Port Tianjin 2030: Long-term Prognosis & future prospects

Methodology Prognosis, economic trends and Port planning

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Foreword

This study is the master thesis of the Master program Port, Transport and urban economics at the Erasmus University Rotterdam.

I would like thank Dr. B. Kuipers for his supervision and patience, in guiding and providing me recommendation to finish this study. Also thanks for prof. P.W. de Langen for providing me the opportunity to be an intern in the Port authority of Rotterdam, which enables me to understand the intern issues within the port sector and international corporations. Special thanks to Mr. N van Limborgh for providing me personal recommendations and instructive feedbacks during my intern period.

Management Summary

The port authority of Nangang Industrial zone port Company (NIZPC, part of the port of Tianjin) approached the port authority of Rotterdam for a corporation in 2010. After several visits and exchanges of opinions, a service contract has been signed between the both parties. One of the deliverables in the signed service contract is the long-term planning for the Nangang North-zone; a reclaimed port area in the south of port Tianjin without any plans.

However, before the long-term planning for the Nangang North-zone can be formulated, an analysis about the expected quantity of different commodities of the whole Tianjin port must be prepared in order to determine what sectors or industries would have the most market potential to be settled in the area. Therefore, different background information, e.g. about the economic trends and future throughput flows, must be analysed, and finally to formulate a prognosis of the whole Tianjin port area over the long-term.

As different background information such as the economic trends and competitors in the vicinity are the “ingredients” of the final prognosis, these must be analysed before the prognosis can be prepared. Considering this structure, a scaling down method will be applied in order to analyse different factors from global economic trends to local sector situations.

The structure of this study is as follows:

The study starts with a brief introduction about the corporation between the port of Rotterdam and the port of Nangang. This introduction will be followed by the methodology of prognoses. In this chapter, a description about the definition of prognosis and planning will be given, and different methods of formulating a forecast in different sectors and study fields will be introduced. This chapter will be further deepened into the port sector to find out how port economists have drawn a long-term port planning. Finally, the long-term vision of Rotterdam will be used as an example (case study).

In the third chapter, different global trends which might affect the port sector will be scrutinized. The most remarkable future developments are among other things the increasing

attention of environmental issues (e.g. global warming), the modernised port management systems (such as the application of the ICT in ports) and the scale-up of container vessels etc.

The scale will be zoomed into China in the next chapter. One of the main points in the analysis is the 12th five-year plan released by the Chinese national government in March 2011, which has mentioned the expected economic growth path and the macro-economic control policies in coming five years. Expectations are that China's energy mix will shift from of conventional energy resources (such as coal and oil) to renewable energy resources (such as hydroelectric and Biomass). Moreover, the economy growth will be slowing down with an average annual rate of approximately 5%. Beside these rose-coloured prospects, Chinese economy also has to face different caveats from domestic inflations, polarizing welfare, and political instability.

In Chapter 4, the above analysed developments will be applied in the Chinese port sector. Since the Chinese government will be stricter in environmental policies in the future, dirty heavy industries such as steel have to limit their production in order to realize sustainability in the Chinese economy. Therefore, less volume of different raw materials and products of heavy industry might be expected in the future. (E.g. Steel, iron ore, coal etc.) Moreover, the Chinese economy will shift gradually from public investments to private consumptions, as results, the purchasing power for imports of end-products will increase in the coming years which is favourable for the container transportation. The container transportation is also partly stimulated by the expected stronger RMB and the domestic urbanisation process.

The port Tianjin will be scrutinized in chapter 5. Currently, the port Tianjin is the 5th busiest port in terms of total throughput (408 million metric tons in 2010) and the 11th container port (10,08 million TEU in 2010) in the world. However, the port did not have a good natural condition such as shallowness and the shortage of lands. After reclamation and deepening constructions, the port is now able to handle mega container vessels of 18,000 TEU. Furthermore, the policies of the port Tianjin will also be implementing in accordance with the five-year program, such as investing in renewable energy infrastructures and the low carbon areas (clusters).

This part will be followed by a chapter about the ports in vicinity and competition analyses (chapter 6). Currently, the biggest competitors of port Tianjin are the port Dalian and the port of Qingdao. Because of the industrial characteristics in the hinterland, the commodities throughput of Dalian is mainly bulk port with a limited volume of containers. Qingdao is a sea port with the most throughputs in containers within Bohai, but the port lags behind in total throughput compared to Tianjin. As these ports all have different characteristics but similar size, no one of them can dominate in the Bohai area.

Finally, a prognosis about the throughput of port Tianjin in 2030 can then be formulated through the found ingredients. Because of the lack of statistical data, the prognosis will be mainly based on growth rates and the judgmental methods. In this prognosis, three different scenarios have been used in order to reduce the uncertainties and provide an apparent image of different changes which might appear in the future. Moreover, the forecast will be made on the level of commodities, i.e. an estimation of throughput will be made for each commodity in three scenarios. As mentioned before, because of lack of internal statistical data, this forecast is based on data and information found on public domain. Therefore, the forecasts will not be expressed in absolute numbers of tonnage throughput, but the expected growth rates of each commodity and the possible trends in the future.

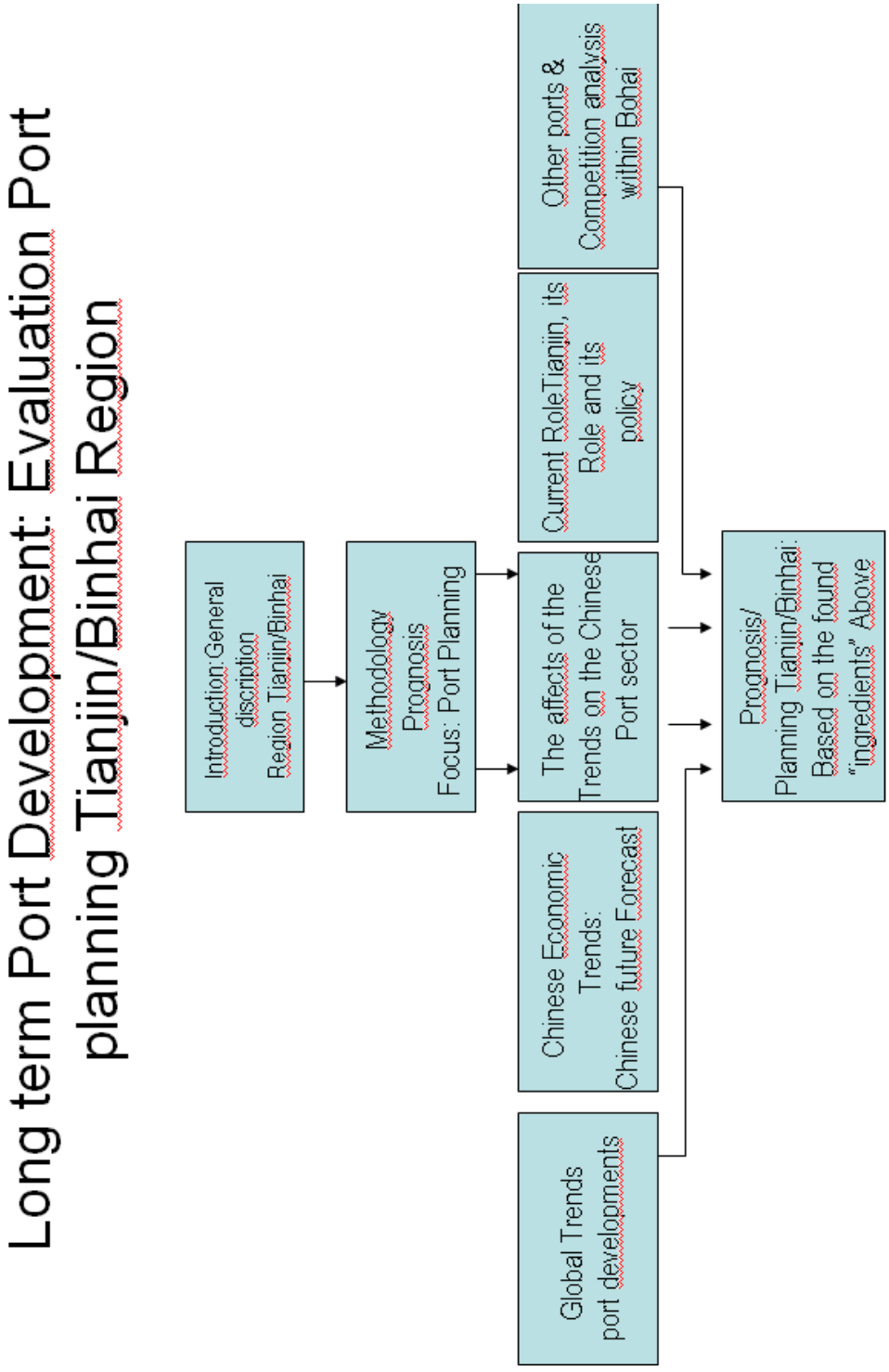


Figure 1: Structure of the prognosis

1. Introduction: Corporation between the Port of Rotterdam and port Nangang (the port of Tianjin)

Nangang is the most southern part of port Tianjin which is one of the busiest ports in the world. Currently,[1] the port of Tianjin is the 5th biggest world port with a throughput of 408 million ton and the 11th container port with a total container throughput of 11,146,000 TEUs in 2010. After the release of the zoning plan of Tianjin port, the authority has announced that heavy industries will be moved from the original northern part to the new southern part of the port such as Nangang. Expectations are that a petro chemical centre will be created in the Nangang area.

Figure 2:Map of port Tianjin after zoning and expansion
Source: Port of Rottedam (2011) Reference document Nangang

In 2010, the Port Authority of Rotterdam was approached by the Nangang Industrial Zone Development Company regarding to the consultancy of port Nangang. After different attempts of discussions, presentations and opinion exchanges between the both parties, a service contract has been signed in March 2011. Since then, different proposals of practical ideas and consultancies have been provided to Nangang, and these have carried off much enthusiastic feedbacks from the Chinese side. However, straight after the positive responses, many problems and questions have raised as well. Currently, discussions have still been going on and hopefully further agreements between the both parties can be realized over short-term.

The main content in the signed service contract is the nine deliverables (see supplement) which must be provided by the port authority of Rotterdam, and one of them is the long-term planning of the North-zone area of Nangang, which the master plan has not been released yet. Since there is still no planning on the North-zone, the port authority of Rotterdam is free to create any concrete proposals for the area. However, in order to determine what sectors are the most suitable and favourable for the future development, a prognosis of the throughput of the whole port Tianjin area has to be formulated to create a general image for sectors with potential to be located in the North-zone.

In this study, the prognosis of the throughput of port Tianjin will be prepared. As much background information are needed, different elements and ingredients about the port planning, global and national economic development, competition analysis between ports in vicinity etc. will be analysed in order to formulate the forecasts.

As no internal data have been provided by the port authority of Tianjin, all the data used in this study are found on public domain which limit the accuracy of forecast and increase the difficulty. Therefore, the prognosis in this study are on the future developments of the port and growth rates of different commodities, instead absolute number of tonnage.

2. Prognosis, methodology and ports' cases

Prognosis' definition and examples

According to the Oxford English Dictionary[2], the definition of Prognosis should be "A prediction, a forecast, esp. of the future course of events based on present observation; the probable outcome of a process or event." However, in practise the field of Prognosis is mostly concerned with medicine and the medical science, Bhandari et al.(2001)[3] has defined a prognosis in the medical world as "investigations examining the possible outcomes of a disease or operative procedure and the probability with which they can be expected to occur". As mentioned above, prognosis is basically a more general word for different kinds of forecasts and predictions, which is concerned with approaches to determining what the future holds. I.e. prognosis is practically interchangeable with terms such as "prediction," "projection," and "forecast"[4]. (J Armstrong, 2001) Generally, prognoses are closely related to uncertainty, even though obtaining guaranteed correct information and data is not possible, a prediction is necessary to be able to make future planning and possible developments.[5]

Three different kinds of predictions have been divided by J Armstrong (2001) [3]. Firstly, a prediction can be made for future values of a time-series, e.g. the number of car accidents in an area or country. Secondly, a prediction might be a one-off event such as the possible effects of a new implemented policy by the government. Finally, the results can also be a distribution, such as the proportion of criminality in different cities in a country or quarters in a city. In practise, forecasting has often been confused with planning. Armstrong (2001) has defined forecasting as what the future will look like and planning as what the future should look. I.e. a prognosis is describing the future objectively, and planning is describing the outcome after using different inputs.

In order to strengthen the reliability and the accuracy of the results, different requirements of selecting and processing data have been proposed. [3]

- The data must be up to date
- Checking errors in the data
- Data adjustments, such as processing inflation in monetary units
- The data should be wide-range and long term period, to be able to be used for similar situation, as this may reduce risks and add accuracy

Methodology

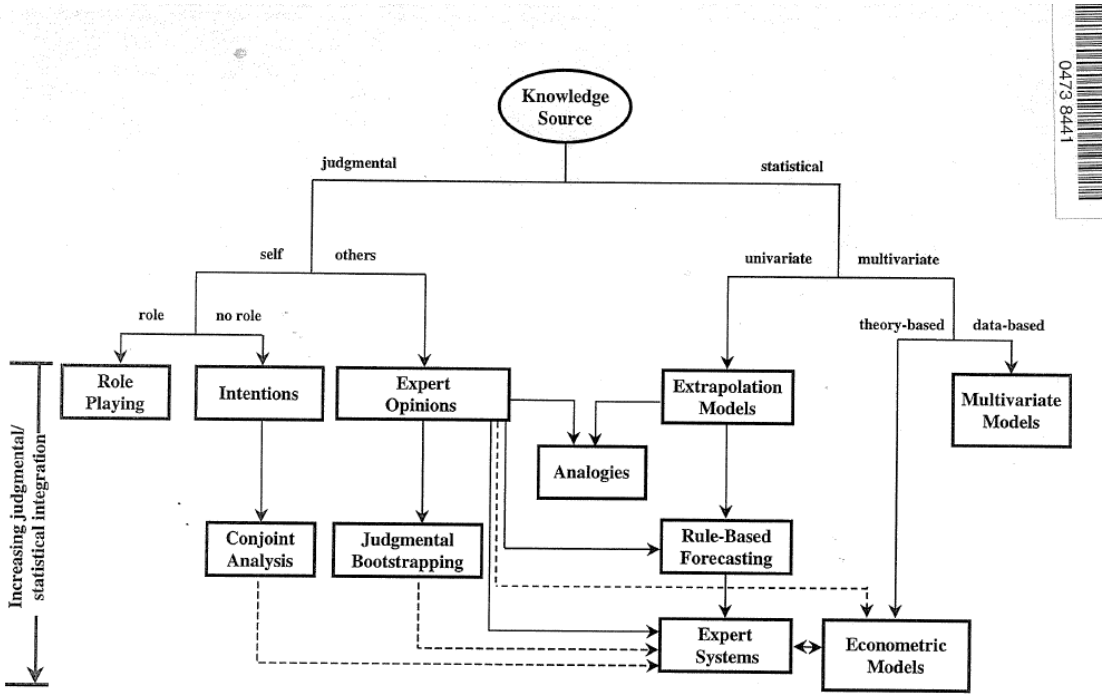


Figure 1: Selection of methodology
Source: Principles of forecasting, J Scott Armstrong (2001)

Figure 3 illustrates different methods which might be used to formulate a prediction. J. Scott Armstrong[6] has collected the most important prediction methodologies since 1960 (methodology tree). He has divided the methods into two different types of features: methods mainly based on **judgments** and those which are mainly based on **statistical data** or sources.

These two features of methodology can be further divided into different methods depending on the characteristics and the available data of the prediction.

Judgmental methods can be further splited into predictions of one's behaviour or prediction of how other will behave. In the case of one's self, this can be divided again whether the prediction is influenced by a role. As the role can often affect behaviours of someone, the ***Role playing*** methods can help by stimulating the interactions among key people. This method can predict someone's reaction and decision by taking his role or standpoint into account. This method is especially useful in conflicts between two roles (parties) such as how would A react by B's behaviour. J. Armstrong (2011) has argued after series of experiments that in order to predict decisions of parties, using role playing is much more accurate than expert judgment method.[7] If the role does not play a role in the prediction, ***intention*** methods might then be applied in which people formulate a prediction of their behaviour in different situations. In this method, intentions can be used and measured in order to find out the possible reactions and decisions of the target group, e.g. the opinion and the intention to purchase of consumers after the launch of a new product. V. Morwitz (2001)[8] has discussed the application of intentions to predict behaviours, e.g. respondents should focus on their own characteristics when responding the questions and not be influenced by preferences of others. He has also argued that this method yield more accuracy when respondents have previously engaged in similar behaviour.

Conjoint analysis can be used to analyse the influences of features of situations in intentions. This is an extension of the intention methods as the intentions of people might be observed when features of a situation are changing, e.g. the intention to purchase different outlook designs of a laptop or to what extent the intern memory of a mobile phone harm sales. This methods' origin are academic and practical which was mainly used on determining the relationships between the attributes of products (soft inputs) and price (hard inputs). D.Wittink and T. Bergestuen(2001)[9] have outlined the main principles of obtaining accuracies in forecasts of customers preferences e.g. combing results of different methods and the usage of simple and complex models in different levels.

In the Branch "others" in figure 1, the ***expert opinion methods*** can be applied in order to determine how companies or individuals act in different situations. In this method, the

knowledge or the opinion will be considered as the foundation and evidence of the prediction. However, as expert's opinions are also subjective, it might cause biases and shortcomings. N. Harvey (2001)[10] has discussed several ways to increase the reliability of experts opinion e.g. retaining forecast records and using more methods to judge the degrees of uncertainties in time series. T. Stewart (2001)[11] has argued that the reliability of experts' opinion is reduced when people use unreliable procedures to collect and analyze information. E.g. people often collect as much information as they can to make an optimal decision, but much research supports the practisethat you should limit the amount of information in judgmental forecasting. D MacGregor (2001)[12] has argued that the experts can make better estimates if the problem can be decomposed in sub-problems; e.g. in order to make a prediction of the throughput of a port, experts can estimate this by dividing the throughput in containers, dry bulk, liquid bulk and break bulk etc. G. Rowe & G Wright (2001)[13] has provided the usage of Delphi procedure to improve the accuracy of experts' opinions in forecasting.

J. Armstrong (2001) has argued that experts' opinion can be inferred using regression analysis in the ***judgemental bootstrapping method***, in order to improve the accuracy of the forecasting. A set of forecasts will then be given to an expert, and then he develops a regression by using his inputs to make a prediction. Armstrong (2001)[14] has also provided a several principles for this method e.g. using simple analyses to represent behaviour.

The ***Analogies*** method can be applied when there are insufficient historical data or observations available to make a research as it might reduce biases or an unrealistic view of the prediction. Duncan, G.T., W.L. Gorr & J.Szczypula (2001)[15] have discussed the mergence of historical data or judgmental opinions of analogous situations and time series. As the developments of a situation can be very similar to another analogous situation, this might have much influence on experts. Duncan, G.T., W.L. Gorr & J.Szczypula (2001) have provided different ways for selecting analogies and pooling results in this method.

Except judgmental methods, a forecast can be formulated by **statistical** methods as well. The statistical methods can be further divided in univariate branches and multivariate branches. The univariate methods, which is also called the ***Extrapolation Model*** methods, is according to Armstrong J.S. (2001)[16] "a way of using values of a series to predict other values". This method is an inexpensive, replicable and objective way of prediction and is especially useful

in shor-term forecasts. However, as this extrapolation model is "purely" based on statistical data, it is also assumed that values of time series are the only relevant parameter of the forecast (e.g. no experts' opinions).

However the traditional extrapolation method has a several shortcomings such as it does not incorporate domain knowledge and it ignores experts' opinion. The ***Rule-based forecasting***[17] method provides a solution and combines domain knowledge with forecasting procedures in time series extrapolations. This will be translated in rules and decide what methods to use based on the quality and characteristics of the available data.

The ***Expert systems*** is the method which represents the rules of experts. In this system, the procedures of the forecast will be replicated and causal knowledge will be applied. In contrary to the Rule-based forecasting which is more focused on time series, this method is mainly about the cross-sectional data.

In the multivariate branch, it can be divided in a data-based approach and a theory-based approach and be both defined by the method of ***Econometric forecasting***. This relies on statistical procedures to estimate the relationships for models based on theory, prior studies and domain knowledge in order to incorporate expert opinions and quantitative information. Allen P.G. & R.Fildes (2001)[18] have discussed when and how to apply econometric forecasting models.

As we can infer from above, finding the most appropriate method to make a prognosis depends on the quality and the amount of the available data. Graefe et al. (2010)[19] has argued that combing different prognosis results from different methods by taking average is the best accurate way to make predictions. Also combining statistical data with experts' opinions will provide accuracy improvements. However, it is still common to search for the (most) correct model as the combination results only provide an average image of the prognosis, i.e. prognosis results calculated by combinations of methods is never 100% correct.

However, J Scott Armstrong (2011) has argued that the judgement method should be avoided as much as possible and applied if there are too less data and knowledge available. The major drawbacks according to Armstrong are, firstly, the result of prognoses based on the judgement

method is much less accurate as the opinions of experts are very subjective and they can not mention an exact number or amount of the prediction. Moreover, in case of a enormous amount or quantity of prediction, the reliability of the results of this prognosis might be very doubtful if it is purely based on opinions. Therefore, statistical methods provide a more objective, less biased, and more reliable results. However, in some cases, complicated and large-scale research might have a detrimental effect on the accuracy of a prognosis, which is actually in conflict with the general belief of making prognosis. I.e., occasionally a prediction of relatively simple regression or empirical findings could have a better accuracy rather than large-scaled researches. (Hogarth, 2010)[20]

B Flyvbjerg (2006) has attributed a few errors which often occur when making prognoses and he has divided these errors in three different forms: Technical, psychological and political – economical errors. Technical mistakes are the most common and the inaccuracies and caused by reliable or outdated data (Vanston & Vanston, 2004 p.33)[21] Inaccuracies can then occur and make the results of prognoses less reliable. Inaccuracies in terms of psychological bias have been developed by Kahneman and Tversky (1979a)[22], it accounts inaccuracies or optimism bias, which means that one would judge future events in an overly positive way than warranted by actual experiences. As result, the prognosis might provide a biased image of the future. Finally, political-economic errors are caused by the optimism bias as well. When a prognosis of a project or plan is prepared by the makers self, forecaster may strategically enlarge the profits and underestimate the costs and risks, in order to gain approval of the project or other funding. (Flyvbjerg et al. 2002)[23]

As mentioned before, there are different methods to formulate a prognosis depends on the available data and knowledge. However, different sectors also have their unique habits to make prognoses, both in research methods and ways of selecting data. Some examples are as follows:

Flyvbjerg (2006) has described how the UK government has tried to make a prognosis for the future planning of transport and other large public procurement with a new method of forecasting: Reference Class Forecasting. This method was first developed by Kahneman and Tversky(1979b)[24], which Kahneman has won the Nobel prize in economics 2002. According to the theory of Reference class forecasting, as focussing purely on historical might lead to

inaccuracies of the final results, the prognosis should also focus on other data. Kahneman & Tversky (1979) have argued that the prognosis can refer to other similar cases to compare in order to gain more accurate results. Therefore, in order to prepare an objective and precise prognosis of the future expenses of the transport sector and other public procurement, the historical data of budget and overspending of different other sectors, such as rail, fixed links, building projects, IT projects, civil engineering etc., been referred to make the prognosis of the UK government.

Bhandari (2001) has attributed the process of how to make and use prognoses in the medical world and he has defined the purposes of making prognoses are: diagnosing the problem/disease, helping administering the disease, and giving the natural history of the disease and the possible outcome. In the medical world, different independent variables can be divided in two different kinds of factors depending on the disease: the prognostic factors and the risk factors. This is because as not all factors or appearances would have the same influences on the result of the prognosis, some more essential (prognostic factors) and some are less (risk factors). Observations and finding historical data of diseases are very important in the medical world. Bhandari (2001) has attributed two different ways: the cohort studies and the case control studies. Firstly the "cohort studies" can be conducted by "following one or more groups of individuals who have, and have not yet, experienced an adverse event and by monitoring the number of outcome events over time". And the second method is the "case collect studies" method, which doctor collect "cases" (the history, disease or other background information of the patient) that already had an outcome event and compare them with those who have not. In order to assess the validity of a (medical) prognosis for the patient, attentions should be paid on the following points:

- The sample of a patient should be representative
- The follow-up should be sufficiently complete and long
- The precision of the estimates of likelihood
- The likelihood of the outcomes to occur over time

Recently, the so-called "prediction market"[25] has risen in the financial and business sector. As a good solution of the increasing difficulty of conducting market researches, one would be asked to produce a prediction for a future event, and a payoff will be paid out if the prediction was correct and nothing if not. The trading price might vary until the outcome is decided. This

method can be used for e.g. the prediction of an election or the likelihood of success of the launch of a product etc. This method is based of on the theory of "the wisdom of crowds" of J Surowiecki (2004)[26] which has argued that "Many (the prediction of a numerous individuals) is more correct than a few (the prediction of a few experts)".

