Challenges

**Disruptions** have played a large role in supply chain management in the last five years. Disruptions include conflicts in the Red Sea, Panama Canal blockage, port congestion, and the chip shortage.

**The future of supply chains** is a heavily integrated network of logistics, which is more digital and autonomous.

Significant **uncertainties** surround the regionalization of supply chains, particularly regarding feasibility and timing. Shifting supply chains is a major undertaking, and questions remain about whether Europe's capacity can support such a transition.

Sources: Mckinsey & Company, World Economic Forum, Kearney, Logistics experts, Junior Consult analysis

# Appendix Market Assessment

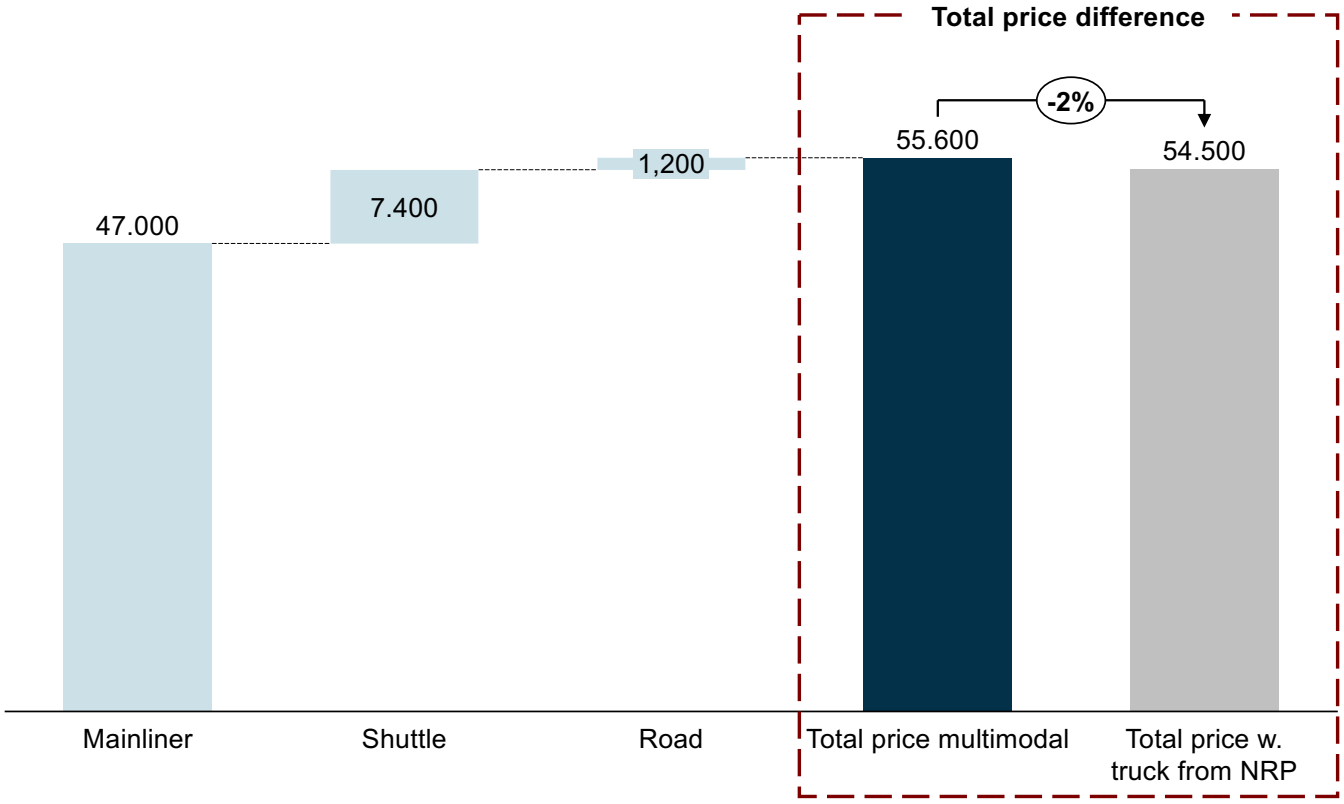
1 Price comparison on different modality types

2 Comparison of CO2 emissions on different modality types

3 Transit time comparison on different modality types

# As prices of trucking from NRP increase, short-sea transportation becomes a viable option in almost the entire country, creating throughput growth in ports due to changes from trucking to short sea

**Shipment of a forty-foot container from Shanghai to Herning**
(DKK)




**Key Take Aways**

**The price of transporting a 40-foot container is 2% higher using shuttle ships from Hamburg** instead of trucking the container directly from Hamburg to Herning.

With price as the sole focus, **trucking directly from Hamburg remains optimal in southern and western Jutland** compared to shuttle to Aarhus and trucking the last mile.