Actually, there are also other reports which have confirmed the theory of "the wisdom of crowds" and the power of prediction markets, and argued that our general beliefs about predictions (statistic and judgement methods) do not have be the only way of formulating a prognosis. Berg et al. (2000)[27] have found out that the market of Iowa Electronic Markets have often outperformed in predicting political elections, by using opinion polls. Pennock et al. (2001a)[28] have found a close correlation between the Foresight Exchange and the Hollywood Stock exchange, and the actual outcome frequencies in the real world. And in some cases these predictions have surpassed expert prognostications.

However, in order to take a closer look at the methodology of preparing a prognosis in the port sector, other ports' prognoses can be referred and consulted as examples.

Long term port planning

In the last decades, ports' functions have been changed from a location of loading/unloading to a hub of logistic & industrial networks and a platform of interfaces between consumption and production centres. As a port is operating in different markets, this complication of markets prompts ports being in an environment of volatility. Therefore, ports have to face many uncertainties, threats or opportunities from different factors such as international trade, world economic conditions and political factors. In order to resolve this problem, the master planning, which describes port's objectives and the expectations of achievements, can be used as an instrument which defines the strategies of ports in the market and recognises future threats and opportunities. However, because of the complexity mentioned above, formulating a Port Master plan, which is mainly focused on forecasts, can be very challenging. De Langen P & van Meijeren J (2010)[29] argue that long-term projections (forecasts) are necessary for ports as firstly that investments in port infrastructure are fixed investments which have a long –pay back period. Therefore, only long-term projections of ports' throughput are able to

analyse the financial viability and profitability. Moreover, port authorities also develop strategies, such as the choice of flows of commodities, attracted customers etc. As these choices are based over a long period, long-term forecasts about the demand and other factors related to the ports are necessary in order to make these choices.

The projections can be used in following ways:

- Developing a vision about the long-term developments in the port, the projection is an important part of this vision.
- As investments in ports e.g. reclamation in sea, might be large-scale and run over long-term. Decisions about these big projections will be analysed by projections of ports in the future.
- Investments in ports' hinterland access depend on the demand, and this can be analysed with the aid of projections about long-term development.

Since ports have long-term targets in terms of e.g. throughput, sustainable growth, durability of environment protection etc., they should develop strategies and implement policies in order to realise these targets. Therefore, a port needs a Port Master Plan as a blue print to analyse the chance of success and to prepare for the worst in the future. This plan should include forecasting elements which involve issues such as (extern) regulations, social, environmental requirements and infrastructural system etc.

Since the future is uncertain, great failures in forecasting and Master plans are inevitable. In order to eliminate uncertainties in the future, different methods can be utilised to have a broader view of possible developments. De Langen P & van Meijeren (2010) have used the methods of the forecasts of Port of Rotterdam to avoid failures in port planning and forecast.

- The forecast and planning of ports should also reckon with other ports in the vicinity, if they serve the same hinterland. I.e. if the hinterland is contestable, developing a prognosis ignoring other competitors would provide a biased image of the future as the strengths and weakness, and also market shares, of other competitors may change over time.
- The planning and forecast should also be distinguished in different commodity flow as well. As commodities transported by ports are very heterogeneous, different changes and developments might affect different industries and commodities differently. In

order to have a more complete, objective and reliable image of the future, forecasts should be done on the level of flows of commodities.

- As the future is uncertain and it is a hard to make a precise progress of developments, different scenarios should be made in order to create a more complete image of the future. The biggest uncertainties for formulating scenarios are economic developments which might affect the throughput of ports, (E.g. the industrial production in hinterland) and the speed of a shift towards sustainable economy which might change the commodities flows. (E.g. modern technology or governmental policies)

P.Taneja et al.(2010)[30] have mentioned the following drawbacks on the precedent theories: Firstly, methods of Master plans used before mainly focus on the potential trade shifts and competitive environment but much less on future policies, technology trends and other new economic conditions.

A typical example of the above mentioned drawback is the deepening and expansions of the Waalhaven of the port of Rotterdam in 2001. At the time, shipping lines Yang Ming and "K" Line have explicitly expressed to have the intention to put the new generation vessels of 5500 TEU in Waalhaven. Therefore, the port Authority of Rotterdam has invested 13.6 million in order to broaden and deepen the entrance and the basin of Waalhaven. However, two terminals in Waalhaven have been taken over by Steinweg and these will be mainly used for storage of empty containers. I.e. No 5500 TEU container vessels are expected anymore at Waalhaven and the invested 13.6 million is down the drain.

Considering the drawbacks mentioned above, a new paradigm for eliminating uncertainties has been emerged. Assumption-based Planning (ABP, developed in 1990's to solve US army strategic planning problem) and Adaptive policymaking (APM) will be applied in order to make an adaptive plan which is more flexible and dynamic. P.Taneja et al. (2010) argues planning is not a shot of a moment at the beginning of a period, but a continuous process of monitoring developments, risks and changes, and adapting these in the planning. I.e. this new approach of planning does not only focus on developing a static plan which is based on the past, but the plan that also allows changes such as in knowledge and other circumstances. As planning should eliminate risks and uncertainties in the future, it mainly focuses on

formulating strategies and minimizing the chance of failure of the plan. The planning should also be flexible and adaptable, and leave rooms for changes.

The proposed approach for port planning can be divided in five steps. The first two steps are derived from the method ABP and the last three from APM.

Firstly: e*xamining the existing plan and identifying underlying assumption.* In this step, different objectives of the organisation, definition of success, different boundaries, available options and underlying assumptions will be identified, in order find out the final goals and targets of the Master plan. This step is necessary to decide when the plans should be changed.

The second step: *identifying the load-bearing and vulnerable assumption.* In this step, some external developments which might affect the planning will be analysed. Both threats (vulnerable assumption) and opportunities will be scrutinized in order to have an overview of possible developments in the future.

The third step: *increasing the robustness of the plan.* In this step, pro-active actions or policies will be devised in order to strengthen the current plan by eliminating future risks. These actions can be taken immediately, before any specific contingencies or expected effects. Four different actions can be divided:

- Mitigating action: reducing certain adverse effects of a plan
- Hedging action: spreading or reducing uncertain adverse effects of a plan
- Seizing action: Seizing certain opportunities.
- Shaping action: affecting vulnerability of a critical assumption, by reducing it or changing it

The fourth step: *contingency planning.* As mentioned before, planning is a process of adapting by monitoring changes and developments. First of all, Signposts must be identified. These signposts provide information which must be monitored to judge whether the plan is still on course. When signpost variables (vulnerabilities) are specified, actions should be taken in order to let the plan moving in the right direction. Also these actions can be divided in four different types:

- Defensive actions: taken after the fact to clarify the plan or preserve its benefits.
- Corrective actions: adjustments to the basic plan after triggers.
- Capitalizing actions: taken after the fact to take advantages of opportunities to further improve the plan
- Reassessment: a process to be initiated or restarted when plan's target have lost validity

Finally the fifth step, *Implementation*. When the Master plan and additional actions are agreed upon, the whole plan can be implemented. Different actions from step three and four can be taken in order to keep the plan on the right track. Even the "saving actions" fail and the plan must be restarted, the next trial might still benefit from the "failed" experiences.

Case study port planning; Port of Rotterdam, vision 2030

The Vision of PorR 2030, which is also called the "Port Compass"31, has been released on the 19th of May 2011. This is the future prognosis of Port Rotterdam over long-term presented by the Port Authority Rotterdam. In order to predict the flows of good and the sectorial economical growth, both statistical method and judgement method have been used in this prognosis. As some new flows of goods, e.g. LNG, which has not had any storage in Rotterdam until 2008, does not have any history of data. As purely statistical researches based on short period data do not seem to be accurate and reliable, therefore, some prediction of some segments are prepared by segment specific experts.

According to the prognosis of PorR, the most important factors which may affect the future of PorR, are economical growth, de scale of world trade, the oil price and the environmental policies. Based on these factors, four different scenarios have been selected for the predictions of flows of goods in the future:

Table 1:Scenarios used in Port of Rotterdam

Scenario	***Description***
Low Growth	low economical growth, low oil prices, dominant fossil fuels and moderate environmental policies

European Trend	existing policies en a moderate economical growth
Global Economy	large-scaled globalization, low oil prices, high economical growth and moderate environmental policies
High oil prices	High oil prices, strict environmental policies, moderate economical growth and relatively fast process of preservation of industry and logistics.

Source: Ramingen Goederen overslag, Haven Visie 2030[32]

However, these scenario scan not always provide all details in all different flows of goods, as the used scenarios are based on the sectorial economical growth, and it does not implicit the production capacity of some sectors. Forecasts of flows of goods of the years 2020, 2030 and 2040 will be formulated, and the year between these periods, it is supposed the developments will be steady. However, the most attention of the vision and the forecasts will be focused on the year 2030.

The prognosis of PorR will not only focus on the forecasts of total throughput, instead this will be divided in different parts in order to increase the accuracy of the assessment. I.e. forecasts of different segments with the similar developments will be calculated separately and with different methods.

As mentioned before, a prognosis of the area Hamburg-Le Havre range will be formulated first. After that, an estimation of the market share of Rotterdam within this Hamburg-Le Havre range will be calculated in order to find out the forecasts of PorR.

3. Global future trends

As the port industry is an important part and platform of the world economy, trade, and business activities, it is inevitable for policymakers to recognize and understand the most important developments in the world which might have influences in the ports. Realising the possible opportunities and threats in an early stage is necessary to formulate an accurate a prognosis. Several relevant global and domestic trends (and developments) have been selected in order to make the analysis.

Long-term developments Global economics

Firstly, a shift of (economic) power is expected from the west (North-America and Europe) to the east (Asia). Mahbubani, K(2008)[33] argue that asian Nations, inter alia China, Japan, India, might be appointed as the new leaders in the world after the weakening enfeeblement of the position of the United States, providing that these Asian nations can collaborate and function as an economic unity. Currently, the proportion of the GDP of Asia in the world amounts to 27%, and this was 20% in the 1980's. The expectation shows that this proportion will be 40% in the future.[34] Therefore, the rise of the Asian Nations seems to be significant and inevitable (R.Kaplinsky, 2008)[35], as they possess advantages such as size in both population and GDP, combination of low wages and innovative potential, competitiveness, growing influences on medial governance and environmental conferences etc. However, many have criticized the theory of Mahbubani (2008) that he has underestimated that nationalism within Asia (e.g. East Asia and Middle East), i.e. delicate political problems could be stumbling blocs for the (economic) integration. Nevertheless, China and Japan are currently the second and the third economy in the world respectively, and these are attended by the enormous dynamic in both social and economic field.

Secondly, different environmental problems such as climate change and global warming have attracted much attention and are highly ranked on the political agenda in the international community. Therefore, it is hard to imagine that environmental regulations and policies will be less strict over the long-term, and the issue of sustainability is getting more important. However, protecting the environment and maintaining sustainability is currently no longer an initiative from the public sector. More and more consumers consider sustainability as an important parameter for product choice and companies also try to differentiate themselves from others in the same way as well.[36] Also corporate conscience might play an important part as well. On the other hand, meeting the environmental requirements has generally been perceived as added costs, i.e. this raising of cost might become a great challenge for some sectors and companies in the future.

Thirdly, a big transformation of energy and fuel mix is expected in the future. Recently, the proportion of the renewable energy in the context of global energy supply has increased substantially in the last years. By 2009, 25 percent of the global power capacity is renewable and 25 per of global electricity supply. Currently, 70 million households in the world are using the solar energy and Grid-connected solar PV has grown by an average of 60% annually for many years.[37] In the case of wind energy, its market has grown by 41% in 2005 and 32% in 2006. [38] Wind and Sun energy mentioned above are not the only examples of this trend, recent released hybrid and electric cars, bio fuels etc. are also booming. This trend is expected to be carried on over long-term.

Fourthly, as a further raising economy of the development countries, e.g. China and India, is expected in the future, sufficient supply of raw materials is crucial for the prosperity and welfare of these nations. Even explorations of new sources and modern technologies have kept the reserve and the supply of raw materials on par with the demand in the past. However, partly because of the enormous increasing number of world population and the inefficient usage, experts wonder this development can continue in the 21st century. Especially the shortage of metal and mineral resources will occur in the next decades, and this might lead to price-rise, trade barriers etc.[39] These shortages of raw materials can also affect the geopolitics and the international stability negatively as well. E.g. the Chinese plan of restriction of the export of rare earth, which is necessary for the production of modern electronics, to Japan

after the Senkaku islands dispute in 2010, has caused much unrest as 95% of the production is currently taking place in China.

Currently, modern Information Technology is enormously influencing our daily life. Communications and exchanges of information do no longer need to be face-to-face, i.e. distance does not hinder human's direct interactions anymore. This might have affection on companies' organisation as well, as some expensive labour work can be replaced gradually by accurate and relatively cheap ICT-systems. E.g. a research argues automated cars can strengthen the traffic security enormously.[40] Therefore, the further popularization of ICT seems to be an uninterruptible trend, and the flexibility and adaptability of firms in the usage of ICT might determine their achievement in the market.

Finally, in order to be sustainable and to realise cost reductions, shipping companies are trying to scale up the vessels. Recently, one of the biggest shipping company Maersk has ordered 10 container vessels with a capacity of 18,000 TEUs, which is 16% larger than the current biggest Emma Maersk with a capacity of 15,500 TEUs.[41] This new giant container vessels, which is called Triple-E, is based on the three main purposes for its creation. Firstly, Economy of scale can be realised as more containers can be transported for trip, a cost saving of 16% is expected after the usage of Triple-E.[42] Furthermore, larger vessels also stimulate energy efficiency, as less trips are necessary for the same amount of containers. Finally, the scaling-up can also improve the environmental issue by reducing the emission of CO2 because of less number of trips. This trend of scaling-up container vessels will carry on in the future as well. Currently, shipbuilding company STX of South Korea is designing a containership of 22,000 TEUs with 450 metre in length, and this can cut the price of container by 40%, according to Seatrade Asia.[43]

4. The Chinese Economic Trends: today and tomorrow

In 2010, China surpassed Japan in GDP and became the second economy unit in the world. Positive expectations are that China will surpass the United States by 2030, thanks to different scale, cost and labour advantages. Enthusiastic and optimistic reactions flood in different media and the world. However, there is no shortage of less positive or even pessimistic voices. Many say the future of the Chinese are less bright because of its downsides of economic developments such as the reliance on export and real estate market, bad debts, domestic inflation etc. In order to make a prognosis, different factors, and possible threats and opportunities should be taken into consideration as it is tough to determine the exact developments and outcome of the Chinese economy. Different Chinese economic characters, both optimistic and pessimistic, will be discussed in this part.

The Chinese economy: a bright future

Recently China is considered as the rising star of the world economy. In the last decades, East Asia is the fastest growing region in the world, and China is the fastest within this Region. Since the economic reform in 1978, the Chinese economy has been growing with an annual rate of 10%. During the economical economic crisis in 1997, the Chinese Renminbi and the Hong Kong Dollar (British) were the only currencies which have not been devaluated in the region.[44] Moreover, China's economy has booked a positive growth rate in 1998, in contrast to other East Asian Nations.

With a total population of 1.4 billion, China disposes of a huge market for foreign and domestic investors with an enormous demand. This makes China a safe and large investment economy[45]. This great number of population does not only provide a market, but also labour.

This can ensure the supply of manpower with relative low wages over the long term. Moreover, as the Chinese government has invested immensely in education, the general education level will increase, and more high-skilled and high educated labour will be available in the market in the future. Currently, the urbanisation process is still going on, partly because of the society shift from rural and agricultural to urban industrialized civilization. The great hinterland for supply of labour and the fast developing education system will further sustain the urbanisation process. Expectations are that China's economy will still increase with an annual growth of approximately 8%, this will further attract the incoming foreign capital and investments into China.

Over the long term, raw materials resources are should be sufficient in order to support the Chinese economic growth. Currently, China possesses relative abundant natural resources, especially the north-eastern part of China, which is mainly focused on the equipment manufacturing. The major industries are steel, shipbuilding, automobile manufacturing etc. The steel industry in the north-eastern for example, accounts for more than 65% of the National production. With this major supply of raw materials and natural resources, the north-eastern will be an important pillar of the Chinese economy in the future.

Many have called China as "copy shop" because of the profusion of replicas of electronic and mode products, and the lack innovation and creativity in the Chinese market. However, Gunde R (2005) [46] argues that this backwardness is not necessary a drawback. He confessed the Chinese technological level and investments on R&D lag far away behind different developed countries, and these are exactly what China needs in order to realize steady growth in the future. Currently, due to the closed relationships with developed countries such as Japan and South-Korea, high technology and R&D accomplishments can then be "borrowed" at a lower cost.

Another argument which has been widely used as an evidence for China's economic success in the future is its similarities of economic developments with Japan[47]. Japan, which its economy took off in the 1960's, has shown similarities in major indicators with current China. An overview is as followings:

Table 2: Table Comparison Japan and China

	China	Japan
Life expectancy	Female:72/Male:68 (1998)	Female:72,9/Male67,7 (1965)
Infant Morality rate	30,1% (1999)	30,7% (1960)
Primary sector as a share of GDP	15,9% (2000)	16,7% (1959)
Engel's coefficient in urban areas	39,2% (2000)	38,8% (1960)
Per capital electricity consumption	1071 kwh (2000)	1236kwh (1960)

Source: The Future of the Greater China Economy. The third Wilbur K. Woo Conference on the Greater China Economy held UCLA

However, the accentuation of this comparison is that both economic powers have implemented the same policies and used the same model to stimulate the economy in the beginning phase of developments. Both countries have implemented the so-called "state" capitalist" system, which tries to boost and stimulate the economy by strengthen the relationships between the government and free enterprises. The government selects "favoured" and potential industries and provides (state-owned) enterprises of these industries and banks subsidy and aids in the form of inter alia financial support. Even though the government does not control the banks directly, outward loans can be controlled efficiently. In the case of China, "pillar" industries such as steel and automobile were supported by the government. In order to support these industries, the RMB has been kept low to boost the export. Partly thanks to the high domestic saving rate in China, this model become more efficient as these enormous savings can be invested by banks. Lin also argues that if China follows this pattern of development and maintains of annual growth of 8% in the future, it can be another economic power (with a much higher GDP) like Japan.

He J and Kuijs L (2007)[48] have tried to characterise the current saving trends which might have a great impact on China's economic future. Because of the "Japan model" of high savings and investments, China's growth is progressively capital intensive. The fixed capital formation in different (pillar) industries and infrastructure etc. has contributed 45% of the Chinese GDP in 2006. The capital accumulation is an important of part of the increasing GDP of labour productivity in China, the contribution is in average 5.3% of the 9.6% average annual GDP between 1993 and 2005.[49] Moreover, China's domestic investments are mostly financed by enterprises. FDI (Foreign direct investments) is also a major engine of the

Chinese economic growth, however not in terms of financing sources (3-4% of GDP) but more as transfer of incoming modern technology and innovation. Generally speaking these enterprise investments should be financed by household savings. However, the current proportion of household income is 60% of GDP and only 25-30% of this has been saved. I.e. it was not household saving but the enterprise saving was the driving force of the Chinese growth in the last decades. He (2007) also argues China's economy is industry-led. The proportion of industry amounts to 53.5% of the GDP in 2006. This is, as mentioned before, also a result of increasing labour productivity partly thanks to capital accumulation by investments from enterprises and households. Therefore, as the trend and tradition high saving rate is expected to carry on, this high capital accumulation will be the pillar and engine of the GDP-growth in the future, in the form of industry-growth and increasing labour productivity.

Caveats in the bright future

As mentioned before, there is no shortage of more pessimistic forecasts of the Chinese Economy. The most popular argument is the distribution of income and wealth in China. As mentioned before China has already surpassed Japan as the second economy in 2010. However, the GDP per capita is still very small because of the enormous number of the Chinese population number. According to IMF, the GDP per capita in China amounts to 4.382 dollar in 2010, which is approximately 10 times smaller than Japanese and USA's GDP. Many are doubtful about the Chinese bright future over long-term as this low GDP per capita also reflects the limited purchasing power and consumption.

Chua (2005) [50] also has concerns about the Chinese economy over long-term. Firstly, Because of the policy of openness for international trade since the economic reform in 1979, the trade between China and other countries has boosted enormously. However, this openness and interconnectedness in the form of trade can also result in trade dependency. Lin (2005) attributes that the trade dependency ratio is currently around 60 to 70% which is much bigger than 20% in the US and 15% in Japan. I.e. China might be very vulnerable if economic crisis would occur, sudden decrease demand from abroad might harm the Chinese export and economy very badly. Moreover, in order to sustain the growth and the industry, many global resources and raw materials such as steel, cement and oil etc. will be highly necessary. As a

world big consumer of natural resources, China might be very dependant on external suppliers.

Furthermore, possible political instability might flare up in China, as this is hard to predict. Recently, minority's problems e.g. separatism in Tibet and Xinjiang have risen up in the last decade, different unrests within and outside China have resulted in troubling situations. Moreover, social inequalities such as rural-urban differences, corruptions etc. have deteriorated the grievances from the society. China is facing great political challenges in the future.

In 1978, the so-called one-child policy has been implemented accompanied with the economic reform. This policy has eased different social issues and the economic pressure for resources and food. However, 30 years after the implementation of this policy, problems such as demographic crunch of a lopsided age distribution in China are getting serious. An army of elderly will challenge the Chinese pensions system, health care and social safety. This lopsided development can aggravate the burden of "young" people and might decelerate the economic growth of China.

As mentioned before, the rapid growth of China is mainly thanks to the support (loans or other financial assistances) of the government (Japanese Model). However, Schuman (2011) argues that this Japanese model also has many downsides and drawbacks, and China should rebalance its policies in order to prevent the possible breaking down in the future, such as Japan in the 1980's. As mentioned before, some Japanese firms were supported by the government in order to stimulate the economic growth. However, this bureaucratic meddling, with close relationships between government, business, and banking, has skewed the incentive structure in Japan as this is mostly based on government preferences or even personal relationships. I.e. the economy was not operating with clear rules based on credit risk or corporate governance. When the economic crisis has broken down, companies which had lived on "easy coming" loans became incapacitated as they could not pay back. The financial system of excess investment and capacity became ruin after the crisis. Currently, China is facing the same problem, in view of the domestic inflation and the corruption in the society. Schuman also argues China has generated some strong years of growth with this policy. However, it can be the seed of future construction as well. Currently, the Chinese government

is also complaining the excessive capital inputs in some industries such as steel, as these can obtain capital easily from the government. Excessive directed lending and government supports might affect the incentives in the economy negatively, and result in asset bubbles and misallocating of resources.

He J and Kuijs L (2007)[51] have also expressed their concerns about the current Chinese economic situation and future. Firstly, the authors wonder whether the current model can hold over long-term. As mentioned before, the enormous economic growth in China in the last decades have based on the high saving and investment rate. If the Chinese government decided to continue the rapid growth with the current mode, the saving and investment should grow even harder than now because of the ageing population. This would be hard to finance as the saving rate is expected to fall because of pressures from demographics. Moreover, as the current investments in "selected" industries do not profit people directly, it is still the question whether these can hold in the long-run.

Secondly, the "industrial-based" growth has to face great challenges in the future as industry is strongly dependent on energy, commodities and raw resources. China's usage of energy soared 70% between 2000 and 2005, and China is now the second consumer after the USA. The energy consumptions have caused much pollution problems already e.g. water & lake pollutions and CO2 & SO2 emissions. Currently, China has become the largest emitter of SO2, and the second of CO2.

Finally, the current economic "industrial based" model has created relatively less urban jobs. In 1993-2005, the GDP-growth in the industrial sector is mostly thanks to the productivity growth, but much less to employment growth. The average value added was 11.2% between 1993 and 2005, while the employment growth was merely 1.6%. This has resulted in a relative big army of agricultural workers of 43% of the population in 2006, and this is high compared to other countries in the same development phase. This has deteriorated the rural-urban inequality as the productivity in agricultural activity is much lower than industrial and urban jobs. Therefore, income inequalities will hold over long-term if this model would be carry on.

Li C (1998)[52] has expressed his concerns about the inflation and economic bubbles in China. After the economic reform in 1978, China had to deal with different inflation periods which have badly damaged the economical structure, factories' production, distribution of wealth, amount of investments, external trade and consumption behaviour etc. Li argues that China still has some "snakes in the grass" which may cause inflation again in the future, or even a collapse of the current bubbles economy:

Firstly, financial instabilities might create inflation in the future. Financial risks have been enlarged mainly because of the bad debts. Li argues that these bad debts amounted to around 10-20% of the total mortgages provided by state-owned banks. Moreover, as there are still imperfections in the regulation of the financial markets in China, there are still many companies or financial institutes which try to speculate on the financial market with unfair ways, and this has resulted in chaos.

Secondly, inefficiencies of particularly state-owned firms will be a major focus point of the macro-economic controls in the future. In 1996, as much as 43.7 of the state-owned companies are loss-making and they are living with financial support form the national government. Li argues the inefficiency of state-owned companies must be solved in short-terms as these companies defend the national interest. The efficiency of state-owned companies might affect the Chinese economic developments over the long-term.

Thirdly, inappropriate investment behaviours of local governments might lead to excessive investments in the real estate market. Due to the large-scale of the country and the limitation from the national structure, many local governments in China have the chance to focus on long-term profits of real estate in order to gain more financial interests, with high real estate prices and possible bubbles as result.

Finally, the current trend of consumption and investments might have hidden danger for the future. As the chance for excessive investments is still real in the future, the Chinese government has to face great challenges in the future. It should stimulate investment on the one hand, but also eliminate excessive investments on the other hand. Considering the income developments of cities and sub-urban areas, shortage on consumption does not seem to happen over short-term. In 2010, the inflation rate was 5.1%, mainly driven by the food prices

(11.7%). Li also argues that excessive demand and investments are not the only major reason of inflation in China. China often has to face different natural disasters such as winter storms and flooding, and these disasters might affect the inflation negatively as well. E.g. the inflation rates in January 2008 and February 2008 were respectively 7.1% and 8.7%, which was highest since 1997, were mainly due to the winter storm in north China.

The hidden dangers of inflation above show that large-scale inflation can still occur in the future. Currently, the Chinese government still has not found an optimal solution and strategy for a steady, fast and health economic growth while eliminating inflation.

The Chinese Five-year plan

In March 2011, China released its 12th Five-Year plan for the period from 2011-2015. Currently, the Chinese economy does no longer utilise a plan system after the economic reform in 1978, many even argue China's model is more a market economy and the western world should further lower their barriers with China. However, as the extraordinary Chinese economic growth in the last decades is driven by the Japanese model, which the national government still possesses much influences on investments in preferred sectors, it is necessary to pore over the plan in order to understand the future trend and where this nation is going to.

Targets of this plan can be separated in economic and non-economic elements. The economic targets are as follows; Firstly, annual GDP growth will be expected (or planned) to be 7%, this is lower than the average growth of approximately 10% in the last five years, in order to curb the domestic inflation and bubble economics. Secondly, the urbanisation rate will be increased from 47,5% to 51,5%, this increase in urbanisation rate might partly ease the problem of inequalities in wealth distribution. Moreover, the proportion of the third sector should be increased to 47% from the current 43% of GDP. Finally, the consumer price index (inflation) should be hold within 4% on an annual basis. [53]

Non economic targets are inter alia; firstly, the utilisation of renewable energy should be stimulated. The usage of non-fossil fuel will be increased to 11.4 % and the general energy usage will be reduced to 16% per unit of GDP. Moreover, in order to ease environmental

pollution problems, the forest coverage in China can be used as a efficient measurement, this will be increased to 21.66% in the coming five years. Finally pollutants such as COD and sulphur dioxide will be decreased by 8% each.

This five-year plan focuses on two themes: High quality growth and inclusive growth, which are related to the environmental protection and the wealth inequality respectively. These themes will be converted in the following more concrete goals; developing western regions, protecting environment & improving inefficiency energy efficiency, stimulating domestic consumption (instead of export as driver of the economic growth), improving the lives of Chinese citizen (less inequality), and continuing focusing on priority industries.

Table 3: The seven new priority industries: Chna's five year plan

China's 12th five-year Plan: Seven priority industries	
New Energy	*Nuclear, wind and solar power*
Energy conservation and environmental protection	*Energy reduction targets*
Biotechnology	*Drugs and medical devices*
New materials	*rare earths and high-end semiconductors*
New IT	*Broadband networks, internet security infrastructure, network convergence*
High-end equipment manufacturing	*Broad band networks, internet security infrastructure, network convergence*
clean energy vehicles	*Hybriad cars etc.*

Source: KPMG (2011) China's 12th Five-Year Plan: Overview

Vis-à-vis the former five-year plans, the following new items have been added or changed. Firstly, regulations and governmental interferences in the housing market will be implemented. As Chinese housing prices have been increasing enormously, 36 million units of affordable housing will be developed in order to rebalance the market. Secondly, emissions of some pollution gases will be reduced; both emissions of Nitrogen oxide and ammonia nitrogen will be cut by 10%, and CO2 by 17% per GDP unit in the coming five years. Thirdly, improving the wellbeing of Chinese citizen; the life expectancy should be increased by one year, from the current 73.5 years to 74.5. Furthermore, the Chinese economy should

focus more on innovation in order to sustain growth over long-term; the targets will be 3.3 patens per 10.000 people at the end of this five year plan and the R&D expenses should be 2.2% of the annual GDP. Finally, the education level should be improved; the enrolment ration of high school should be improved from 82.5% to 87%.

Different parties and sectors will be impacted, both positively and negatively, by this new plan. Firstly, further urbanization and increase in service sector will lead to income increase. Therefore, Chinese citizens are expected to enjoy a higher standard of living than before. Secondly, low carbon sectors and priority sectors will benefit from the plan in the form of investments, financial incentives or subsidies etc. Furthermore, because of rise of labour cost at the coast areas and the initiative of developing of the western regions by the Chinese government, more companies may need to consider moving production and operation to the west in order to realise cost benefits. However, for this plan might be a great challenge for the low-end manufacturers, as the countries focuses on high value-added productions and services.

5. Application in China's port sector

In this chapter, the possible global and Chinese economic trends will be applied in the port sectors. A concise overview is as followings:

- As a shift of (economic) power is expected in the future to eastern nations such as China and India, a closer trade relationship between the West and Far East is expected in the future. As shipping transportation is significantly less costly than air in transcontinental shipping, the port sector in China will be playing a more important part in the Chinese economic growth.
- Even China is a huge nation with a surface of 9 million km2, because of its stock and enormous demand to natural resources, China is however, relatively lack of raw materials. In order to sustain the economic growth over long-term, raw materials such as steel and crude must be imported form abroad. This development is also favourable for the port sector in China. Moreover, other traditional fossil fuel will be gradually replaced by non-fossil or bio-fuels. More chemical products and LNG products might be expected to be transported in Chinese ports accompanying with less throughput from conventional resources e.g. crude oil and coal.
- The Chinese economy has taken off in the last decades; however this enormous growth is at the cost of the environment. Environmental problems such as emissions of gases and water pollution have caused many domestic and international grievances already. Expectations are that more environmental restrictions and regulations (also in terms of money) will be implemented in the port sector. Efficient usage of energy is

no longer a strategy of differentiation but a necessity. Among other things emission of gases of the industry sector will be reduced and the usage of renewable will be highly stimulated. According to the Chinese five-year plan, in order to realise the sustainable growth and resolve the environmental issues, the Chinese government will provide priority industries (financial) incentives to support there developments. Therefore, traditional priority industries' production such as steel will be expected to decline in coming years. Therefore, throughput such as iron ore and steel will make rooms other "sustainable" goods.

- According to the five-year plan, more urbanisation will be expected in the future in order to increase the social welfare. As the second city in terms of the number of inhabitants and an important hinterland area of port Tianjin, the urbanisation trend will also carry on in Beijing. As urbanisation often means increase in welfare, this may strengthen the purchasing power and lead to more demand for import of products and the transportation by port (especially end products and containers).
- Since the chance of great inflation in the future stills exists and this might harm the Chinese economy severely. Therefore, the Chinese government might cut its investments in different sectors, and among other things also the port sector (e.g. investment of the project Nangang). Different ports in China would then obtain less financial supports and resources from the public sector in order to prevent overly investments.
- Currently, the Chinese currency Renminbi (RMB) is by many experts considered as unevaluated and China is suffering the consequences such as high domestic inflation (in exchange for export). Therefore, evaluation of the currency is expected in the future which is favourable for the Chinese import and the demand for transportation by port.
- Innovation and knowledge are also important focus points of the Chinese five-year plan released in March 2011. Thanks to the modern technology and the ICT-development, different means of communication have been invented which have lead to information spillovers and knowledge distribution, and the innovation process can then be stimulated. Even currently China lags behind in innovation compared other developed countries; however, the country has the intention and potential to book much progress in this field. The increasing innovation level in China might have many influences in China's port sector, as it can change the energy usage efficiency and mix

in the future. The five-year plan has explicitly mentioned that China's industry should shift from traditional fossil fuel to renewable energy, such as LNG, bios mass and other bio fuels. This plan can also be executed by recycling, reusing and reducing of Energy. Therefore, other forms of bulk might be expected in the future, and ports should be flexible to adapt these changes.

- In order to optimise and improve the quality of logistic chains, different parties in the chain will further corporate together (e.g. information and knowledge exchange) in order to have more efficient competitive and sustainable port processes in China. As this development is a worldwide trend, also customers will argue both the efficiency and sustainable of an important parameter for the selection of ports.
- As the capacity of container vessels has been getting bigger in the last decades, this also requires the sufficient depth of ports in order to be able to handle these mega vessels. Deep ports (e.g. Rotterdam) will have more potential as container vessels will be further enlarged in the future.

During the research, it is remarkable that the expected storage of Chinese ports highly depends on the oil prices. Even China will be focusing on new and "clean" industries such as new energy and biotechnology etc in the future. However, expectations are that the demand of fossil oil will not decrease in the future. Moreover, as the stock of oil is diminishing gradually, the supply will still be very tight. On the other hand, as China will invest more in new and clean priority industries, the usage of traditional fossil oil is strongly discouraged by the Chinese National government, and this can be realised by e.g. charging levy or tax on the usage of oil.

As mentioned before in part 2, in order to have more accurate results, forecasts should be segmented in different sub parameters (segmentation method). In the case of ports' throughput, dividing it into different sorts of bulk will be more efficient. The division of ports' storage is as followings:

- Dry bulk; such as iron core, coal, agribulk etc
- Liquid bulk; such as crude oil, chemical products, LNG etc
- General cargo; such as containers and steel

By taking the possible affection on ports mentioned above, the following throughput forecasts have been formulated.

Dry bulk

Firstly, iron ore is an important material for the steel industry, and it is mostly imported from Brazil and Australia. However, as China will be focusing on sustainable growth and protecting the environment in the future, the Chinese steel industry, which used to be a priority industry, will be diminishing its production. In Hebei province for example, some of the steel fabrics will be close down and the production will be stabilized or even reduced by 30%. Therefore the Chinese import of iron ore will probably decrease in the coming 20 years.

Secondly, the coal production in the Chinese hinterland and storage in the ports have played an important part. Also the demand for coal in China highly depends on the stock and price of oil and gas, as coal can be a good alternative of these materials. Also the coal does not have a bright future in the port sector as the Chinese government will be focusing on new energy solutions which might replace the coal.

Finally, the storage of agribulk in Chinese ports might have a bright future. Firstly, despite the one-child policy, the Chinese population is still expected to be increasing in the future. As the primary need of human being, it will be unlikely that the demand for food will drop in the future. Moreover, because of the distribution disparity of agricultural activities in China (mostly in the southern areas), the demand for transportation of food also has much potential for growth.

Liquid Bulk

Because of the shortage of raw materials and the expected economic growth in China, the demand for crude oil will remain enormous. Expectations are that the number of cars in China will keep increasing, but 75% of cars in 2040 will still use gasoline as fuel (less usage per car by efficient utilisation and modern technology). Therefore crude still has much potential in

the Chinese market. However, according to the Chinese five-year plan, crude oil does not fit in the future prospects anymore. More resources will be focused on new priorities such as renewable energy, biotechnology and new materials which are more environmental friendly. In order to put this into practise, policies such as providing priority industries financial incentives or charging levy on crude oil. Therefore, the crude oils will have much potential; however this will not obtain much support from the Chinese government.

The mineral oil products are mostly stored new refineries, chemical plants and tank storage terminals. Currently, mineral oil products do not have a big market in China as the most of the Chinese cars use gasoline (petrol), in contrast to Europe which is a “diesel” market. However, as Diesel does not use up as much fuel as gasoline, it is more environmental friendly because of its frugality; the popularity of Diesel in China will be undoubtedly the trend in the future. Moreover, mineral oil products can be used now on more different specific markets by mixing with different other products. I.e. mineral oil products have a wide range of market potential in China.

Also Chemical products might have many market potential in the port sector. The demand for chemical products depends on the rise and the popularity of bio fuels and other fuel components. As mentioned before, the Chinese government will support bio and non fossil fuels as substitutions of traditional fossil fuels. As China is lacking of natural and chemical resources, different chemical products e.g. petro chemistry and bio fuels will be imported from the middle east and South-America.
Also the demand for vegetable oil strongly depends on the future environmental policies and the developments of R&D in bio fuels and energy. The demand for vegetable oil might be very small if there are strict environmental policies on fossil fuels, as the switchover to 2nd generation bio fuel is necessary. I.e. vegetable oil products are substitutes of renewable energy. Therefore, the expected high oil prices in China will inhibit the demand for vegetable oil.

In contrast with the vegetable oil, LNG might benefit from the expected high oil prices. The relative high oil prices in China might reduce the energy consumption per person. However, the proportion of LNG within the consumption will be expected to grow enormously in the future, as LNG is in accordance with the future plan of the Chinese government.

Break-bulk

The future of container market in China is still a very doubtful case. Currently, thanks to the strong export and the industrial production in China, relative cheap end products (particularly clothes and toys etc.) have been exported massively by containers. This is the driver of the Chinese economic growth in the last decades partly thanks to the relatively under valuated RMB. According to the five-year plan, the Chinese economy should grow with “quality”, which means that the wealth should be better divided in order to realize a fairer income distribution. If so, the domestic consumption and the import (also end products, not only raw materials) will increase and the RMB will be revaluated. Therefore, this might be a great stimulant for the import of (particularly) end products from foreign countries and the container sector for incoming stream.

However, the revaluation on the RMB might be a big slap for the Chinese export. Currently, China is often called as the factory of the world, which means that the Chinese economy is mainly based on industrial production which has caused many environmental problems, and thus China would like to resolve this problem by focusing more on environment protection, and investing and supporting renewable energies. Moreover, the Chinese five-year plan released in March 2011 has explicitly mentioned that the driver of the economy should not be the export but domestic consumption. I.e. all these factors might affect the Chinese export negatively. Therefore, the future of container transport depends on the net effect of the two developments mentioned above.

Another development which might affect the throughput of containers is the Chinese foreign direct investment (FDI). Partly because of the strong Chinese RMB and the support of the Chinese government for the private sector, more and more Chinese companies have invested overseas in order to expand the international trade with foreign countries. The FDI has created more bilateral trade relations, in stead purely investment in China by foreign companies. Thanks to the bilateral trade relationship, the container transportation of end products will no longer be a one-way traffic from China to abroad, but also Vice Versa.

In order to stimulate the Chinese economic growth, the steel industry has been chosen as one of the priority industries which are supported by the Chinese government after the economic reform in 1976. Currently, China and the some south-American countries are still one of the biggest exporting producers of steel. However, as the steel industry is relatively costly and antiquated, it is no longer an attractive investment object. Furthermore, the market of steel industry is relatively mature with relatively low growth and there are also threats from substitutes such as synthetic and aluminium. As the steel industry also harm the environment severely by emitting gases and polluted water, China will be reducing its steel production gradually (e.g. the steel production in the province Hebei will be cut by 30%). Moreover, also if the environmental policies will be further tightened, other extra costs such as emission costs, production costs and environmental costs will be added on the steel industry which makes the future of the steel industry less rosy.

6. Tianjin port and its policies

Port Tianjin[54]

Port Tianjin is located at the west side of the Bohai sea and the estuary of the Haihe (sea river). The port has shorter relative distance to the hinterland in North & west China and Beijing than other ports in Bohai. Tianjin port is not only an international hub of water transport; it also possesses a complete network towards the hinterland. Three different national railways, Jingha (Beijing to Harbin) Jinghu (Beijing to Shanghai) and Jingjin (Beijing to Tianjin), cross in Tianjin and it has direct access to different national motor ways such as Jingjintang, Dan La, and Jingjin etc. Moreover, the port also has an advanced network of pipelines such as aviation kerosene lines to Beijing, and Crude oil pipelines between Dagang and Tianjin petrochemical areas. As one of the most important international hub and multifunctional port in China, port Tianjin has defined its self as a main transhipment port of energy and raw materials to North and west China, and a container and modern logistic port in North China. Expectations are that the economy in the hinterland of Tianjin will keep growing in the coming years, the port will further its functionality such as transport organization, loading and unloading goods, transhipment, industry, modern logistics etc. in order to be a multifunctional port with efficiency and quality.

Table 4: Physic characteristics port Tianjin

Port Tianjin	
Land Surface	37 km2
Channel	100,000 ton
Berths	140 berths
From which deep berths	53 berths
Depth	22m

Source: Tianjin port Development holding limited, http://www.tianjinportdev.com/index.htm

Berths

Currently, there are 140 different berths available in port Tianjin, of which 76 public berths. There is one berth of more than 200.000 ton, two of 100.000 ton, eleven of 70.000 ton, eleven of 50.000 ton, and 55 berths of 10.000 ton. The entire shore line of berths is 14.5 km.

Throughput

After the economic reform in 1976, the throughput of port Tianjin has increased enormously, particularly after 1995 with an average annual growth of more than 1 million ton. In 2001, the total throughput surpassed 100 million ton and 200 million in 2004. Since then, the port of Tianjin is the biggest port in terms of throughput in North China (the area to the north of the Yangtze River). The throughput of the port was 240 million ton in 2005, 258 million ton in 2006 and 300 million ton in 2007. In 2008, the throughput was 355 million ton and the port was the fifth port in the world and the third in China. The throughput in 2009 was 380 million and 400 million in 2010.

As the first container port in China, Tianjin port has booked great results on throughput in containers. E.g. the throughput of containers has increased six fold between 1992 and 2002 from 400 thousand TEUs to 2.4 million TEUs, with an annual growth of 20%.

The throughput of Tianjin port is as followings:

Table 5: Throughput Tianjin port

Year	Total Thoughput/million ton	Throughput Containers/million TEUs
2004	200	3,8
2005	240	4,8
2006	258	5,95
2007	300	7,1
2008	355	8,5
2009	380	8,7
2010	400	10

Source: Tianjin port Development holding limited, http://www.tianjinportdev.com/index.htm

Hinterland

The direct hinterland of the port Tianjin includes Tianjin city, Beijing city, Hebei province and Shanxi province. The indirect hinterland can be reached by the existing transport network to e.g. Gansu province, Ningxia province, Xinjiang province, Tibet province etc. The total

surface of direct and indirect hinterland together is around 4.54 million km2 with a total population of 240 million people.

Other properties of the port

- Tianjin port is the largest synthetic port in China, which is built on muddy shallow by reclamation. Thanks to the development of sediment deposition techniques, the advantage synthetic ports have been getting clearly. Currently, Tianjin port after reclamation belongs to one of the deep port of the world.
- The port of Tianjin possesses a special geographical advantage with the vicinity to Beijing and the Bohai special economic area. Currently, more than 90% of the import and export value of Beijing is transported via Tianjin port. Therefore, the two big cities, Beijing and Tianjin, function as a big back-up for the port with the enormous demand and their modern transport facilities. These two cities also provide other services in the field of finance, business, insurances and IT etc. to the port. Moreover, the port also has relatively the lowest transportation costs compared to other Chinese ports, thanks to the vicinity to the Northern and western part of the country. In the last 10 years, there has been a remarkable trend of shifting the economic resources from the South to the North. Therefore, as the largest and busiest port of North-China, the port of Tianjin will play a more important part in the Chinese economy.
- The port of Tianjin is an international multi-functional port, with containers, crude oil, ore and coal as priority throughput. Currently, the port of Tianjin is biggest exporting port of coke and the second biggest importing port of ore.

Industries around the port of Tianjin

Industries around the port are particularly petro chemistry, cars and equipment manufacturing, modern metallurgy and food processing.

In the future, the most of the petro chemical industry will be located at Nangang industrial zone and Dagang Sanjiaodi zone in the port. Petro chemistry will be further considered as an important pillar industry in the developments of port Tianjin, and it will be expanded and supported by the development of the new Nangang industrial zone, in order to strengthen the

techniques of oil mining and exploration, and improve the productivity of oil in Bohai region. Different projects such as the “Sino-China 13 million ton refining”, “China Korea Qatar 1 million vaguely”, “BlueStar chemical industry” etc are currently on the way. Expectations are that the total production value of petro chemistry in port Tianjin will amount 450 billion RMB in 2015.

Cars and equipment production will be mostly located in the Beijiang area. The car industry will be mostly focused on R&D and the production of car supporting components. The production of equipments will be focused on large construction machinery, oil drilling and rail transport equipments. Expectations are that the production will be 1,5 million cars and the total value of production will be 600 billion RMB

Modern metallurgy will be focused on high quality steel and metal products and are located in Nangang industrial area and Haihe river downstream industrial zone. Main productions and projects will be e.g. tubes process, pipes, high-speed wires, stainless steel sheet, marine plate etc. in order to create a high metallurgical production chain. In 2015, the expectation of the production value of modern metallurgy will be 250 billion RMB.

Food processing industry will be mainly focused on highly quality production and process of food and will be mainly located in Lingang economical zone. Expectations are that the production of press oil and refined oil will be 140 million ton in 2015, and the total value of food processing will be 160 billion RMB.

Policies and prospects of port Tianjin[55]

As mentioned before, the 12th Chinese economic five-year plan was released in March 2011. In order to put this plan into practise, the municipality of Tianjin has drawn a plan of Binhai region (including port Tianjin)[56] in the coming years in accordance with the national five-year plan.

Opportunities and threats Port Tianjin

In the coming five years, considering the international and domestic situation, both opportunities and threats may appear for port Tianjin.

Opportunities and chances could be firstly the existence of new rising industries. After the financial crisis, traditional exporting industries were under attack and these provide opportunities for the new ones. As one of the most important economic and industrial area in China, Tianjin port might receive incentives and supports from the central government easier. Secondly, because the trend of the globalization and economic integration will be further carried on in the coming years, as one of the country with the most population numbers and growing market; capital, technology and talents will be further agglomerated in the Chinese market. As the biggest port in Northern-China and the fifth in the world, the reputation and the current status of the port are very favourable for attracting resources. Finally, thanks to the status of special economic region and the enormous size of the port, the port of Tianjin often function as a white mouse of national policies (new policies are often been tried out in special economic region), this might be an advantage and incentive for future innovation.

Threats and challenges might be firstly the instability of the global economy. Stronger international competitions and the existence of different risks might affect the investments negatively. Technical barriers and trade protectionism might hinder the international business and financial innovation. Secondly, the Chinese RMB has to face revaluation pressures which means that the port of Tianjin probably has to cope with cost increment such labour costs in the future. Therefore, macro control will be harder for the central national government, and more efficiency and limitation to the port maybe required. Finally, as mentioned in the new five-year plan, new industries such as renewable energy have been selected as the new priority industries and more attention will be paid on protecting environment. However, the proportion of high tech industry is relatively high in Port Tianjin, and the new directions of the five-year plan might become limitations for the development of the port.

New projects and developments in Port Tianjin

Currently, the reclamation of the 30 km2 Dongjiang port area is completed. The 10km2 free trade zone of Dongjiang and different infrastructure such as railways, highways, water facilities, electricity, gases etc. are already in operation. Also the wharf areas, the logistic zone and the port service areas have been put into use. In 2015, the total accumulated investments in Dajiang port and the free trade zone will amount 20 billion RMB, and the throughput of containers will be 8 million TEUs. Currently, the planning of the second man-made (reclamation) port island in Dongjiang is on the way.