However, price differences have decreased and are expected to continue to do so, meaning greater areas will use short-sea resulting in **greater throughput through Danish ports.**

Note: Data from MSC on container shipping from 1st of August 2024.
Sources: Kuehne Nagel, MSC and Expert interviews

# Multimodal transportation yields lower CO2 emissions than road transportation when considering different end destinations in Jutland

## Total CO2 reduction with multimodal transportation from Shanghai to Denmark

Port

Savings of 16-18% $CO_2$

Savings of 13-18% $CO_2$

Savings of 10-18% $CO_2$

**C02 reduction on entire shipment when using shuttle from Hamburg to Aarhus compared to trucking directly from Hamburg**


## Key Take Aways

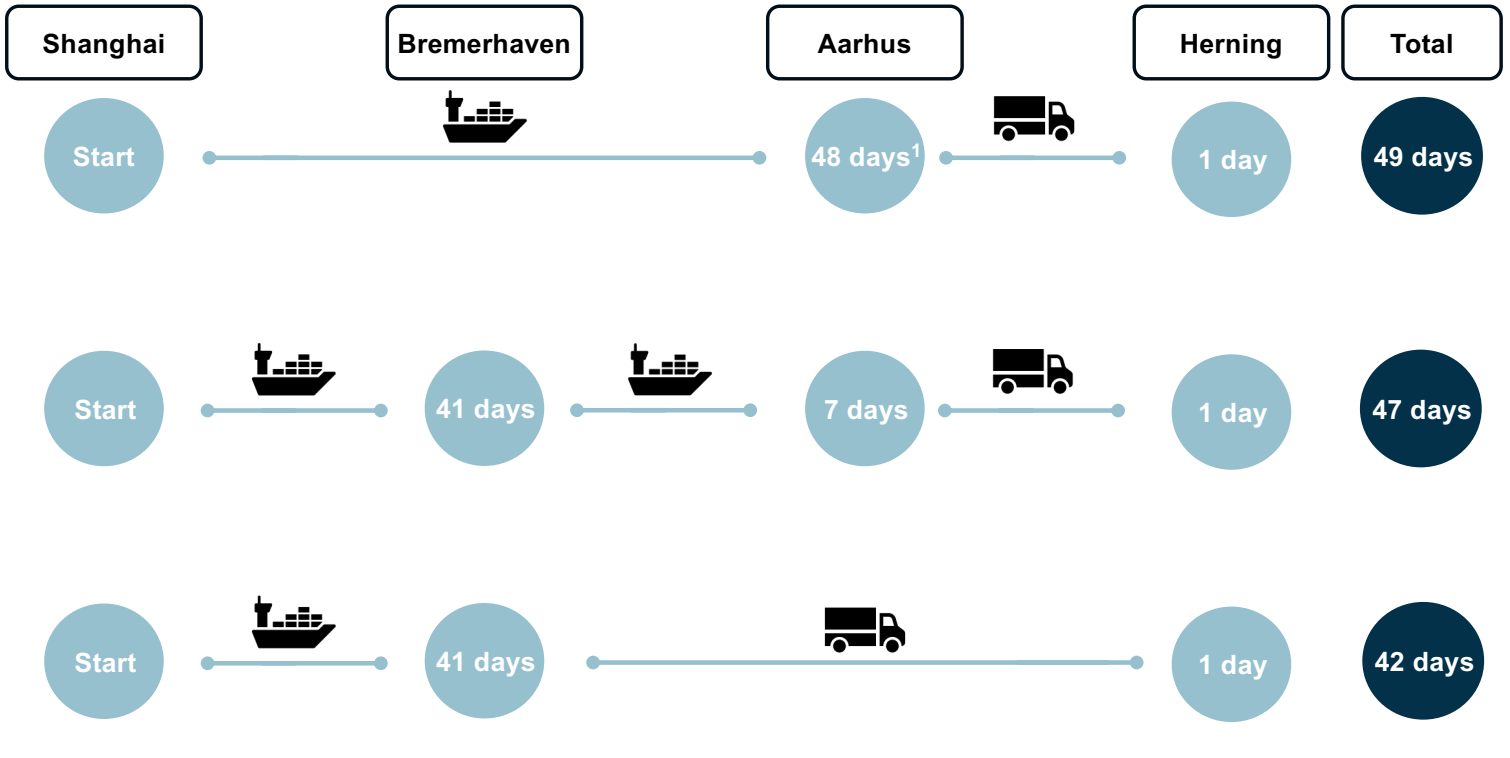
The total transportation of containers from Shanghai to an end destination in Jutland yields **substantial CO2 emission reductions** with multimodal transportation relative to trucking from Hamburg to Jutland.

Shipping to Aarhus and then transporting by road within a radius of 20 to 30 km from Aarhus results in CO2 emission savings of 20% of total emissions. For 50 to 70 km from Aarhus, the CO2 reduction averages 5-15%.

Multimodal transportation is a clear advantage for **companies that monitor CO2 emissions, as they can lower their scope 3 emissions significantly**. Thereby, Danish ports hold a comparative advantage against mid- to long-haul trucking

Sources: Kuehne Nagel, Junior Consult analysis

# The total time for container goods to arrive at their destination relies heavily on the number of calls for a mainliner and the transit time in ports




**Key take-aways**

Transit times, especially foreseeable transit times, remain important when choosing a modality type.

Transit time and reliability are highly sensitive to geopolitical events, where congestions in major ports are delaying sea freight.

Short-sea from NRP is generally faster than mainliners, as the mainliner from Shanghai to Aarhus calls to more ports.

Note: [1]May be sensitive to when cargo is shipped. Less frequent departures of mainliners to Danish ports relative to NRP
Source: Expert interview, Junior Consult analysis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