Nangang port and Nangang industrial are also created by reclamation, and is mainly focused on projects of petro chemistry, modern metallurgy, port logistic and other supporting industries. The reclamation of land of 100km2 will be finished in 2015 with a total accumulated investment of 200 billion RMB and industrial value of 150 billion RMB. Moreover, the construction of infrastructure in Nangang should be based principles such as environmentally friendly and low-carbon emissions.

In the Lingang economic zone, the most of the basic infrastructure such as reclamation, port wharfs, rail, roads, water and electricity have been completed. Main industries such as heavy equipments production and food processing should be further attracted with other supporting related industries and logistic companies. Expectations are in 2015, the total accumulated investment will be 210 billion RMB with 100 km2 extra land and 200 billion RMB industrial value.

The old parts of Tianjin port (Dongjiang, Beijiang, Nanjiang and Haihe) and the new parts (Nangang, Lingang, Dagukou and Gaoshaling) will be functioning as an entity and complement each other. Some goods and industries, such as bulk cargo and petrol chemistry will be gradually shifted to the southern part of the port such as Nangang. In the future, deep water channels of 300.000 ton and 100 new or converted berths will be built in the port of Tianjin.

Directions, purposes and policies

The main points of the directions are improving productivity, investing in innovation, maintaining sustainable growth, and globalization. By taking these main points, the following concrete targets and policies have been drawn:

1. Port Tianjin as logistic centre
2. Port Tianjin as Modern industrial production point
3. Port Tianjin as a green environmental friendly port

Firstly, the port Tianjin as a logistic centre; thanks to the favourable location of the port and already existing industrial cluster, a modern logistic chain of different transport mode should

be created. Further investments in the port should make different industries around the port (e.g. cars, steel, food processing, cotton etc.) as industrial logistic centres with a modern complete network of collection, transport and distribution functions. This integration of logistic chain should be further expanded in the future and cover the trade-free areas in the hinterland. Moreover, the existing logistic chain and policies should be further improved. Well-experienced foreign firms should be attracted to the port in order to create logistic headquarters and operation centres. Large and medium size firms within the port will be stimulated to share resources and make collective investments in order to improve the efficiencies. Small firms will be encouraged to innovate in logistic and service systems. Also different logistic information, with regard to port, customs, maritime services etc. should be integrated on the same platform. An integrated logistic hardware which allows exchanges of electronic statistics, electronic orders, and automatic data processes must be implemented in order to cater the world's logistics standards.

Secondly, the port of Tianjin as a centre of new and modern industries; in accordance with the Chinese five-year plan, the Port of Tianjin should be focusing on high-end and emerging industries, e.g. new materials and new energy, while strengthening existing traditional industries, e.g. petro chemistry, modern metallurgy, cars etc.

- New Energy, e.g. electricity, solar energy, green batteries and new energy cars are mainly developed in the Binhai/Tianjin port area. Different projects such as green batteries, hybrid cars will be further supported in the future. Currently, the biggest cluster centre of wind energy in China is in Binhai/Tianjin port area. Expectations are that the total production value of new energy will be around 180 billion RMB.
- New materials are mainly related with petro chemistry, electronic information, biology and medicine, and new energy etc. In Nangang industrial zone, different green and new chemical industrial material products such as membrane materials, optoelectronic materials, special polymer, special plastics etc. are currently being developed.

Traditional existing industries in the port will be upgraded by means of modern and appropriate technology. High-energy consuming, high-emission productions will be eliminated gradually, in order to make resources available for green industries. Industries in the northern part, such as the cargo bulk distribution centre should be replaced to the southern part of the port, to make rooms for high-end service industry and urban developments.

Finally, the port of Tianjin as a green and environmental friendly port; this target will be realized by different ways in the port: reduce emissions and energy consuming, recycle economy, low carbon areas, and ecological restoration and protecting environment.

- Reducing emissions and energy consuming: In the future, developments of high energy consuming sectors should be limited, and instead, (financial) incentives and support should be provided to other new industries. Industries electricity, chemical industry, metallurgy etc. will be transformed to low-energy consuming in the future, this will be further expanded to other sectors. Over long-term, the standards of gas within the port emissions will be further tighten up, high-emission industry will be eliminated. Moreover, a compensation system of gases and wastewater will be introduced, which means that the manufacturers have to pay for the caused pollution. Also new techniques which can reduce the emission of sulphur dioxide and oxide oxygen, and industrial oxygen etc might be applied to realize emission reducing.
- Ecological economy development: This will be realized by the three principles “reduction, recycle and resource”. Industries in the upstream and downstream of the supply chain should be better integrated and expanded around the port in order to support new industries such as petro chemistry, equipments production and metallurgy etc. Other supporting companies and complementing industries will be attracted in the port in order to create clusters and networks around the port.
- Low-carbon areas: Because of the worldwide climate change, the port of Tianjin will also be following this trend by reducing the emission of gases such as carbon dioxide. Furthermore, the port will be adopting the utilisation of energy mix, limiting the consumption of coal, enlarging the proportion of clean energy resources such as natural gases. Other new energy such as wind energy, solar energy, terrestrial heat energy, hybrid cars etc. will be strongly supported by the Chinese government.
- Ecological restoration and environment protection: Especially the ecology at artificial coastline will be recovered and an ecological isolation zone will be created between the industrial and living area. More institutions will be created in order to monitor the process of the environment protection such as the process of dangerous rubbish at Nangang, sludge drying at Dagang etc.

7. Other ports in Bohai and Competitor Analysis

In order to have a better overview in the Binhai/Tianjin port area, it is necessary to analysis its competitiveness in comparison with other ports in the vicinity. According to the ranking of the total throughput of world ports, Tianjin port is the 5th port in the port with 408 million metric ton throughput in 2010. Within the Bohai area, Tianjin is followed by Qingdao (7th with 350.1 million ton), Dalian (8th with 300.8 million ton) and Qinhuangdao (11th with 257 million ton), these ports are also considered as the biggest competitors for port Tianjin.

Figure 2: Bohai region

Port Qingdao[57]

Port Qingdao is located in the southern part of the Shandong peninsula, and is also an important port for international trade and maritime transport hub. The port consists of three parts: Dagang, Zhonggang and Huangdao, the three parts are interconnected with railways and motor way (Ring Jiaozhouwan). The direct hinterland of the port is mainly the province Shandong and Northern China. Port Qingdao is also the biggest exporting port of Jinzhong

Meitan and Shengli Youtian which are one of the Major Chinese coal and crude oil producers. Moreover, the port is the 4th container port in China (with a throughput of 12,012 million TEUs behind Shanghai, Shenzhen and Guangzhou) and the 8th in the world in 2010.

Table 6: Physic characteristics port Qingdao

Port Qingdao	
Throughput 2010	350,1 million ton
From which containers	12,012 million TEU
Oil throughput (2003)	25 million ton
Iron ore throughput (2003)	45 million ton
Food throughput (2003)	2 million ton
Alumina Throughput	1,5 million ton

Source: The Port of Qingdao, http://www.qdport.com/En/index.aspx

Overview

Currently, Port Qingdao has 15 wharfs and 72 berths of which 6 berths of 50.000 ton, 6 berths of 10.000 ton and 2 berths of 30.000 ton. Port Qingdao also has container terminals for container vessels bigger than 15.000TEUs. The port is mostly focused on the handling, storage, transfer and distribution of containers, coal, crude oil, iron ore, and agribulk, and has trade relationships with 130 different countries and 450 ports. The shoreline of wharfs is 3420 meter with 10 jetties of -10m to 18m deep. The total capital of the port is 11.04 billion RMB, and the port possesses different wharfs for containers, crude oil, iron ores, coals and agribulk. 20 international multinationals (joint-venture with a Chinese company) have invested in port Qingdao, from which 6 belongs to the Fortune global 500.

Port Dalian[58]

Port Dalian is located in the Liaodong Peninsula's Dalian Bay, which is mainly serving the three provinces in the north-east (Heilongjiang, Liaoling, and Jilin) and is also the biggest port in that region. In 2010, Dalian was the 8th largest port of the world and the 6th in China with a throughput 300.8 million metric ton. The port is relatively deep and wide, and will not be frozen or silt in any season. The port has a free sea zone of 346 km2 and the land surface is around 15km2. Port Dalian disposes of 84 different terminals for containers, crude oil, product oil, food, coal, bulk-ore, chemical products, RoRo etc., from which 52 terminals can handle vessels more than 10.000 ton. Currently, the port has trade relationships with 160 countries and 300 ports, also 75 international container routes.

Currently, Dalian disposes of 30.000 ton terminals for both crude oil and iron ore which are the most modern in Chinese ports. The total oil storage tanks is more than 3 million cubic meter; with an annual storage more than 56 million ton. Dalian port is also the biggest distribution centre of bulk liquid chemical products. There are 38 crude oil tanks, in total 2,75 million cubic meter, 36 product oil tanks of 368 thousand cubic meter and 24 LNG storage tanks of 66,4 thousand cubic meter.

The port of Dalian is connected with the Hada railway and the Shenda Motor way which makes the port directly connected with its direct hinterland in the north-east China.

Port Qinhuangdao[59]

The port of Qinhuangdao is located at the south west side of the Bohai, and is also a famous non-frozen port in the north-eastern China, which enables vessels with a capacity of more than 10.000 ton can enter the port. Currently, port Qinhuangdao is the biggest energy (coal and crude oil) exporting port in the world. Because of the natural resources disparity in China, coal is mainly produced in the northern part of China while there is major demand from the south (such as the pearl delta area in Guangdong), and the port of Qinhuangdao has always been acting as an important transport note of this transportation of coal. Port Qinhuangdao is responsible for more than 50% of the transportation of coal in China.

Hinterland, goods and port overview

As port Qinhuangdao is an important transport node of coal and crude oil in the northern China. In the last years, Qinhuangdao has been trying to transform to be a modern multifunctional port. The propositions of goods are as followings:

Table 7: Incoming and outgoing throughput overview

	Incoming streams	Outgoing Streams
Domestic	Mostly Bulk, around 0,2% of the total throughput	Mostly coal and crude oil, about 71,5% of the total throughput
Abroad	Mostly grain, iron ore, wood, steel, fertilizer, sugar and Cement etc. around 5,1% of the total throughput	Mostly coal, crude oil, non-metal ore, steel, food etc. around 23,2 % of the total throughput

Source: Port of Qinhuangdao, http://www.portqhd.com//

The current port Qinhuangdao has a total land surface of 9 square meters, 61 square meters water territory, and 54 square meters anchorage territory. The total shoreline is 6,27 km, from which 5,52 km are wharfs. There are 21 coal berths available in the port, with a total annual capacity of 193 million ton. These berths dispose of modern facilities and infrastructures, such as long trains with a capacity of 20.000 ton, unloading speed of 7200 ton per hour, and ship loading speed of 9250 ton per hour. There are also 17 berths for bulk, from which 15 can handle a capacity of 10.000 ton.

Port Caofeidian

The port of Caofeidian is located between Port Tianjin and Port Qinhuangdao, and it is 60 kilometres away from the Dagang area of Tianjin. In spite of the vicinity to port Tianjin, the throughput portfolio of Caofeidian is fairly different than port Tianjin. Thanks to the vicinity to steel plants, Oil fields and rich natural resources in Hebei and Inner Mongolia, the greater part of the throughput of the port is raw materials e.g. Iron ore and crude oil, or industrial products such as steel. I.e. the port of Caofeidian is a bulk port.

The natural condition of Caofeidian is very favourale, the port has a 6 kilometres long deep shore line of 30 metres and terminals with capacities of 300 thousand ton. Moreover, the port is surrounded by empty lands which provides the port cheap lands for future developments such as industrial clusters. Moreover, the port has located between Dalian and Tianjin, which means that the ports provides access to the both hinterlands.

Although the port of Caofeidian is still a small port compared the Big-threes, and does not belong to the top-40 ports in the world. However, as mentioned before the port is located closed to urbanised areas e.g. Beijing, Tianjin and Tangshan, and has a good natural condition (particularly the depth), even the port is currently still not developed in container transportation, the port may further expand and have much potential in the future.

The competition analyses

According to the regular pattern of the developments of international shipping centres, in a certain size of region, once a port has established its hub position, it can benefit from accumulation effect and scale advantages which make other smaller ports as its extension and

"feeding" ports. (Such as the relation of the ports of Rotterdam and Singapore, and other ports in the same region) As this system is the most efficient and command the most benefits for the whole area, excessive and disorderly competition and the absence of leader in the area might lead to inefficiencies in the area. Even all ports in the region might benefit from the competition; however, partial benefits are not enough to compensate the entire loss in the region.

Bohai region is one of the three most prosperous regions in China, behind the Yangtze delta region and the Pear River delta region. As mentioned before, Tianjin, Dalian, Qingdao and Qinhuangdao are the biggest ports with the most throughputs in the region. Except Qinhuangdao, which is mainly focused on the transportation of coals; other ports all have the ambition to be an international shipping centre and fulfil the function as the hub in the Bohai region. Therefore fierce competitions between these ports are inevitable. In the western and the southern part of China, Port Shanghai and port Shenzhen have already consolidated their position as the main port (hub) in the region. However, in the Bohai region (the Northern part of the Chinese port cluster), this leading position still can not be established by one of "Big-threes". Although all of the three ports have to ambition to be the Main Port in Bohai, because the three ports have strengths and weakness in hinterland, geographic location, natural resources and condition, and throughput etc., no one succeeds to be the number one.

Competition between ports

There are different reasons why ports compete to each other. The most direct reason is that in order to ensure the continuity and the developments, ports have to create the demand for transport of goods and develop the market of transportation, and this will lead to competition naturally. Especially because of the worldwide developments of hinterland transport such as vessels and motor way net works, the transit of goods to the hinterland has been getting more and more convenient. As result, more hinterland areas are getting contestable which means that it can be served by more than one port, and this process has strengthened the competition of ports again.

Moreover, ports also compete for the proportion of a certain part of the throughput such as the container transport. Compared to bulk transport, container transport is more profitable and can create more benefits for the ports self. Therefore, the contention for the containers has been getting fierce in the last decades, e.g. between Port Shanghai and Port Qingdao which are both

serving Yangtze-River downstream area (one of the biggest economic powerful area of China). Moreover, as the container transport in a port also reflects the economic strengths of a country and it might also be the foundation to be a international world city, container throughput has gained much attention and this has stimulated the competition between ports as well.

Finally, the disparity between demand and supply might also cause fierce disparity. In case of a lower demand in the hinterland than the construction and scale of port, port market competition will be then more intensely. In China, there more medium-sized ports with the similar functions and huge investments, while the macro-economic control system is not optimal. I.e. there is a unbalance between supply and demand on marine transport which has caused the fierce competition between ports in China.

The competition between ports has basically the same characteristics as the competition between firms. However, it also has its own features:

Strong influences from the public sector and government. As the port industry is a basic infrastructure of the national economy, governments often consider the port as an important and preferred industry, the port industry often gains much attention. E.g. in China, much incentives and supports have been provided to ports in order strengthen the Chinese economy and the national competitiveness. Therefore, the competition between ports is to some extent not a real “market competition”, but more a competition for “favoured policies”. The attitude and the support from the national government to the port is also a kind of competitiveness, e.g. the main port policy of Rotterdam port in the Netherlands.

The location of a port plays an important part. The competitiveness of a port mainly depends on the quality of services and the efficiency of the operation. However, the location of a port is also a major factor, such as the location, the depth of the channel and berths etc. Moreover, the location may also be the economic power in the hinterland, such as the GDP, purchasing power, financial services etc. The existing traffic infrastructures, the modal shifts etc. might affect the competitiveness of the port as well.

As mentioned before, the port is an important basis of the national economy and strategic sensitive industry for the country. Therefore, the benefits of ports might be ignored or

weakened in order to realize social benefits. Until today, the most of the ports in Europe are not privatized because of this “quasi-market” competition.

Parameter of competition[60]

The competitiveness of ports depends mainly on four different variables:

- The economic strength of the hinterland of the port, which is often measured by the GDP, affect directly and indirectly the throughput of the port. Generally speaking, the higher the GDP in the hinterland the more throughputs transported in the port. Moreover, the structure and sectors in the hinterland may also play an important part. Basically, ports with hinterland of light industries and high-tech sectors will have more container transportation. On the contrary, ports with hinterland of heavy-industries will have more transportation of bulk, oil etc. Also the extern aimed economy in the hinterland might be favourable for the competitiveness of ports. After the economic reform in 1979, more foreign productions have been moved to China and the country is more dependent on international business and trade. This might be a strong stimulus for the port sector. Currently, as the most of the Chinese ports are hinterland depending with relatively less short sea shipping, the economic strength in the hinterland is a determinant factor of the future of Chinese ports.

- The geographic location and natural conditions of ports might affect the operation costs directly. These conditions might be the depth of the port, the number of days of operation in a year, the condition of sediment, the conditions of golf and the natural resources etc. E.g. the port of Caofeidian is often considered as one of the ports with the best natural conditions; the average depth is -25m with the deepest point of -36m, there is also a natural watercourse of -27m to the Yellow Sea, which makes the port of Caofeidian the only port in Bohai which can handle more than 250.000 TEU’s/ per year without constructions of basins or channels.

- The quality and speed of the transportation of goods to and from hinterland depends of the system and the quality of infrastructure and modal shifts. E.g. the quality of the system of motorway, rail way, water way, and air transport. The better the quality of these infrastructures, the faster and cheaper the goods can be transported, the more efficient and competitive the port is.

- Operational efficiency is a major factor for lowering the operational and logistic costs, and this can be realized by scaling-up and specializing vessels. In the future, ports also have to be deeper in order to cope with the increasing competition and the scaling-up of vessels. Currently, water in front of the terminal must be deeper than -20 meter to be able to handle container vessels of 10.000 TEUs + and VLCC oil vessels. Because of the increasing throughput of ports, more interactions and communications between shipping companies, terminals, and good owners. Technologies such as new methods of transportation, standard information systems will be playing an important part in the quality of the port.

Tianjin, Dalian and Qingdao

From the current situation, port Tianjin, port Dalian and port Qingdao all have dominant competitive position within the level of own port region. However, on the level of the whole Bohai region, no port can give prominence in being the most important one. Currently, the above mentioned dominant players in Bohai are all local hubs and mainly focusing on their hinterlands with relatively few short sea transfers.

From the location of the ports, Dalian is located at the “entrance” of the Bohai and has a relative closer way to the international main maritime routes. In contrary, Tianjin is located in the innermost of Bohai and has a closer land distance to the hinterland. Port Qingdao is located closer to port Shanghai which is the biggest port (both containers and Bulk) in China. Therefore, its hinterland may be contestable with port Shanghai’s market.

From the perspective of the natural conditions, both port Qingdao and Dalian are natural deep ports. In contrary, Tianjin port is more a river port, and the current depth and width are mostly man-made. Moreover, many parts of the port are created after reclamation. Therefore, the investments in infrastructure and “hardware” in port Tianjin are much more large-scaled than its competitors in Bohai

From the perspective from the structure of commodities, port Qingdao is focusing on all different kinds of goods such as coal, crude oil, iron ore and container. Qingdao is also the only port in China which has more than 15 million ton throughput in all of these four main commodities. In contrary, Tianjin is more a bulk port, its coal, iron ore and coke amounts to more than 90% of its total throughput. Port Dalian is mainly focusing on crude oil, Agribulk

(food) and containers. Port Tianjin has the biggest throughput in oil in comparison with Tianjin and Qingdao.

Table 8: Comparison growth throughput of Qingdao, Tianjin and Dalian

Thoughput 2011		
	Toal thoughput (xmillion metric tons	Containers (million TEU's
Tianjin	408	10.080
Growth compared to 2010	7,40%	15,90%
Dalian	300,8	5,183
Growth compared to 2010	47,70%	13,90%
Qingdao	350,1	12.012
Growth compared to 2010	11%	17%

Source: Zhu(2006) Study on the competitiveness of Qingdao port

Even the current strengths between these major ports do not differ significantly from each other, but the relative competitiveness is polarizing remarkably. In 1994, the total throughput of Dalian Tianjin and Tianjin were respectively 62.12 million ton, 46.52 million ton and 42.13 million ton. The strengths of the three ports in the Bohai region did not differ significantly, and Port Dalian had a slight lead in the competition. However, ten years later in 2005, the throughput in Dalian amounted 170.64 million ton, which is 70 million ton less than Tianjin and 16 million ton less than Qingdao. Also the throughput of containers of Dalian lies behind compared to Tianjin and Qingdao; in 2005, the throughput of containers was 2.65 million TEU is just 55% of Tianjin and 42 of Qingdao.

The remarkable decrease of competitiveness of Port Dalian with in the Bohai region is particularly because of the relatively low economic growth in the hinterland and the competition impact from other smaller ports in the vicinity. The most important hinterland area of port Dalian is the North-eastern China (Province Liaoning, Heilongjiang, Jiling) and Eastern part of the Inner Mongolia, which barely overlaps the hinterland of port Tianjin and Qingdao. However, the weakest point of Dalian is that the economy of the hinterland is relatively small scaled and grows with a lower speed. Therefore, the demand and supply of containers (especially containers of international trade) lag behind in comparison with Tianjin and Qingdao, and this is unfavourable in hinterland competition. This disadvantageous position of Dalian is recognized by the government of Liaoning province and it has appointed

the port as the only “Mainport” of the province in order to recover its power within the Bohai region. On the other hand, Tianjin has a big urban area as hinterland with two million cities. (Beijing and Tianjin city) However, this advantage has not made Tianjin as a container port and this is also partly because of the relatively weak economy in the western areas. In the case of Qingdao, even the port does not have mega cities in the hinterland such as Tianjin, but thanks to its vicinity to the eastern-Asian countries, many industries from Korea and Japan have been shifted to Qingdao and clusters of different sectors have been formed around the port which is a great impulse for the development of the port.

The container transport is often considered as the most important part of the throughput of the port because of its profitability, high value, and contribution to the National economy. As mentioned before, the urban areas in the hinterland have not made Tianjin a container port, partly because of the weak economics in the western hinterland areas and its relatively bad natural conditions. Instead, Qingdao has much better natural conditions and better economic strengths in the hinterland. Therefore, port Qingdao has been leading in containers for longer than ten years. Port Dalian is the gate of the North-eastern China, and that area is also its major hinterland. However, as that area is more an industrial area, there are relatively less demand and supply for containers.

Zhu(2006)[61] has discussed the competitiveness in the Bohai economic areas and has used different parameters to measure the competitiveness of the “Big-three” in Bohai. An overview is as follows:

Table 9: Parameters comparison competitiveness between ports

Parameters	Qingdao	Tianjin	Dalian
GDP Direct hinterland x100million RMB	12430	5998,8	1295736
International trade value x 100million USD	446,5	978,3	380,6
Fees of port (USD per TEU)	80	82	75
Average time of anchorage (hours)	24	25	22
Density of container lines per month	350	300	300
number of lines	80	70	74
Number of terminal containers	7	9	9
The surface of	39	68	63
Speed of loading and unloading (TEU/per hour)	473,78	240	269
Freedom of the port	5	5	5
The depth of the port	21	15	18
Number of operation days	363	340	340

Source: Zhu(2006) Study on the competitiveness of Qingdao port

From the results above, the following competitiveness scores of different parameters have been calculated in order to be able them between the port:

Table 10: Result Parameters of port Competition

Parameters	Qingdao	Tianjin	Dalian
GDP Direct hinterland x100million RMB	3,29	1,6	3,44
International trade value x 100million USD	1,61	3,52	1,38
Fees of port (USD per TEU)	-1,93	-1,98	-1,81
Average time of anchorage (hours)	-1,82	-1,94	-1,7
Density of container lines per month	5,2	4,65	4,65
Number of shipping lines	4,8	4,2	4,44
Number of terminal containers	3,76	4,84	4,84
Surface	2,42	4,22	3,91
Speed of loading and unloading (TEU/per hour)	2,29	1,16	1,3
Freedom of the port	3,08	3	3,08
The depth of the port	1,99	1,42	1,71
Number of operation days	1	0,94	0,94
Total	26,01	25,73	25,42

As we can see from the results above, the port Qingdao has scored the highest in comparison with Tianjin en Dalian. However, the differences are minimum. All the three ports have advantages in different fields, e.g. the most containers transportation in Qingdao, the large total throughput of Tianjin and a strong industrial hinterland at Dalian. That is also the reason why no port can stand out in the Bohai area.

Another remarkable point in the result is the openness of the port in view of the external trade. Even port Qingdao has a bigger hinterland with more GDP than Tianjin, but in terms of abroad trade value the port Qingdao lags much behind Tianjin. I.e. the enormous throughput of containers in Qingdao is mainly domestic transportations.

Competition within the port cluster

Except the competition between the “Big Three”, there are also struggles within different clusters. Some relative minor ports within the Bohai region also have much potential and have invested in infrastructures and other foundations. These have resulted in higher efficiencies and created impacts for the major ports.

In 2005, the total throughput of the Port Dalian was 170 million ton and was relatively less than its competitors Tianjin and Qingdao, and this partly because of the rise of smaller ports

such as Yingkou, Dandong and Jinzhou as they have “snatched” much throughput put from Port Dalian. The hinterland of Port Dalian (The North-eastern China) is mainly focusing on heavy industry, which there is an enormous demand for raw materials e.g. iron ore, Steel, and oil products. Since these bulk has a relatively low added value, low transportation costs are greatly preferred in cost-reducing. As the port of Yingkou is closer to North-Eastern China and so also lower transportation costs than Dalian, the port’s advantage in relation to Dalian is getting clear. Between 1998 and 2005, the Compound annual growth rates of Port Yingkou and Port Jinzhou are respectively 25.5% and 22%, which are considerable more than Dalian with 13% and 10 %

As the Railway system in the hinterland of Qingdao also has to handle passenger transportation, the port has to face capacity problems of the modal shift. Since 2000, the growth of throughput of Port Qingdao has been decreasing as result. In contrary, the port of Rizhao has fewer barriers in capacity (because of the two iron ore terminals with a capacity of 200.000 ton and 300.000 ton). Since 1995, the compound annual growth rate of Qingdao is 14,67%, which is 2% higher than Yantai but 4% lower than Rizhao. In 2005, the growth in throughput of Rizhao and Yantai were respectively 65% and 31%, but this was merely 15% in Qingdao.

The NO.1 in Bohai

As mentioned before, different ports in Bohai have different features and advantages and it is still too early to determine which one is the main port in the area. In comparison with the other big ports in Bohai, Dalian is a typical Bulk port with relative less container throughput. This has to do with the direct hinterland area of Dalian (North-eastern China), which is a less thriving area in China. The North-eastern area is mainly focused on heavy industry (e.g. steel production) and therefore less demand for containers. Considering the future plans of China, heavy industries will no longer receive the priorities from the Chinese government and the future of Port Dalian is not as rosy as the container ports in the south of Bohai.

Even the port of Tianjin has a bigger total throughput in 2010, however Qingdao has a bigger proportion of containers in the Bohai area. As mentioned before, Qingdao had better natural conditions to be a container port mainly because of its favourable depth. On the contrary, Tianjin was not actually a river port with limited depth which was basically not suitable for the huge container vessels. Therefore, the container transport in Qingdao has developed

earlier than Tianjin. After reclamation and deepening constructions, Tianjin has become a man-made seaport with a depth of 23m. However, because of the enormous investments in infrastructures, the charges of port Tianjin might be higher.

Currently, because of the different specialities of ports within Bohai, it is still very tough to determine which port will be main port in the future and function as a hub within the area.[62]

Table 11 Overview throughput port Qingdao and Tianjin

	Total throughput x million ton	Container throughput x million ton (1TEU=12 ton)	%
Qingdao	350	144,14	0,41182857
Tianjin	408	120,96	0,29647059

Source:Port statistics, port of Rotterdam

8. Prognosis Throughput Port Tianjin

As mentioned before, one of the deliverables of the service agreement between Nangang and Port Rotterdam is a planning for the development of the area north of the northern-break water (The Nangang North zone). In order to put this plan in practise, a prognosis about the throughput of the whole Tianjin port area must be formulated in order to determine the proportion Nangang.
In the preceding chapters, different “ingredients” such as the theory about formulating prognoses, economic trends in the world and China and the competitive situation within the Bohai area have been prepared in order to make the forecast for Tianjin port. These will be applied in combination with the local situation of the port. In this prognosis, different scenarios will be used in order to provide a broader view of the throughput in the future and reduce the uncertainties. (De Langen P & van Meijeren (2010))

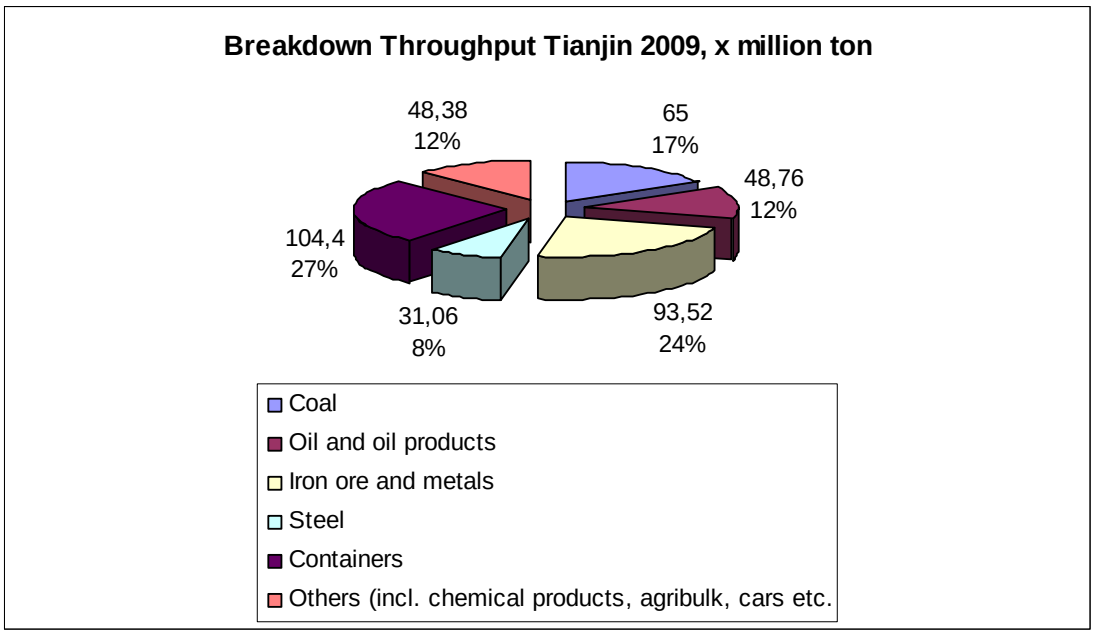
Methodology

Since the historical data of the storage of commodities of port Tianjin are missing, this forecast will not be based on the absolute volume of commodities but more on annual growth rate and relative scores. Different forecasting methods will be applied and combined in order to improve the accuracy of the prognosis (Graefe, 2010), Moreover, as mentioned before, the judgemental method should be used in case of lack of data. In this forecast, mainly experts’ opinion (the method of expert opinions(N.Harvey (2001)) will be analysed and applied in order to make an accurate forecast of the growth of different commodities and industries in port Tianjin. Moreover, the method of analogies (Duncan, G.T., W.L. Gorr & J.Szczypula (2001)) will also used in order to increase the accuracy. I.e. different data and prognoses of other ports and other sectors will be taken into considerations as well.

Commodities and industries

De Langen P & van Meijeren (2010) have also argued that the throughput can be predicted with more accuracy if it can be divided in different types of commodities. The most important commodities of Port Tianjin are as follows:

Figure: Breakdown throughput Tianjin 2009



Source: Main planning port Tianjin 2010

As mentioned in the graphs, the most important commodities are coal, (crude) oil, Iron ore, steel and containers. Therefore, the following streams of goods will be separated to formulate estimations for each single commodity:

Table 12 : Commodities of this Prognosis

Commodities and industries in Tianjin
Crude oil
Coal
Natural Gas
(petro) Chemicals
Containers
Steel and Iron ore
Biomass

Scenarios

The most important factors which may affect the results of the estimations are the national policies (environmental requirements etc.), the economic growth and the oil prices. On the basis of these factors, three economic scenarios are selected in order to make estimations for the future developments of industries around the port and streams of commodities.
The selected scenarios are as followings:

- Chinese trend scenarios; as mentioned before, the 12th Chinese five-year plan have been released. This plan has given the direction of the Chinese micro-economic forecast and the main priority industries in the coming five years. In short, China will be slowing down its growth gradually, and old heavy industries have to make way for the new environmental friendly ones. This plan will also affect the future of the port Tianjin, and the prediction of its throughput will be based on this scenario which assumes the five-year plan will come true.
- Low growth; in this scenario, the Chinese economy will be dragged by the worldwide stagnation or even recession. Currently, both the EU and the US are facing problems from the enormous public debt which have caused much concern by investors. Other problems such as the high employment rate in the US and the financial instabilities within the EU have made problems even worse. Although the Chinese government has ambition to be less dependent in foreign exports, but this can not realized over the short-term. The low RMB-policy is a good evidence of the export dependency. If the western world was being involved in stagnation over long-term, it might be very tough for China to be immune in the global economic climate. Moreover, there are also a several intern

developments and factors which might lead the Chinese economy to long-term stagnation. These might be e.g. the domestic inflation, the instability in economic issues and the unsound politic system. If so, a great decrease in Chinese annual economic growth is expected in the coming twenty years. Therefore, fossil fuels are still considered as the main fuel in 2030 due to the low investments in R&D and renewable energies. Moreover, high oil prices and strict environmental policies are not expected in China in order to stimulate the economic stagnation.

- High oil prices; as the development of the storage of different commodities and the settled industry around the port highly depend on the oil prices, this must also be taken into consideration to make an accurate forecast. In this scenario, an enormous increase of oil prices is expected in the coming years, this might be $150 in 2013 and $200 after 2040. There are some factors which might affect this development: firstly, the oil price will further increase if there are more evidence of the run-out of stock of oil are coming to the surface. Moreover, as being environmental friendly is the world trend, many policies such as heavy levy will be made on crude oil in order to discourage its demand and these will further have a stimulating effect on the oil price.

An overview of the scenarios:

Table 13: Overview Scenarios

	Low growth	Chinese trend	High oil price & sustainability
Economic growth	1%-2% per year in the coming 20 years because of the failure of the stagnation in the world market and intern problems (e.g. economic bubbles and domestic inflation)	6%-7% in the coming 10 years and around 4%-5% until 2030.Policies of slowing down the economic growth will be implemented in order to realize a fairer distribution of wealth, and prevent other economic problems e.g. bubbles and domestic inflation.	The annual economic growth will be approximately the same as Chinese trend scenario. The energy consumption per person will retreat because of the high oil prices. However, there will be more investments on R&D of alternatives such as renewable energy.
Trade developments	The world will be divided in trade blocs due to political or other reasons. Levies or taxes will be charged for trades betweens blocs, which will be unfavourable for the economic growth	Constant growth of trade with foreign countries. But less than before 2010 due to macro-economic control and more independancy toward foreign countries.	More than the low growth scenario, but also less than as proposed by the five-year plan due to higher transport costs.

Oil price	A decreasing price development expected in the coming 20 years. Stagnation will keep the oil price lower in order to stimulate the economy	Higher oil prices are expected as the chinese government will pay more attention on environment protection. Clean renewable energy will be supported by the national government and levies might be implement on oil.	Extremely high oil prices due to big demand and less stock.
Energy demand	Less Energy demand due to stagnation	High demand in energy due to constant economic growth in the coming 20 years. More proportion of clean renewable energy.	A bit less consumption of energy per person than in the Chinese trend scenario due to the high oil price, and because oil still can not be still 100% replaced by other alternatives.
Energy mix	Oil and coal will still have the dominant position due to low prices and less investments on alternatives	Less proportion in Coal and crude oil due to strict environmental policies. More alternative energy such as gas and renewable energy	Much less oil and coal than in the low growth scenario. High oil prices have force investments in R&D of other energies such as Nuclear and renewable energy.
Environmental policies	Some few effective national environment protection policies	Stricter environmental policies in accordance with the five-year plan	High investments and incentives in alternatives of oil

Crude oil

In order to forecast the throughput of crude oil and the developments of related industries, it is important to analyse the oil price trend over long term as this have the most influences on the demand and the production of oil. Moreover, the oil price is also of vital importance for other energy and chemical commodities, as they might be the possible substitutes and alternatives of oil products.

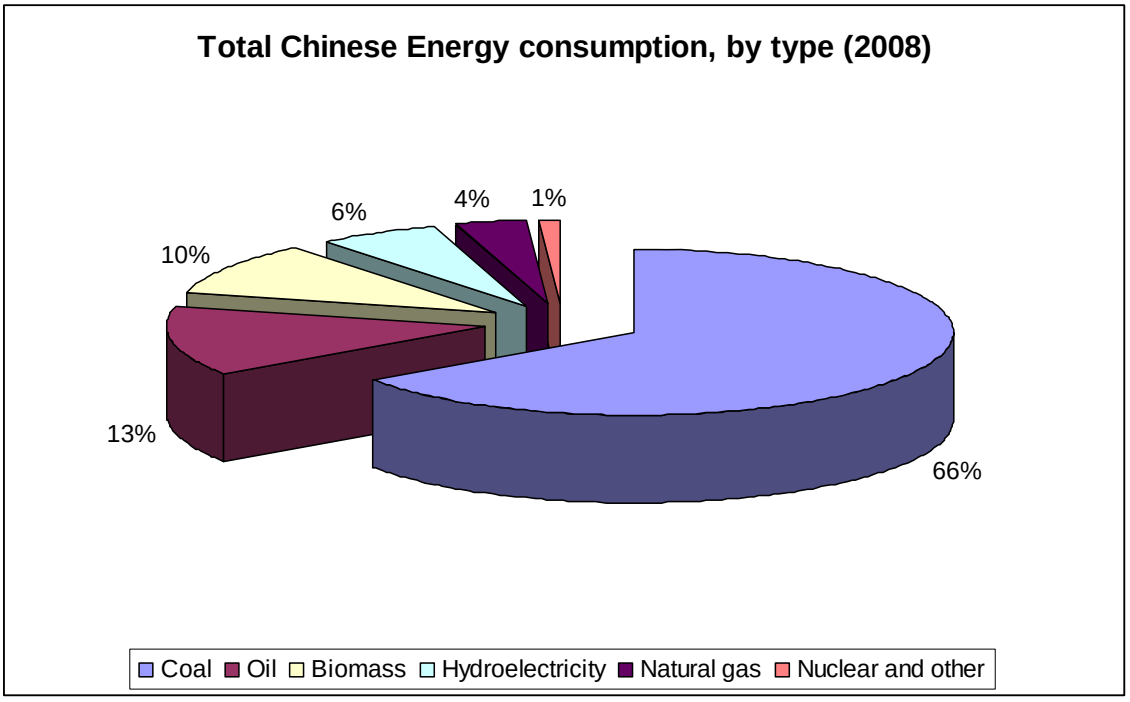


Figure 3:Chinese Energy Consumption

Source:EIA International Energy statistics 2008

Analysis trend oil prices: High oil price expected

There are a several main factors which have major influences on the (worldwide) oil price:

- The world economy and the risk preferences of investors;[63] after the financial crisis, the world economy has recovered gradually which has made investors more willing to run more risk of there investments. Moreover, because of the relatively accommodating currency policies and the expected inflations, expectations are that

these developments will make the commodity market and this has a favourable effect on the demand for crude oil.

- The demand and the supply of oil; the demand of oil mainly depends on the progress of the recovery of the world economy, particularly the main consumers of oil e.g. the US and China. The supply of oil depends on the world production capacity, the stock on oil and the cost prices. However, indirect factors such as the political instability in OPEC-countries (such as Iraq and Libya) might also affect the oil price.

- The interrelation with the US dollar currency[64]; there is a significant (negative) relationship between the US dollar and the oil price, and this is even more obvious during the economic crisis. Since the decline of the USD currency in 2002, the oil price has been increasing since that year; the elasticity was in -0.74. During the crisis years in 2007, 2008, and 2009, the elasticity was respectively -0.97, -085 and -0.82.

In view of the above mentioned factors, the following forecast of the oil price (in China) has been formulated: firstly, the trend of the oil price can be derived by the low dollar over the long-term. As mentioned before, there is a significant relationship between the US dollar currency and the oil price. In the coming years, the USD will not evaluate obviously in view of its sky-high public debt, lofty deficits and the gradual accommodating currencies. As result, the oil price will be expected to increase gradually in the coming decades. Secondly, the speculation behaviours of investors might affect the oil price as well. According to the NYMEX rate of the CFTC, the stock for speculation by investors has increased 7% between 2009 and 2010, which reflects the general optimism and confidence in the demand for oil. Moreover, the consumption of oil are still expected to expand in coming few years,, the daily consumption of oil in 2011 was 1.4 million barrels and this will be expected to be 1.6 million in 2012. However, this increasing demand has not resulted in appreciate expansion in production by OPEC-countries. In 2010, the production of crude oil by OPEC-countries has remained more and less steady and has further stimulated the rise of the price. Expectations are that the growth of daily production of OPEC and Non-OPEC countries will be 90.000 barrels and 60.000 barrels in 2012, but this growth in production will not have major affect on the diminution of the oil price.

As the biggest developing country with the highest GDP-growth rate and the enormous number of population, China is a major consumer of crude oil (e.g. 18 million cars sold in

2010, which is a record sales of all time). Even the consumption has been growing in the last years; the domestic production of crude oil has remained steady with monthly production of 16 million ton. Therefore, China has to import from abroad and is being more independent. In 2010, the consumption was 500 MTPA (=Million ton per annum), from which 250 MTPA was domestic production and 250 MTPA was imported. The enormous Chinese demand can further stimulate the price increase. Moreover, as the last five-year plan of the Chinese government has explicitly mentioned that China should be more independent on crude oil, and pay more attention on environment protection and sustainability. Therefore, the usage of oil might be discouraged and this can be realized by levies and taxes, which makes the oil more expensive in China.

In 2010, the capacity of installed oil refineries was 400 million tons, and this will be 600 million tons in 2020, which is a growth of 50%.

Therefore, expectations are that the demand of crude oil will still exceed the supply because of the enormous demand and the steady growth in supply, the oil price still has to face much pressure for growth.

Scenario high oil prices & sustainability

In this scenario, extremely high oil prices are expected in the coming 20 years. Except the factors mentioned above, there are also other factors which might further deteriorate the balance in the crude oil market and makes the oil more expensive: firstly the political instability in OPEC countries. In the last decades, different political incidents, terroristic attacks, natural disaster and labour disputes etc. have often negative influences on the stability of the crude oil price. Some examples are as follows[65]:

- Terroristic attacks in Nigeria, Indonesia and Saudi Arabia.
- Damaged port infrastructures and pipelines in Iraq because of the war
- Lower production from Iran by the possible US military action because of the nuclear crisis
- Intern conflicts between the government and the opposition parties in Venezuela

- Natural disasters such as Tornados in Southern US

Moreover, there are also some other issues which cause anxiety for the supply of oil in the market. Some examples are as followings:

- Crude oil companies ignore the exploration for new oil sources because of the fear for decline of oil prices by substitutes
- Isolated economy of some OPEC countries which limits the external investment and decelerate the production expansion.
- OPEC's refusal for production expansion because of increasing competition and threats from non-OPEC countries e.g. Russia, Brazil and Mexico
- The initiative to skimp the consumption of crude oil from green activists and the academic world

This possible long-term oil crisis might lead to an enormous decrease of energy consumption per person in China and less demand for crude oil in the domestic market. Instead, China will be seeking for substitutes such as coal, LNG or even renewable energy by investing on R&D and developments of these alternatives. Moreover, the reducing consumption of oil is desired by the Chinese government as well, the industrialization in the last decades was at the expense of the environment and this has caused much dissatisfaction and intern contradictories in the country. Therefore, the economy will slowly shift to sustainability and environmental protection, and the consumption of oil will then be one of the main points to be tackled.

However, the short-term developments of crude oil provide a less pessimistic image. As the oil products can not be replaced massively by their substitutes, and the transformation of the economic structure from industry to the service sector can not be realized in a short time, the Chinese economy in the coming years still depends much on oil. On the other hand, as the domestic oil production is limited, the extra demand for oil in the future will be mainly imported from abroad which is favourable for the port sector.

Therefore, in this high oil price scenario, the height of oil will definitely harm the (the growth of) throughput of oil and its related industry over the long-term because of the decreasing

attractiveness. However, the throughput of crude oil products will keep increasing over the short-term in spite of the high prices.

Chinese trend scenario

In this scenario, the government will take the initiative to reduce the usage of oil without regard to the world oil price. This can be realized by R&D on clean and renewable energy, or by introducing high levies on oil usage. Although the oil price will not surge to the level as in the high oil price & sustainability scenario, it might mount to a higher level than the current price which can harm the (growth of) crude oil import. Moreover, crude oil products and its related industry (e.g. oil refining) also have to face threats from other substitutes such as LNG and renewable energy as these are supported by the national government. Therefore, the future of crude oil in this scenario is not too rose-coloured.[66]

Low growth scenario

In this scenario, in order to stimulate the national economy and resist the stagnation, the Chinese government will probably try to keep the oil price lower instead of adding levies. In this case, different environmental protection policies will be ignored to a certain extent and projects of R&D on sustainability will be set aside as these cost a large amount of money. Basically, the low price might be a favourable development for the throughput of oil in the port sector. However, as the national economy is in stagnation, it is very uncertain whether the low oil price would have a positive effect on the throughput.

Application in Tianjin

Currently, the throughput of crude oil and oil products takes place in the Nanjiang area in the port of Tianjin. The port authority has always had positive ambition about the throughput of crude oil in the port. After the release of the eleventh five-year plan in 2006 different big projects have been formulated in order to expand the capacity to process crude oil and other related oil products. (E.g. the Sino petrochemical Tianjin Co: expansion project and Sino oil Tianjin Co. new oil refining project). Through these projects, the refining capacity of port Tianjin has been expanded to 30 million ton per year. After the twelfth five-year plan released in March 2011, this capacity will be 45 million ton per year. Moreover, the Chinese Bohai oil field Tianjin co.(the most important producer of crude oil for Tianjin Port) has expanded its annual production capacity of crude oil to 30 million ton per year.

The ministry of transport has drawn a forecast of crude oil for the port of Tianjin in accordance with the national future plans. This forecast has taken the possible future policies into account, which try to limit the usage of crude oil. In 2030, throughput of oil will be 115 million ton with an annual growth of 4.17% (Chinese trend scenario). In the high oil scenario, the demand for oil will be impeded by the high oil prices. However, because of the great number of the Chinese population, the demand for oil will still be increasing in spite of decreasing consumption per person. The throughput in 2030 will be expected to be 66 million ton with an annual growth rate of 1.5%. In the low growth scenario, different investments on R&D of renewable energies will be hold and the oil prices will be kept low. However, because of stagnation, the future of oil will be less rosy than in the Chinese trend scenario. The throughput of this scenario in 2030 will be expected to be 82 million ton with an annual growth of 2.5%.

Table 14: Thoughput crude oil, forecast 2030

	2009	**2030**
Chinese trend scenario[67]		
Throughput x million ton	48.76	115
Annual growth %		4,17
High oil price & sustainability scenario		
Throughput x million ton	48.76	66
Annual growth %		1,5
Low growth scenario		
Throughput x million ton	48.76	82
Annual growth %		2,5

Coal

Currently, China is the biggest producer and consumer of coal. In comparison with the rest of the world, the proportion of coal in the energy portfolio of China is significantly higher and more dependant. (See the graph below)

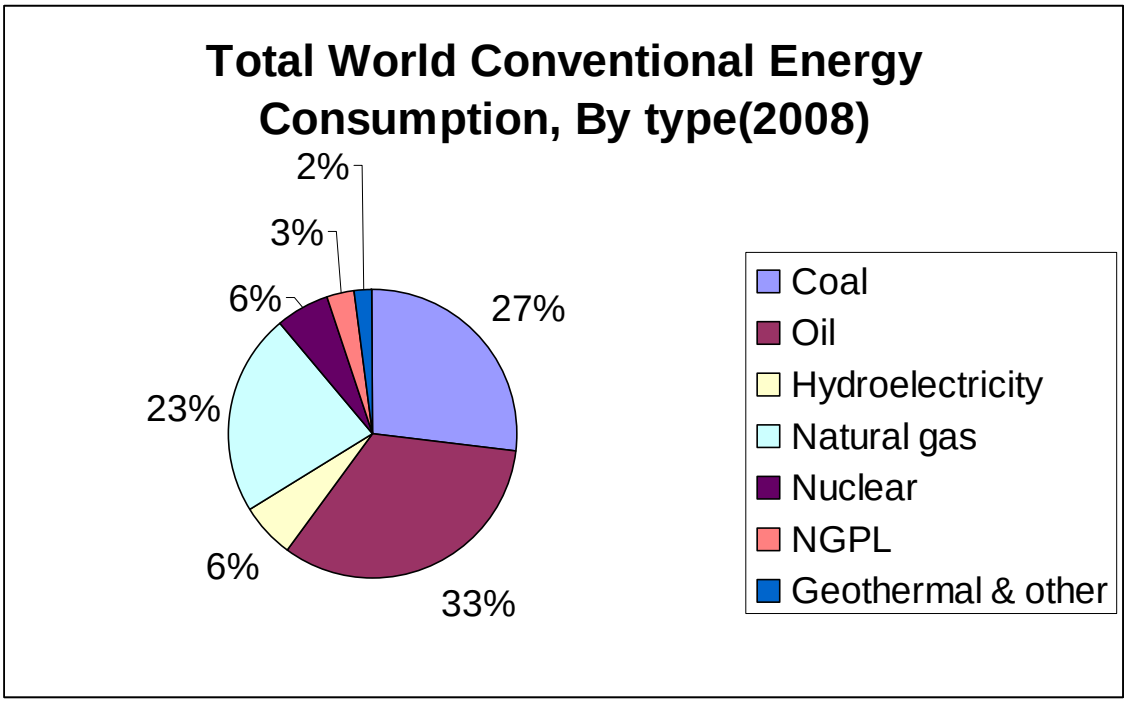


Figure 4: Energy mix of the world, 2008

Source:EIA International Energy statistics 2008

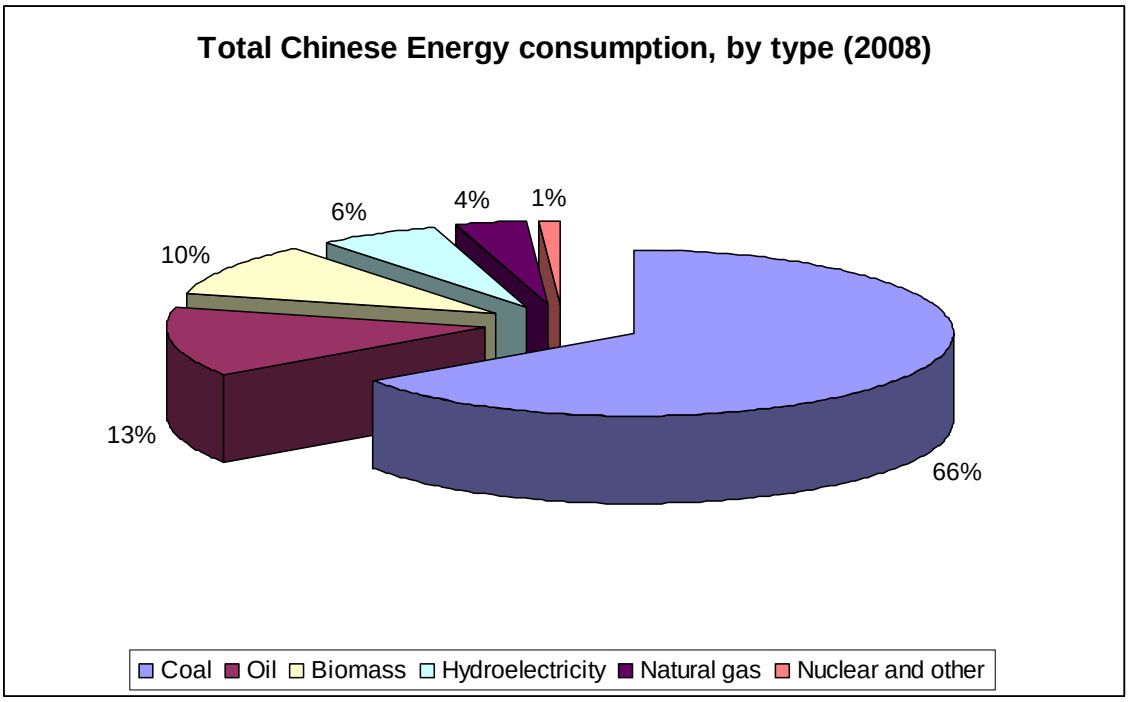


Figure 5: China's energy mix 2008

Source:EIA International Energy statistics 2008

During 2001 and 2009, the period which the Chinese economy has been growing with an average annual rate of 9%, the domestic consumption of coal has grown from 1.34 billion ton to 3.02 billion ton with an annual growth of 10%. I.e. the consumption of coal has been going hand in hand with the Chinese economy.[68]

The following sectors account for the solid demand for coal in China, which are responsible for the 90% of the domestic consumption:

- Electricity/power generating
- Steel
- Construction materials
- Chemical industry

Firstly, the power industry in China based mainly on the generating of electricity by coal. The consumption of coal in the power industry has grown from 650 million ton in 2001 to 1.56 billion ton in 2009, which were 47.1% and 51.7% of the total consumption by power industry.

In the future, coal power generating has to face fierce competition from other sources such as hydroelectric power, wind power and nuclear power etc. Through this competition and the unfavourable national policies, the consumption of coal in the power generating industry in 2015 will be approximately 20 billion ton which is a decrease in growth. Moreover, coal is the main energy consumption in the Chinese steel industry as well. As opposed to the power industry, coal will remain a major engine for the steel, mainly because of the relatively high costs of its substitutes (oil among other things) which must be imported from abroad. The consumption of coal will remain around 70% of the total energy consumption of the steel industry. Between 2001 and 2009 the consumption of coal by the steel industry has increased from 150 million ton to 470 million ton, which were respectively 10.9% and 15.6% of the total coal consumption in China. The construction materials' products are mainly cement, plate glasses, building ceramics, and other chemical materials etc; from which more than 50% cement. Coal is responsible for around 70% of the energy consumption of the construction material industry and it has grown from 260 million ton in 2001 to 440 million ton 2009.Finally, the industry of chemical products is another main consumer of coal as well, which has grown from 80 million ton in 2001 to 160 million ton in 2009.

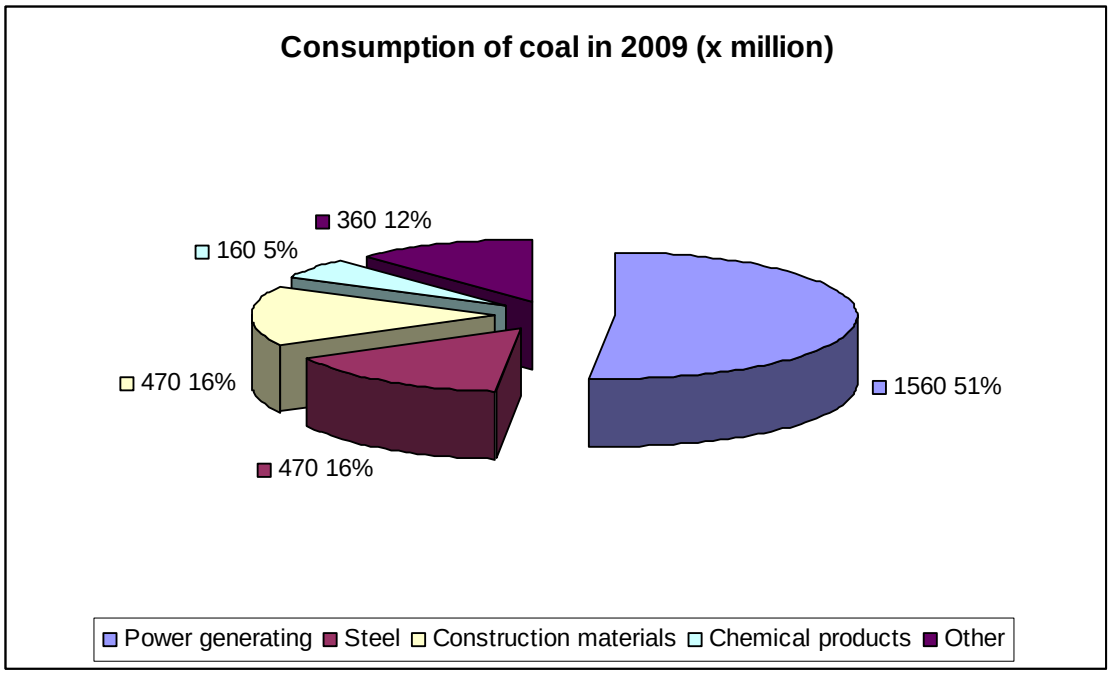


Figure 6: Consumption of coal in China, 2009

Source: Liu H.T 2010

As mentioned before, China is a country with rich resources of coal but an enormous lack of oil. Therefore, the economic growth in the coming decades will still highly depend on the coal and the production will keep soaring, although China has the ambition for environment protection and sustainability. Moreover, as the main energy resource in China, the price of coal has been kept low by the National government in order to stimulate economic growth. However, this policy has lead to high consumption and high wasting as well. In the 16th national governmental congress of the communistic party, the government has decided to abandon this policy and the coal price will be further regulated by the market. Therefore, higher coal prices are expected in the coming years.

From the developments mentioned above, Liu H.T(2010)[69] has argued that the domestic consumption of coal will be increasing in the coming years with an annual rate of 2%, which has been slowing down already than in the last decade.

High oil price & sustainability scenario

The high oil price might be a favourable development for the throughput of coal in the port sector as this may be a substitute of oil. Even increasing demand and market price regulation are expected in the future, coal prices will probably not rise exaggeratedly.

Chinese trend scenario

As the same as oil, both are not longer preferred by the Chinese government and have to face fierce competition from substitutes. Therefore, minimal growths are expected in the coming decades. However, as China has an abundance in coal resources which means that it does not have to be imported from abroad, coal will still be the major energy consumption in China until 2030.

Low growth scenario

In this scenario, the demand for coal will probably decrease because of the lower demand and economic stagnation. Even the coal price will probably be kept low and less threats from clean energies. Negative growth for coal consumption in China is not evitable during stagnation because of less energy demand.

Application in port Tianjin

Even China is a country with rich coal resources and there is tentatively no lack of it. However, China has imported 125.83 million ton coal in 2009 with a trade deficit of 103,43 million ton. Morse R.K. and He G. (2010)[70] argue that the massive import of coal is a marketing strategy of the Chinese government. As China still considers coal as an important energy resource, a huge reserve of goal is one of main points of the resource strategy. Coal will be imported from abroad when the world market price is "right", even there is no necessary demand. This strategy of importing coal is a favourable development for the port sector in China.

Moreover, there is a disparity of distribution of coal resources in China. Most of the coal mines are located on the Northern and western part of the country, and long-distance transportation of coal is necessary to take coal to the thriving regions in the east and the south. Particularly the North-south transportation is favourable for Port Tianjin as the port is biggest bulk port within the Bohai region.

Currently, new railways such as the Huang-wan Railway have been built in order to meet the increasing demand. The first part of the Huang-wan railway will be finished shortly with a total capacity of 37.5 million ton, and the designed capacity of the second part will be 45 million ton. I.e. the port of Tianjin will have more capacity to handle coal from the west.

Partly because of the scandals of the accidents in China in the last decade[71], the Chinese government has decided to shut down some coal mines of small and medium sizes in order to guarantee the safety of the industry. Moreover, as the five-year plan has considered coal as a "dirty" energy resource, the production and consumption might be reduced in the future.

Currently, the coal terminals in Tianjin are located in the Nanjiang area. However, according to the newest plan of port Tianjin, these coal terminals will be moved to southern part of the port, such as Gaoshaling area and Nangang area. As less coal terminals will be available, this development of moving terminals might affect the throughput of coal negatively.

In the Chinese trend scenario, the throughput of coal in 2030 will be expected to be 140 million ton with an annual growth rate of 3,72%. In this scenario, the growth of throughput will be harder until 2020, but the growth will slow down because the environmental policies will be further tighten-up. In the high oil price & sustainability scenario, there will be more

demand for coal as it is a substitution of oil. However, coal still has to face competition with clean energy on the other hand. A throughput of 164 million ton is expected in 2030 with an annual growth of 4.5%. Finally, in the low growth scenario, the coal price will be kept low by the central government in order stimulate the economy, but the throughput will no be as high as in the other scenarios. A throughput of 100 million ton is expected in 2030 with an annual growth of 2%.

Table 15: Throughput of coal, forecast 2030

	2009	2030
Chinese trend scenario		
Throughput x million ton	6499	140
Annual growth %		3.72
High oil price & sustainability scenario		
Throughput x million ton	6499	164
Annual growth %		4.5
Low growth scenario		
Throughput x million ton	6499	100
Annual growth %		2

Natural Gas

Although according to the five-year plan, China will reduce its carbon emission by different policies and the consumption of energy per person might be reduced through this development. However, because of the increasing population numbers, the total consumption of energy may still be increasing in the coming 20 years. Therefore, China will be remaining the main consumer of natural gas. However, new energies such as shale gas and LNG will be the most rapid developments in China. (Exxon Mobil Corp. 2011)

In comparison with other regions, the demand for Natural gas in China will raise the most with a daily consumption of 880 million cum (cubic meters) in 2030. This is enormous in comparison with 137 million cum in 2005.

The rising star of the natural gas is the Liquid Natural Gas (LNG)[72], which natural gas will be cooled off to a certain temperature to change the gas in liquid form in order to facilitate the

transportation. Currently, different LNG projects and LNG terminals have been taken place in the coastal areas and different ports.

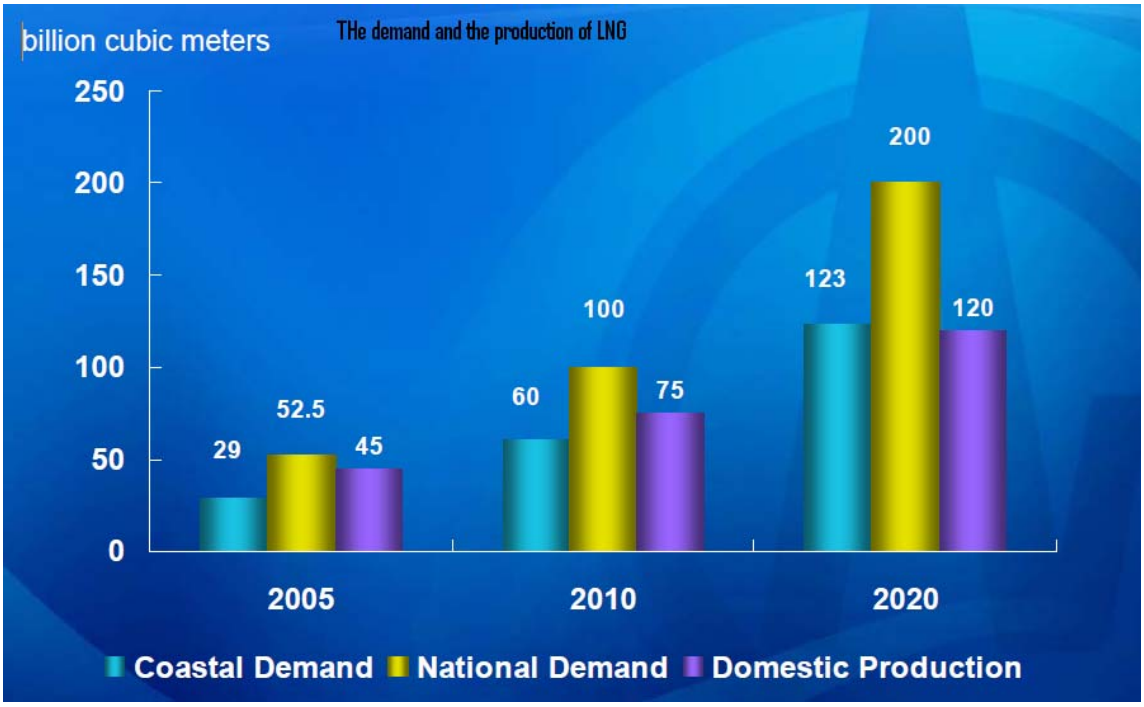


Figure 7: Production and demand overview LNG in China

Source: Luo 2005, CNOOC Gas & power limited

As mentioned in the graph above, the demand for LNG will be increasing in the coming 10 years. However, the domestic production will still lay behind the domestic demand, which means that the gap must be imported from abroad and this might lead to high prices. The relatively low domestic production might be an unfavourable development as China will be more dependent to foreign countries.

Another rising star of gas is the Shale gas. Shale gas is an unconventional natural gas made from shale. The shale is embedded very deep in the ground which was not reachable by old technologies. However, thanks to the modern techniques, shale can now be taken out and refined in to shale gas. According to Liu Tienan, estimations are that China has 31 million square kilometres of reserves of shale and this will have an important contribution to fulfil the demand of China because of its enormous economic growth. Another advantage of the great reserve is that shale gas can be obtained in China which means that the country does not have to be dependent on the import from abroad.

High oil price & sustainable scenario

As gas might be a substitute of oil, natural gas and shale gas will be more attractive in case of high oil prices in the future. Especially, shale gases which can be provided in the market for a relative lower price has much potential because China has a great reserve of shale.

Chinese trend scenario

The last Chinese five-year plan has explicitly mentioned that the natural gas (LNG in particular) will be supported by the Chinese government as China has the ambition to diversify its energy portfolio. LNG can then be a solution of clean energy resource and replaces dirty resources such as coal. If this plan might be realized, the share of the usage of oil and coal will then retreat and replaced by natural gas among other things.

Low growth scenario

In case of stagnation and low economic growth, the cheapest energy source will be often chosen, and other clean and expensive will be ignored or less popular. For example, LNG which must be imported will probably be a minor source of energy. However, as China has a relatively big reserve of shale, shale gas might then be provided cheaper in the market. Therefore, dramatic decreases in the growth of gases in the Chinese energy proportion are improbable.

Application in Port Tianjin

Partly because of the dependency on coal, the current Chinese consumption of natural lags far behind the world average, (4% in China VS 23% world average) and the trend in port Tianjin was the same. Despite the transportable LNG is still a minor component in the throughput of the port, this will have a rosy future and high growth rates are expected in the coming years. In order to meet the expected demand of LNG, a new LNG terminal will be built in the Nangang area.

The expected growth of Natural gas in Nangang is as followings:

Table 16: Growth rates of throughput 2030, Natural gas

	Growth %
Chinese trend Scenario	10
Low growth scenario	4
High oil price & sustainability scenario	14

(Petro) Chemical industry

The production of chemical products of 2004 is as follows:[73]

Table 17: Overview production chemical products

	Production x 1 million ton	Growth compared to 2003
Ethylene	6,23	2,40%
Synthetic resin & Copolymer	17,91	10,10%
Synthetic rubber	14,78	11,70%
Synthetic fiber & Copolymer	7,88	8,10%
Crude oil processing	273	13,70%

In 2004 the production of the petro chemical was 2.44 trillion Chinese RMB and the industrial added value of 765 billion RMB. The growth of petro chemistry in China is partly thanks to the solid and fast growing auto industry, electronic industry and the industry of building materials. Generally, the production of 10.000 cars needs 780 ton plastic, 280 ton rubber, 363 ton paint, 188 ton adhesive which the most of these materials are directly or indirectly related to the petrochemical industry.

The expansion of electronic industrial market is another pillar for the chemical industry in China. Different chemical components e.g. plasma monitors, PDP, optical coating, printed circuit boards, plastic shells etc. can be massively used and applied in different electronic products. The electronic market in China has been growing more than 30% annually since 2004, and did the demand for chemical products as well. In 2004, the total revenue was 2.15 trillion Chinese RMB; a growth of 30.45% compared to 2003. The profit was 82.1 billion RMB and the sale rate is 97%. In 2004, the (petro) chemical's annual growth rate is 18% is the twice the National average GDP growth (9% from 1998). The Shandong province is the leading area in the chemical market with a production of 346.3 billion Chinese RMB in 2004 and followed by the Jiangsu province with 280.9 billion RMB.

Except the above mentioned industries, the future developments of Petro chemical products also depends on the developments of bio fuels and other new fuel components which are supplements with each other.[74]

High oil price & sustainability scenario

The high oil price in this scenario may be a favourable development of the throughput of petro chemical products. The high price will then be a great setback for the demand of oil and this provides the opportunity for the development of other substitutes such as bio fuels. The R&D on petro chemical products will then be getting more and more attractive to replace oil and goal as main energy source. Therefore, a steady growth in throughput in the port sector is expected over-long term if oil price remains at a high level. As mentioned before, even China is natural source-rich country, there is surprisingly lack of chemical inputs and much of these must be imported from abroad, which is also an advantage for the transportation of the port sector. On the other land, if a huge amount of chemical products must be imported from abroad, China will be more dependant on foreign countries which is political very unfavourable. It is hard to forecast how big the effect is of this political sensitiveness on the import.

Chinese trend scenario

As petro chemical products might be substitutes of oil products, it will probably be greatly supported by the national government. Therefore, the petro chemical industry will have a bright future as well as in the high oil scenario, but the effect is less as it is supposed the oil price in that scenario is higher.

Low growth scenario

This is the most adverse scenario for the developments of petro chemistry in China. A long-term stagnation means that must less resource will be invested on sustainability and new fuels (petro chemistry). Moreover, the oil price will be relatively low which reduce the attractiveness of other clean and sustainable fuel.

Application in port Tianjin

Currently, the throughput of (petro) chemical products is still a minor part of the total throughput portfolio. However, as the liquid chemicals might be substitutes of the current "dirty" fuels, enormous growth in the coming decades will be expected. According to the future expansion plans of port Tianjin, chemical terminals and clusters will be created (moved) to the Nangang area. Therefore, more capacities and potential will be available for (petro) chemical products. The forecasts of growth of Chemical products are as follows:

Table 18: Throughput of (petro) chemical products 2030

	Growth %
Chinese trend Scenario	10
Low growth scenario	4
High oil price & sustainability scenario	14

Containers

Containers are often considered basic element of the global trading system and this sector will have the brightest future compared to other commodities in Chinese ports. Firstly, after the economic crisis in 2008 and 2009, the global trade has recovered gradually, which is a favourable development for both the world and Chinese economy. Moreover, the engine of Chinese economy will shift from (governmental) investments to consumptions from the private sector. As mentioned before, the Chinese government has always taken the initiative to invest in big projects such as industries and infrastructures, which has leaded to demand for raw materials and steel metals. However, the recent five-year plan has mentioned that this will shift gradually to the private sector with domestic consumption. Therefore, more demand for imports might be expected in the coming decades.

Even short-term growth is still expected in the port sector, it will not be as high as before. Jia D.S (2011)[75] argues that the container sector is very sensitive to the world economy, as the most of the goods transported by containers are end products and 2/3 of the containers in China are international trades. Until November 2008, the throughput of containers in Chinese ports has been increasing uninterruptedly. However, between November 2008 and September 2009, the container sector has suffered a negative growth which has hampered the Chinese port sector very badly. Finally, before 12th five-year plan has been released; heavy industries were the priority industries of China. Therefore, national policies will be much more effective in saving commodities such as raw materials and less in end products or industrial products.

As mentioned before, even the global trade will recover gradually, the growth of containers will not growth as strong as before. The most important reasons are as follows[76]; firstly, as 2/3 of the container transportation in China is the export of end products (such as toys and cloths), it highly depends on the demand from markets abroad. However, the main markets for Chinese exports, US and the European Union, have to face different obstacles in their recovery process. According to Zhang M.N (2011)[77] , the economic recovery of the US and EU is lack of internal engine. US is currently struggling with an unemployment rate of 9.1 percent (June 2011), and debt supported fiscal and monetary policies are coming to an end. I.e. new stimulations and policies are necessary to boost the economy. In the EU, there are concerns about the public debt in some EU-countries such as Greece, Portugal and Ireland, and ensuing tightening policies. Zhang has added that these developments and factors will not only hamper the economy recovery in the US and EU, but also the global trade and Chinese export. Secondly, the current enormous export is partly created thanks to the relatively low Chinese RMB, which has stimulated the Chinese export in the last 20 years. However, as the prosperity in China has showed great progressions, the extra income has resulted in inflation as the currency has been kept low. Therefore, as China has to ambition to realize sustainable growth in the future. The RMB will face much pressure for appreciation, which can be a great obstacle for the export and the container sector of China in the future. Finally, the high share of export might make China (both economically and politically) dependent to foreign countries; the government could implement policies which might harm the Chinese export.

Chinese trend scenario

As mentioned before, the Chinese national government has the ambition to shift its economy from (public) investments to domestic consumptions. Increasing purchasing power, as well as

import, from the private sector might then be expected in the future. Therefore, the throughput of container will have the most rosy-coloured future of all the commodities. However, there are also "snakes in the grass" such as the unemployment rate in the US and the public debts in the EU zone. Therefore, the forecasts of the throughput of container sector in China should not be too optimistic.

High oil price & sustainability scenario

The forecasts of containers in this scenario will be approximately equivalent to the estimation in the Chinese trend scenario, as the oil price does not have direct influences on end prodcts. The main difference would be the high oil price might lead to high transportation cost, which means that the throughput might be slightly lower.

Low growth scenario

As mentioned before, the container sector is very sensitive to the world economic situation and the global trade. In case of economic stagnation, the container sector in China might be hampered seriously e.g. the negative growth in 2008 and 2009. A much lower growth is expected in this scenario.

Application in Port Tianjin

In 2008, 80% of the containers came from the direct hinterland of Tianjin (Beijing, Tianjin, and Hebei province), 10% from Shanxi, Henan, Shaanxi and Inner Mongolia and 10% from the west. The share of the direct hinterland is relatively high, which means that Tianjin does not provide many threats in the contestable hinterland with Dalian and Qingdao in the field of containers. This is mainly due to the congenital shortage of the port, port Tianjin is the biggest artificial port in China, and the current depth of the port is mand-made. However, the depth of Tianjin is still not as deep as natural ports such as Qingdao, which might limit the future developments of the port; particularly because big vessels will be the trend in the future. On the other hand, 85% of the containers in the direct hinterland are handled in Tianjin, which that the port comes into possession of dominance in its direct hinterland.

Considering the factors above, a forecast of the throughput can then be formulated. The throughput of containers in 2030 of Tianjin will be 35 million TEU with an average annual growth rate of 6.85%. In the high oil price & sustainability scenario, estimations are 30

million TEU with an average annual growth rate of 6 percent. Finally, the throughput in 2030 will be 17 million TEU with an average annual growth of 3%.

Table 19: Throughput of containers, forecast 2030

	2009	2030
Chinese trend scenario		
Throughput x million TEU	8.7	35
Annual growth %		6.85
High oil price & sustainability scenario		
Throughput x million TEU	8.7	30
Annual growth %		6
Low growth scenario		
Throughput x million TEU	8.7	17
Annual growth %		3

Steel & Iron ore

Steel

As Iron ore is the main raw material and ingredient of steel, these two commodities will probably have the same trend development in the coming years. In the view of the national policies (five-year plans) and the increasing competition in the world market, the Chinese steel industry have to face much more pressure than before.

As one of the “priority industry” appointed by the Chinese government, the steel industry has realised enormous growth rates in the past. Even in 2010, the total national production of steel was 626,65 million ton with a growth of 9,3% compared to 2009. [78]

However, according to the latest five-year program, the dirty and costly steel industry is no longer considered as a priority industry as the government steered the national economy to be more sustainable. As result, the total steel production in 2011 will be expected to be 660 million ton with a growth of 5% and this rate will drop gradually in the coming years. The newest policies include among other things the efficient usage of energy and raw materials, reduced pollutions such as gas emissions etc. As result, 44 million tons of outdated iron ore

and steel production capacity have been eliminated in 2010. Moreover, in order to guarantee the quality of steel and dampen the production of steel efficiently, many medium and small size steelmakers will be closed down in the coming years. The 10 largest mills in China account currently for 50% of the National production, and this rate will be 70% by 2020.[79]

Moreover, the steel industry also has to face extern pressures such as international competition, other powerful steel producers such as India and Russia are providing steel for a reasonable price in the world market. Therefore, the growth of the Chinese steel industry will probably be dampened in the coming years.

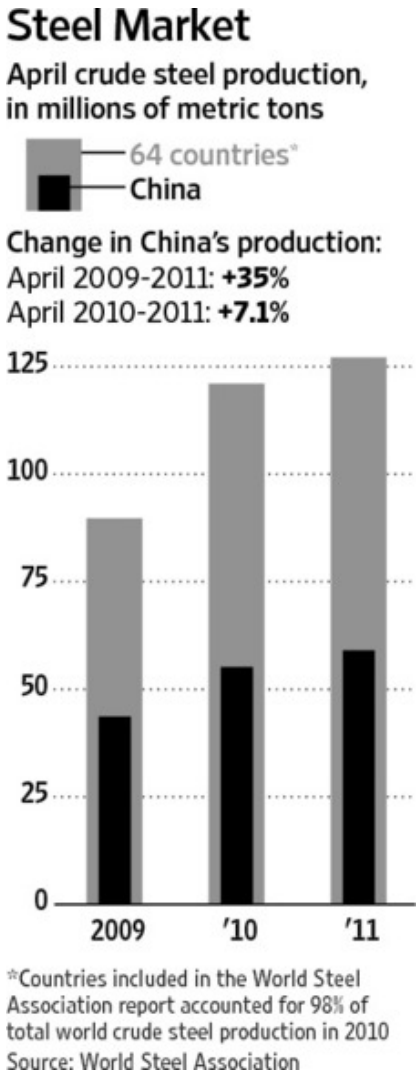


Figure 8: Overview worldwide production Steel
Source: Matthews R.G. (2011) For Global steel industry, China poses Guessing game *The wall street journal http://online.wsj.com/article/SB10001424052748704083904576335630184298602.html*

Iron ore

As mentioned before, Iron ore is the main ingredient of steel. Therefore, the trend of developments of these two commodities will probably be interrelated. As the growth of the Chinese steel production will be slowing down gradually, the Iron ore will not have a rosy future as well.

One of the indicators for the demand is the stockpile of Iron ore at the Chinese major ports. The stock in June 2011 was 95.53 million ton, which had been increasing for 7 straight weeks and was a record high in the history. This increase might implicate the decreasing production of steel to some extent in the Chinese hinterland. [80] As the demand of iron ore will shrink, the price will decrease over the long-term as well. In 2011, the average price of iron ore was $US173 and this will be expected to be $US123 in 2015.[81] However, the Chinese domestic price of iron core will be increasing on the contrary because of the monopoly system by small number of international companies such as Vale SA, Rio Rin to PLC and BHP billiton LTD.[82] In order to change this monopoly situation and to be less dependent on the import, the domestic production of iron core will be increased from the current 1.1 billion ton (2010) to 1.5 billion in 1.5. Expectations are that this development will have a release effect on the domestic price of iron ore, also partly because of the decreasing demand of steel.[83]

However, the decreasing production for steel is not the only reason for the decreasing demand of iron ore. Ker P. (2011)[84] argues that the domestic inflation might have a great impact on the import of iron core. As mentioned before, the China has to face different intern economic problems such as inflation; the inflation rate in July 2011 was 6.5% which was the highest in the last three years. In order to release and resolve the problem, the Chinese government has lifted the interest rates and introduced different requirement to the banks such as the minimal amount of capital available in the reserve. These policies might have a dampening effect on investments and so also the import of sensitive commodities such as Iron ore.

Chinese trend scenario

In this scenario, the demand for iron ore will not have a negative growth as it is affected by the decreasing domestic steel production, domestic inflation, and less imports. On the other hand, the throughput of steel will still increase gradually over the short-term and stabilize over long-term. Even the steel production will drop in the hinterland, because of the enormous demand and population number, steel will be imported from foreign countries to compensate the domestic production.

High oil scenario

The high oil price might be a favourable development for the throughput of steel, because of the increasing environmental costs and emission costs. The production of steel will then disappear faster from China and more imported from foreign countries. However, this might be dramatic scenario for iron ore as the demand will drop harder when there is less steel production in the domestic market.

Low growth scenario

In this scenario, the demand for steel might decrease over the long-term. However, because of the less strict environmental policies compared with the other scenarios, more steel mills will be remained within China. This is also a favourable development for iron ore because of the domestic steel production.

Application in Port Tianjin

Currently, the Tianjin port is mainly serving the steel mills in Hebei, Shanxi and Inner Mongolia. According to the long term planning of the Chinese steel industry (inter alia the five-year program), the demand for iron ore will be diminished in the coming years especially from Tangshan and Tanxing areas. In the future, the demand for iron ore will be more based on local companies (less on steel industry) and high growths in throughput of iron ore are not expected.

On the other hand, the steel processing industry will have a brighter future. According to the Long term steel planning of Tianjin city, the processing capacity of steel was 20 million ton in 2010, the capacity will be 30 million over the long-term.

In the Chinese trend scenario, the throughput of iron ore will be 80 million ton in 2030 with an annual growth of -0.58%. The throughput of steel will be 55 million ton in 2030 with an annual growth of 2.76%.

In the high oil scenario, the throughput of iron ore will be 75.7 million ton in 2030 with an annual growth of -1%. The throughput of steel will be 47 million ton in 2030 with an annual growth of 2%.

In the low growth scenario, the throughput of iron ore will be 115.25 million ton in 2030 with an annual growth of 1%. The throughput of steel will be 38.3 million ton in 2030 with an annual growth of 1%.

Table 20: Forecast of throughput 2030, Iron ore

	2009	**2030**
Chinese trend scenario		
Throughput x million TEU	93.52	80
Annual growth %		-0.58
High oil price & sustainability scenario		
Throughput x million TEU	93.52	75.7
Annual growth %		-0.1
Low growth scenario		
Throughput x million TEU	93.52	115.25
Annual growth %		1

Table 21: Forecast of throughput 2030, Steel

	2009	2030
Chinese trend scenario		
Throughput x million TEU	31.06	55
Annual growth %		2.76
High oil price & sustainability scenario		
Throughput x million TEU	31.06	47
Annual growth %		2
Low growth scenario		
Throughput x million TEU	31.06	38.3
Annual growth %		1

Biomass

Beside the consumption of coal, China's consumption of Biomass is also noticeable higher than the world average. The popularity of biomass is owing to the big rural area and its inhabitants, which still use fire wood and agricultural residues for cooking or hearing etc. However, the consumption of biomass has several major disadvantages[85]:

Firstly, the direct combustion of firewood and agricultural may create air pollution which is harmful for the human health. Especially children and women are exposed directly to pollutant concentrations which is higher than the international standards.[86] Moreover, the usage of biomass requires much time which is at the expense of other more productive activities such as education and income-earning activities.

Because of the improving prosperity in the Chinese rural areas and the increasing urbanisation process, the consumption of biomass has been gradually replaced by other more convenient energy resources such as liquid gas and electricity. Thanks to the modern new technology, clean energy with limited pollution and emission of gases.

The most important resources of biomass are[87]:

- Wastes: among other things domestic waste (urban garbage), industry organic waste (waste water and waste residue), waste from agriculture machining (rice shuck peanuts suck etc.), and waste from forest machining and livestock waste.

- Unused Biomass: Crop straw, which are corn, wheat, rice, oil plants and cotton etc.
- Biomass energy resources: Firewood forest resources and Energy crops (for non food purposes such as sweet sorghum, cassava, sugarcane, jatropha etc.).

One of the most important energy products is the Liquid Bio fuel Ethanol, it is mainly produced by grain. Between 1990 and 1999, the increasing prosperity in China has boosted the supply of agricultural products. In order to prevent wastes from the abundant supply of the grain, the Chinese government spent a huge amount of money to purchase the surplus in order to develop the Bio fuel Ethanol. An overview of the production of Bio fuel ethanol is as follows: the total production in 2005 was 1.02 million ton;

Table 22: Overview of CHina's production of Fuel thanol

area	Production (1000T/a)	material	material consume (1000T/a)
Ji'lin	3000	corn	9900
Heilongjiang	1000	corn	3300
He'nan	3000	Wheat /cassava	9000
An'hui	1200	corn	3600

Source: Zhao (2006) The current status and prospect of China biomass development, Center of energy and environment protection Technology development, Ministry of Agriculture

Currently, the Chinese government is also setting up R&D projects on other resources to produce bio fuel ethanol e.g. cellulose, starch, saccharum etc. Other examples of Biomass energy are Bio-diesel, Bio gas and Biomass power generation.

Even the above mentioned modern bio mass energy is considered as environmental friendly and clean energy resource. However, the future trend of development still has to face different barriers:

- Lack of funding and incentives, currently mainly driven by incentives from the government and foreign investment

- Biomass energy market is not well developed; the technological and organizational methods are not sufficiently to compete with traditional fossil-fuel. E.g. lack of investments in promotion and high prices have caused lack of confidence under customers. Moreover, the current Chinese market is still in the early stage of development, fewer customers are willing to pay more for clean energy.

- Immature modern biomass technology; even the biomass energy accounts for more 10% of the Chinese energy consumption mix, however still around 85% of the biomass energy is the combustion of firewood etc. for cooking and heating.

Chinese trend scenario

As mentioned before, the development and the consumption of Biomass will not harm the environment by e.g. gas emission. Therefore, the development of Biomass is explicitly appointed as one of the priority industry in China according to the five-year plan, big growths may be expected future. Approximately the same prospects such as the chemical products might be expected in the future.

High oil price scenario

The high oil price in the future might be a favourable development for the future of Biomass, as the biofuel, which is produced by biomass, could be a substitute of the traditional fossil-oil. Expensive oil price reduces the demand for fossil oil and more demand for the R&D and consumption in Biomass renewable energy

Low growth scenario

This is the most adverse scenario for the development of Biomass. Oil price will probably be kept low in order to stimulate the economy, and R&D expenses on renewable energy will be retreated (of which also Biomass energy). Environmental restriction will be gloomy and less support from the government will be expected.

Application in Port Tianjin

As mentioned before, the most of the resources are agricultural products which are low-value and the transportation coast might be relatively high. Therefore, import of biomass goods from foreign countries is not realistic. Moreover, traditional biomass energy is particularly consumed in the rural area and there is relatively less demand for transportation. Therefore,

although high growth rates of biomass are expected in the future, it is unlikely that the biomass throughput will be a major part of the throughput of Tianjin. An overview of the growth of Biomass in port Tianjin is as follows:

Table 23: Forecast of throughput 2030, biomass

	Growth %
Chinese trend Scenario	6
Low growth scenario	4
High oil price & sustainability scenario	7

Overview

In the view of the above forecasts in different commodities of port Tianjin, the following summary of growth rates haven formulated:

Table 24: Overview of growtth rates of throughput Tianjin

	Oil	Coal	Natural gas	(Petro) Chemical	Iron ore	Steel	Biomass	Containers
Chinese trend scenario	4.17%	3.72%	10%	10%	-0.58%	2.76%	6%	6.8%
High oil price and sustainability scenario	1.50%	4.50%	14%	14%	-0.10%	2%	7%	6%
Low growth scenario	2.50%	2%	4%	4%	1%	1%	4%	3%

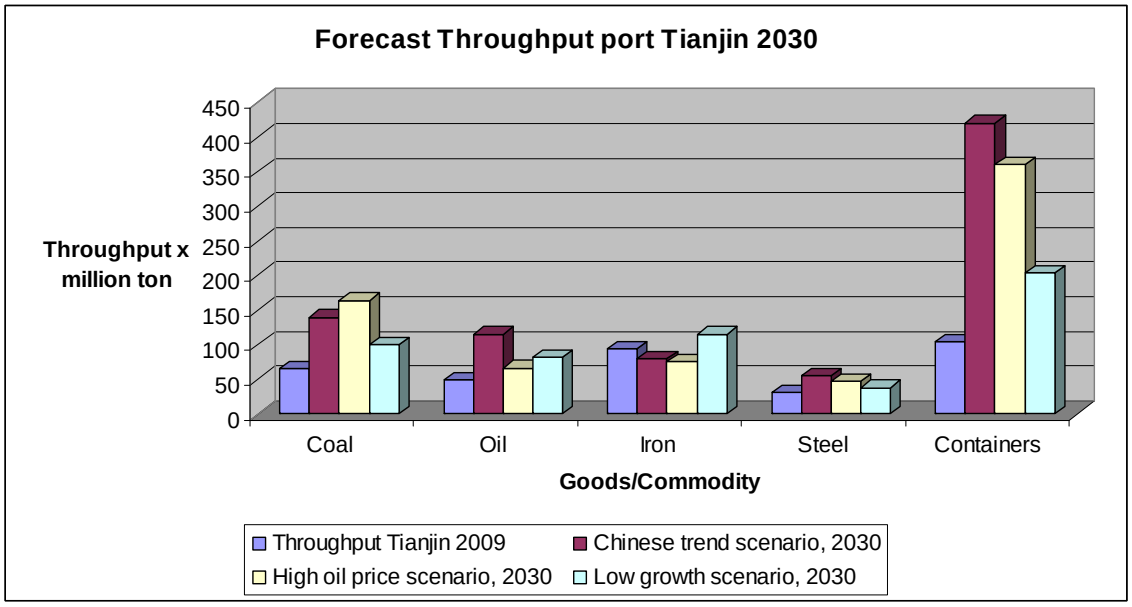


Figure 9: Overview throughput in different scenarios

Analogies

As mentioned before, except the scenarios, the method of analogy, which data will be compared with similar cases, can also be applied to get accurate forecast result and increase the confidence of the study.

Container TEU per capita

Because of lack of data, not all of the commodities can be scrutinized. Therefore, the total throughput of containers has been selected in order to analyse the future trend of containers. As mentioned before, the Chinese government was the economy engine after the economic reform in 1979, by supporting and investing in so-called priority industries. These industries are often heavy industries and have mostly need for raw materials. From the 1990's, the export of end products (e.g. toys and cloths) rose up and it stimulated the (outgoing) container transport. A comparison of container throughput per capita with other developed and developing countries will be carried out in order to analyse the potential of container transport.

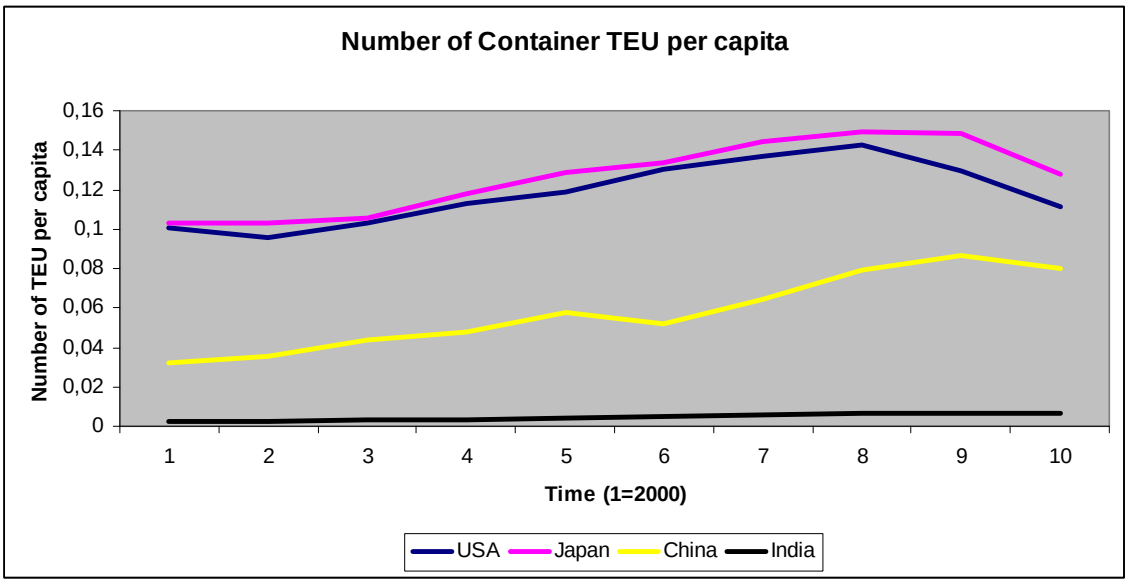


Figure 10: TEU per capita in China, India, Japan and the US

The graph above illustrates the developments of TEU per capita in the last decade of China, USA, Japan and India. Compared with developed countries, China's TEU per capita is still considerable lower. There are different reasons for the lower rate of China. Firstly, the population number is 4 times bigger than the US and 10 times bigger than Japan. As the container transport is still mainly serving the prosperous coastal area, the TEU per capital is strongly rarefied by the huge population numbers in the west. Secondly, because of the national economic policies, the main container streams are exports of export products (such as toys and cloths). As the national economic was driven by the governmental investments, a relative low consumption has lead to low import.

However, as the Chinese government has the ambition to develop and invest western China, the economy in the west will definitely catch up the east gradually and create more demand for containers in the future. Moreover, as the newest five-year plan has explicitly mentioned the shift of economic driver from governmental investments to private consumption, growths of containers may still be expected in the future. In 2000, the number of TEU per capita in the US was 0.1 which was 0.068 more than China. In 2009, the difference between the two nations was 0.032 and it will be further narrowed in the coming years.

Comparison in international trade

As mentioned before, Japan has had a very analogous development trend as China with similar economic systems and structure. Scrutinizing the data, China in 1999 had the very similar economic and social situation with Japan in 1960. There, the same trend of economic development might also be expected in the future:

Table 25: Comparison Japan and China

	China	Japan
Life expectancy	Female:72/Male:68 (1998)	Female:72,9/Male67,7 (1965)
Infant Morality rate	3,1% (1999)	30,7% (1960)
Primary sector as a share of GDP	15,9% (2000)	16,7% (1959)
Engel's coefficient in urban areas	39,2% (2000)	38,8% (1960)
Per capital electricity consumption	1071 kwh (2000)	1236kwh (1960)

Source: The Future of the Greater China Economy. The third Wilbur K. Woo Conference on the Greater China Economy held UCLA

As the throughput of ports highly depends on the (international) trade volume, the total import and export have been selected in order to compare the two nations, and predict the potential of ports' throughput in the future. As mentioned above table, Japan in 1960 has the similar situation with China in 1999; these two years are selected to be the beginning year of the analysis. The results are as follows:

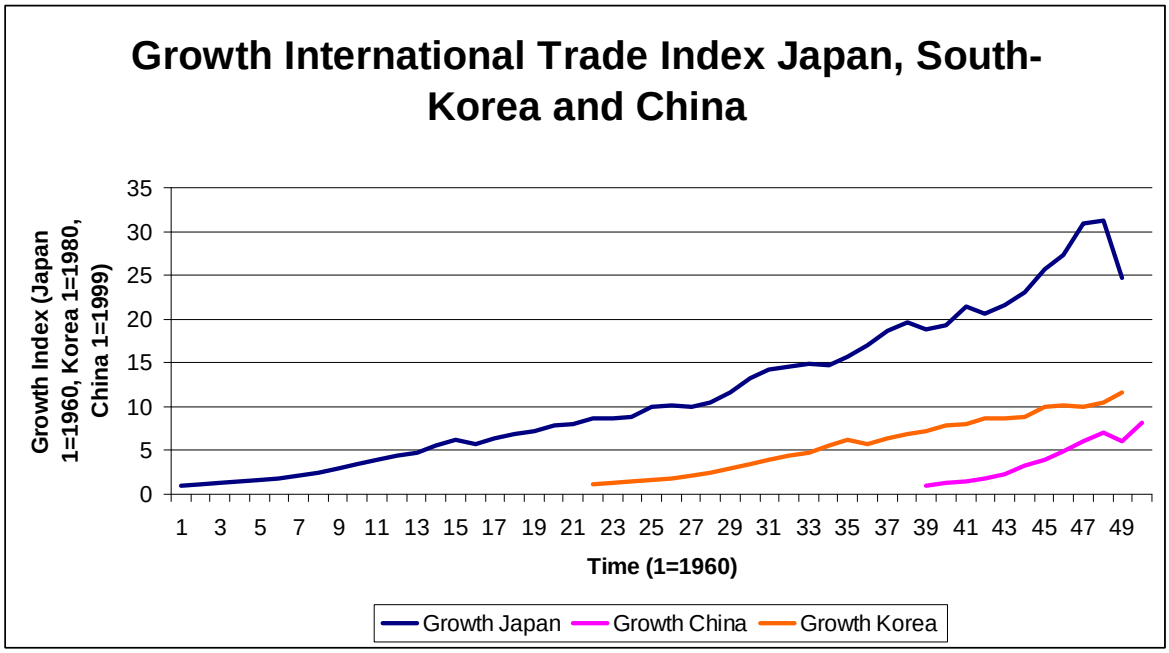


Figure 11: Growth International trade Japan, China and South Korea

As illustrated in the graph above, the period between 1999 and 2010 in China has the approximately the same shape of growth in international trade with the one in Japan between 1960 and 1970. During the second world, the Japanese economy and industrial infrastructures have been massively destroyed. After the war, the national government has taken the initiative to boost the economy by investing industries such as steel and shipbuilding. The biggest growth was realized between 1955 and 1975 (often called the "Golden sixties") and the flourishing economy has resulted in increasing goods trade and throughput in the port. The economy in China has shown similar developments. The Cultural Revolution between 1966 and 1976 has caused enormous damages in the economy and negative growth in industry. After Mao's death in 1976, Deng has introduced the economic reform plan in order to boost economy with the "Japanese model" (governmental initiatives).

As the two nations have the similar economic model and developments in the past, a similar future might also be expected in the future. Ten years after the beginning year of the analysis, both Japan and China had to face a drop in the total international trade (also throughput); for Japan this is caused by the oil crisis, and the worldwide credit crisis and public debt problems have dampened the trade volumes in China now. However, straight after the crisis in the 1970's, the Japanese trade has shown resilience and has recovered the growth with the same rate as before the crisis. In the view of the developments in Japan, China also has the market

and potential (e.g. the enormous population number) to realize growth in trade over the long-term. As the trade is an important factor for the throughput, the same trend may be expected for the port sector in China.

Forecast China energy mix 2030

As mentioned before, China's energy produced from coal and the conventional energy amounted more than 85% of the total consumption in 2008. However, as China has the ambition to change its economic character in to sustainable, different policies and plans in order to realize the economic shift such as production decrease in steel and more in investment in renewable energy. Through the analyses and the prediction of ports' throughput above, a forecast of the energy mix of China can be formulated:

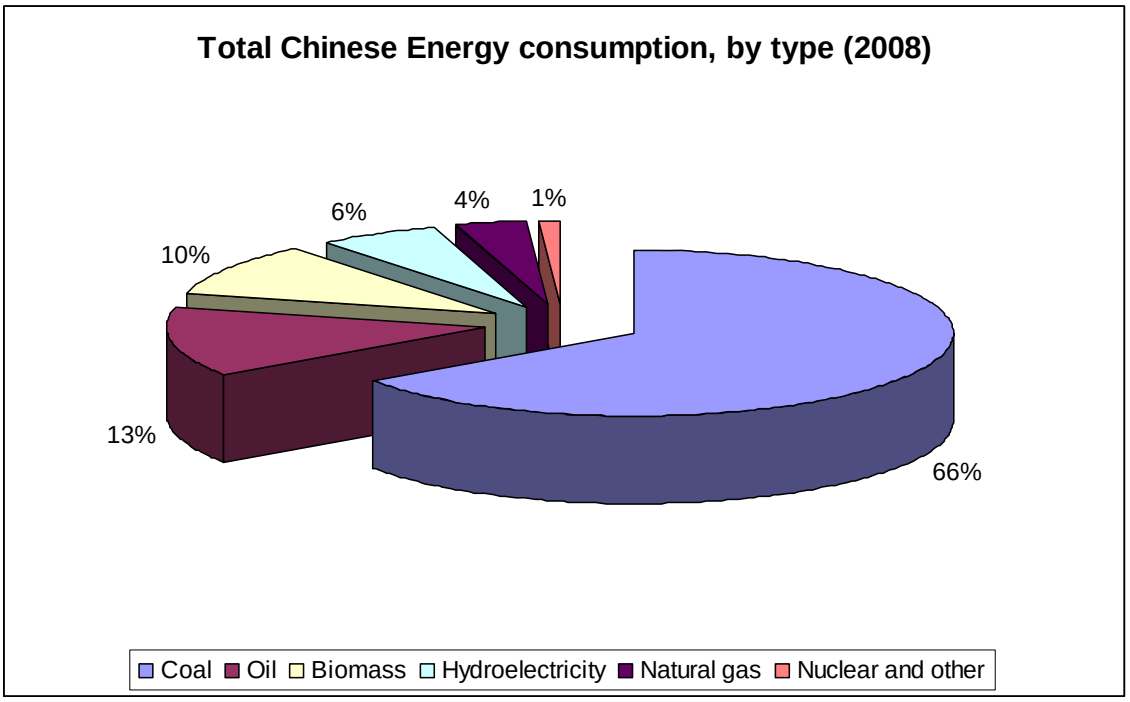


Figure 12: Current Energy mix China 2008

Source:EIA International Energy statistics 2008

The forecasts of the energy mix of China are as follows:

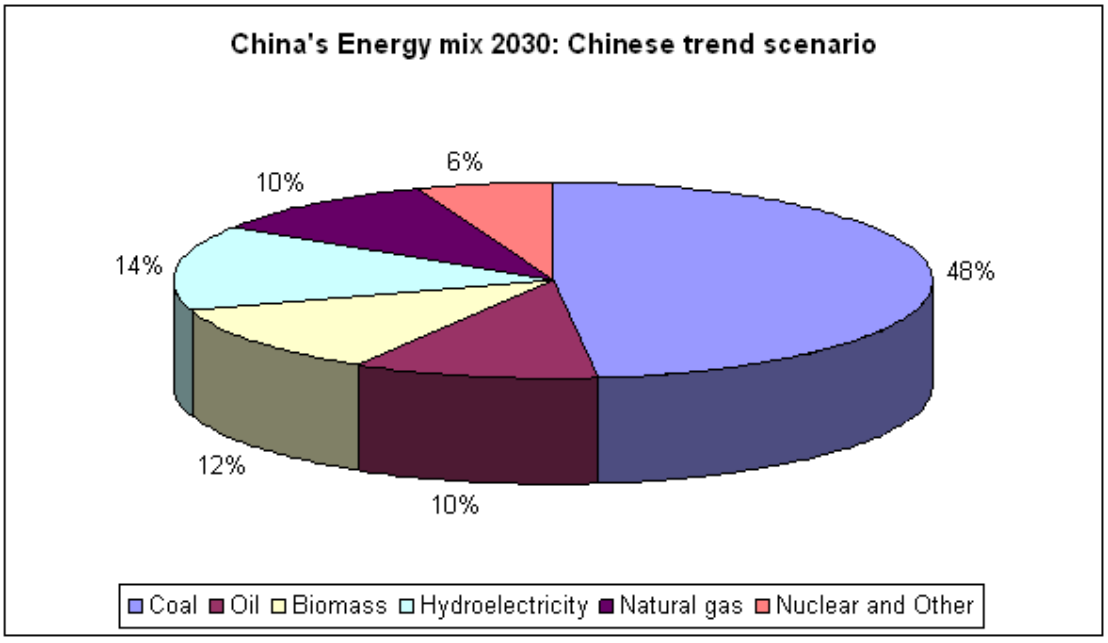


Figure 13: China's Energy mix 2030: Chinese scenario

The graph above illustrates the expected energy mix of 2030 in Chinese trend scenario. As the Chinese government will be implementing different environmental policies, traditional dirty energy source will retreat remarkably in proportion of the total energy mix compared to 2008. This will be replaced by other energy resources such as Natural gas, renewable energy, and Biomass. However, expectations are that conventional energy still can not be replaced by other alternatives in 2030, which means that it will still have a considerable proportion in the energy mix of the coming 20 years.

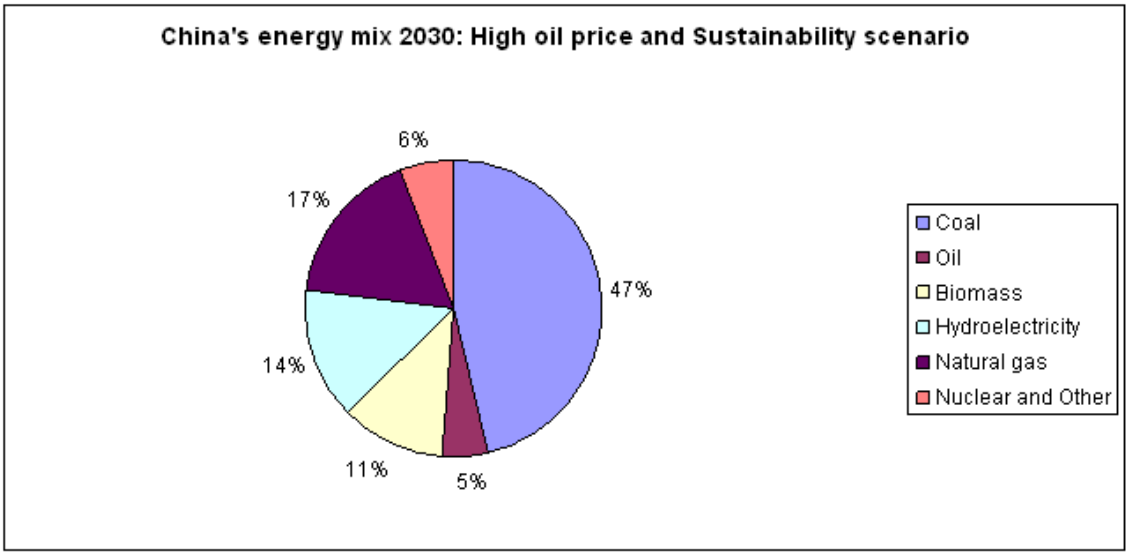


Figure 14: China's Energy mix 2030, High oil price and Sustainability scenario

In the high oil price and sustainability scenario, an enormous loss of proportion of oil in the energy mix is expected. Industrial companies will be called for strict environmental policies and different requirements which limits the production and consumption of coal and oil. Alternatives such as biomass and Natural gas will take over a part of the consumption of oil. Moreover, the conventional energy will, as in the Chinese trend scenario, not be replaced by renewable energy,

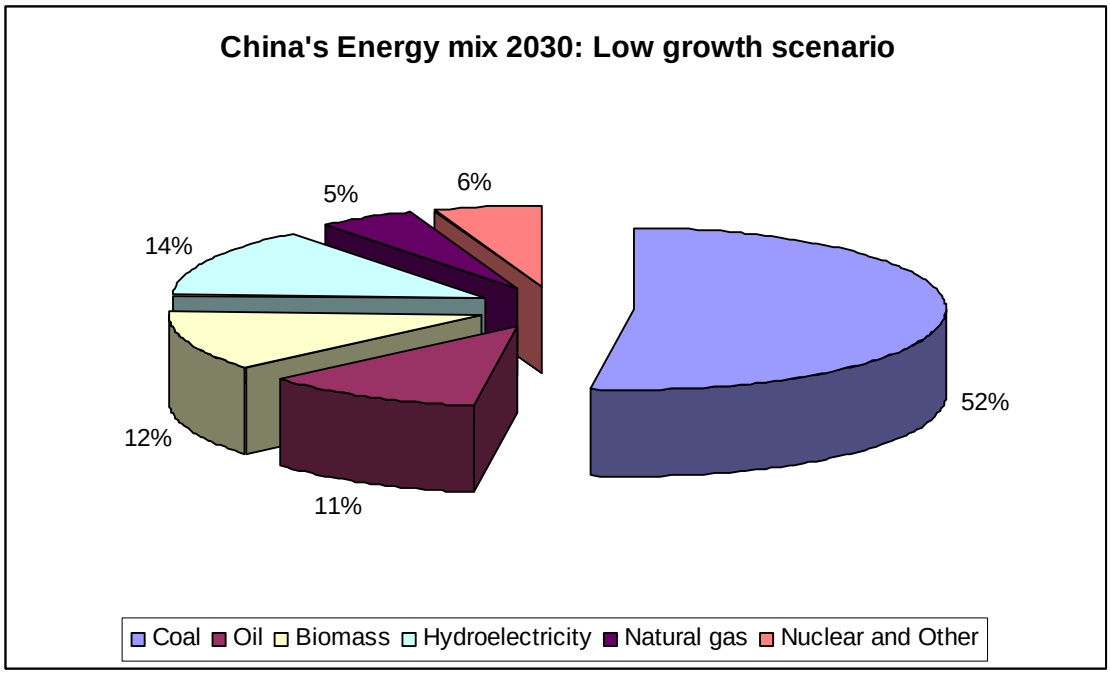


Figure 15: Energy mix China 2030: Low growth scenario

In the low growth scenario, the price of conventional energy price will be kept in order to stimulate the economy. As the most important energy resource, coal will still have more than 50% share in the total energy mix because of its abundant stock in China and low price. Because of the adverse economic situation, less investment will be spent on the development of R&D. Therefore, the share of renewable energy will be limited in 2030.

9. Conclusion

Based on the found ingredients found in the study, the following growth rates of the commodities in each scenario have been estimated. The results of the growth in throughput of port Tianjin in 2030 are as follows:

Table 26: Overview of growth rates (2030 in the view of 2009) of throughput port Tianjin

	Oil	Coal	Natural gas	(Petro) Chemical	Iron ore	Steel	Biomass	Containers
Chinese trend scenario	4.17%	3.72%	10%	10%	-0.58%	2.76%	6%	6.8%
High oil price and sustainability scenario	1.50%	4.50%	14%	14%	-0.10%	2%	7%	6%
Low growth scenario	2.50%	2%	4%	4%	1%	1%	4%	3%

Expectations are that the Chinese economy will surpass the US economy in 2030. Therefore, strong Chinese economic growth is expected in the coming 20 years and this development will also be reflected in the throughput of port of Tianjin. Table 26 illustrates the growth rates of different commodities. Generally, all commodities are expected to grow until 2030 thanks to the Chinese economic advantages e.g. the huge domestic market and the number of the population.

One of the most important elements in the forecast is the future planning of the Chinese government. According to the 12th plan five-year plan (released in March 2011), China will pay more attention on environmental issues and sustainability; stricter environmental policies will then be implemented and heavy industries will reduce the production gradually. These developments will also affect the forecasts; e.g. the growth rates of sustainable energy resources (such as chemical products, biomass etc.) are expected to be higher than old conventional energy resources (e.g. Oil and coal)

Another important change in the future is the shift of the economic structure. After the economic reform in 1978, the enormous Chinese economic growth was mainly driven by the Chinese government e.g. public investments and incentives. This system has lead to enormous

economic growths in the thirty twenty years. However, this system has also caused many social and economic problems such as corruption and unfair welfare distribution. Therefore, China has to change its economic structure in order to realize sustainable growth in the future. Expectations are that the economic structure in gradually shit from governmental investment to private consumption. As the consumption from the private sector will increase, more demand for end products from abroad may then be expected in the future which stimulates the container transport. Therefore, the container throughput in port Tianjin is also one of the commodities which will shoot out compared to others.

Figure 168: Overview throughput in different scenarios

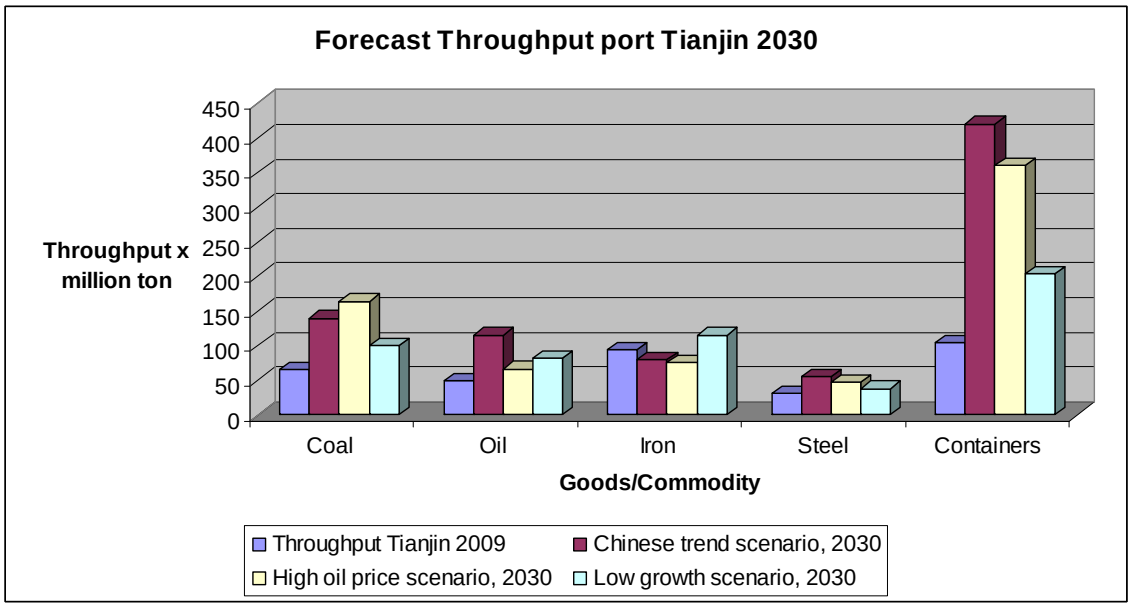


Figure 18 illustrates the expected throughput volume of the most important commodities in different scenarios. Even the growth rates of the Chinese economy will slow down in the future in the Chinese trend scenario, but this is still the most rosy-coloured scenario with growth in almost all of the commodities. In the high oil price and sustainability scenario, minimal growth in oil is expected and it provides opportunities for the development of new and renewable energies. The low growth scenario is most adverse for the development of new energy resources such as chemicals and biomass due to the stagnation of the Chinese economy. Minimal growths are also expected for containers and oil.

Enclosure: Corporation Port of Rotterdam and Nangang

In 2010, the Port Authority of Rotterdam was approached by the Nangang Industrial Zone Development Company regarding to the consultancy of port Nangang. After different attempts of discussions, presentations and opinion exchanges between the both parties, a service contract has been signed in March 2011. Since then, different proposals of practical ideas and consultancies have been provided to Nangang, and these have carried off much enthusiastic feedbacks from the Chinese side. However, straight after the positive responses, many problems and questions have raised as well. Currently, discussions have still been going on and hopefully further agreements between the both parties can be realized over short-term.

International partner and Service Agreement

In order to find a foreign partner with international experiences, the Tianjin government institute which is responsible for the development of the Nangang Industrial Zone has visited different world ports (Rotterdam, Busan and Antwerp) to observe their daily operation. During the visit of the TEDA delegation, many presentations about the Port Management Practices and the operations of the port have been given, and these initiatives have won much enthusiasm and positive feedbacks. Finally, the port of Rotterdam received the massage that the Rotterdam is chosen as the best potential partner of TEDA in May 2010.

After this confirmation, more contacts and opinion exchanges have followed and at the end, a service contract between PorR and the Nangang Industrial Zone Port Company (NIZPC) is recommended by the Chinese Partner, as this company is more directly involved in details of the operations and developments of port Nangang.

In the position of the port of Rotterdam and the international department (PORint), PoR is not willing to provide purely consultancy to any ports. I.e the corporation and the Service Contract must be based on a possible long term participation of PorR in port Nangang in the future.

On the March 3th, 2011, after the NIZPC and the PoR have reached a consensus on the issue, the Service contract between both parties was signed. A brief content of the contract is as followings (!):

1. Port area detailed planning
2. Port area development Management Model
3. Port rules and regulations
4. Port operational procedures
5. Management standards and best practises
6. Operating Vessel Traffic Management System
7. Construction plan for the port area
8. Management plan for the public used shore line and ownership shoreline
9. Planning for the development of the area north of the northern-breakwater

On the 10th of March, 2011, three specifications of the nine deliverables of the Service Contracts above have been released. Firstly, a second opinion on the port-design of First Harbour Consultancy (FHC) will be given by the PoR (Nr. 1 & Nr. 7 from the above deliverables). The Port will also give comments on other elements such as the design of jetties, trestle wharf and the berths at the quay wall etc. This will mainly focus on phase 1, which includes the design of the west basin, and its north, south and west side. Data such as the drawing of the basin and safety requirements will be provided by NIZPC. Secondly, PoR will design a nautical VTMS-plan with its experiences and operational practises. (Nr.6 from the above deliverables) Thirdly, an organisational setup of NIZPC will be presented by PoR (Nr.2), also attentions will be paid on corporate management, operational management (Nr.3) and account management (Nr.8). Later on, as the subjects are getting more refined, procedures for the organisations will be provided in details to NIZPC (Nr.4). Finally a conceptual approach about the North Area of Nangang will be given.

Port Tianjin, Port Nangang and background information

As the biggest country in the world in terms of population, China is now the second economy in the world in GDP at market value, and it is expected that the USA will be surpassed by this huge nation in 2030. After the economic reform and openness in 1978, the Chinese government has introduced a so-called "dual economy" in order to stimulate the export industries in two special regions at the coast area (Shenzhen and Shanghai Pudong). China has become the factory of the world.

Afterwards, the Binhai area has been designated as the third focal point at the coast area. This region, which is part of the Tianjin municipality, consists of three different cities: Tianjin (8million inhabitants), Tanggu (3million inhabitants) and Dagang (0,5 inhabitants). In order to stimulate the economic development in this Binhai-area, a special organisation has been created to be responsible for all day-to-day operations within the area: Technical and Economic Development Administration (TEDA).

Thanks to the vicinity to Beijing, the port of Tianjin (which is also part of TEDA) is the eighth port in the world, just behind Rotterdam. [88] Partly because oil is found in the Binhai-area, Petrochemical industries and power plants flourish in the industrial area around the Port Tianjin. In the port self, besides the logistics complex of containers, mainly crude oil and coal is handled in large quantities.

Different tasks of the Tianjin port, such as planning, are also the responsibilities of the Tianjin municipality. E.g. the Tianjin Economic development and Reform commission is responsible for the economic prognoses and economic justification. However, other details such as technical, spatial issues will be regulated by the TEDA. Furthermore, other day-to-day activities are the responsibilities of the Nangang Industrial Zone development (NIZDC). For the water front activities, a subsidiary Nangang Industrial Zone Port Company (NIZPC) is created. Moreover, other nautical issues such as safety and the function of Harbour Master will be tended by the Marine safety administration (MSA).

According to the Tianjin Master plan 2005-2020[89], the Tianjin port is divided in two parts: The north port and the south port. In the future, more and more heavy industries (coal and petro chemicals) will be moved to the southern part as because of the heavier congestions

and the population density in to north. Therefore, the project of Nangang (which belongs to the southern part of Tianjin port) seems to necessary for this development.

The division of work within the Tianjin port became clearer after the zoning plan (which is part of the prognose) released by the Tianjin Development and reform Commission. In order to realize a better efficiency and functioning, the former Tianjin port will be divided in five parts.

- Eco-city
- Tianjin ports (which is smaller than before)
- Daguquao (Northern part of Lingang)
- Quoshaling (Southern part of Lingang)
- Nangang Industrial Zone

In case of Nangang, it has positioned itself as a port industrial area which is focusing on heavy industries and multifunction petrometical. The main target market and hinterland will be particularly the north of China. Even though the zoning plans have divided Nangang from Port Tianjin, all developments and policies will be considered in connection with the northern areas for bilateral complementation. Moreover, more attention will be paid on Sustainable and environmental issues.

In order to stimulate interactions and positive competition between different firms within a sector, different clusters of different sectors will be create within Nangang, this will be clusters of petrochemical sector, manufacturing and processing sector, logistic sector etc. E.g. in the area (cluster) of petrochemical, two refineries of have been envisioned already as anchoring companies, with an annual capacity of 30 million tons.

Currently, the construction and reclamation of Nangang are still in the initial phase, and the half of the planned reclaimed land is still in water. However, detailed plans about the infrastructure and modalities have been released already. Railways and 4 different highways will be built within the Nangang Industrial zone, and the expected completion of the first railway will be in 2013. Also pipelines and gas pipes will be build in order to meet the needs of the developments of Nangang. The total investments of the whole Nangang Industrial Zone amount 800 billion RMB, and the most of these investments will

be spend on Petrochemical projects. The annual output in 2023 will be expected to 1000 billion RMB, with an employment of 200.000 persons. As mentioned before the reclamation of Nangang is still under way. Currently, fishing activities and shrimp farming are taking place in the in the future industrial area; financial compensation will be paid to these fishers after the start of the reclamation of the eastern part of Nangang.

The Masterplan of Nangang, which is mentioned above, has been approved already by the National Reform and Development Commission and the operation of it is under way. I.e., the chance of any big changes of this Master plan will be hardly ever nil. This master plan of Nangang is mainly copied of the plan of Lingang, as this port used to have the same function of Nangang as a port of petrochemical industries and manufacturing. The function (division of work) has been changed after the release of the Master plan of the Tianjin city.

Figures:

Tables

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