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Regional Environmental Impact of Tourism

– Linking the regional tourism satellite accounts and the regional environmental accounts within the Danish regional model framework

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ABSTRACT

The main purpose of this paper is to assess tourists' contribution to greenhouse gas emissions. To achieve this goal, it is necessary to construct the regional environmental satellite accounts for Denmark. The national environmental air emission data from Denmark Statistics is broken down into the regional level in order to carry out analysis at the regional level. It requires also a linkage between the regional tourism satellite accounts and the regional environmental accounts within a regional economic modelling framework.

The paper presents the data from both regional tourism accounts and the national environmental accounts. The main discussion focuses on the methodologies needed for constructing the regional environmental accounts and the linkage between the two accounts. The linkage between the two accounts involves two connections with greenhouse gas emissions. One connection shows that tourism demand through the tourism related sectors is connected (i.e. backward linkage) to intermediate consumption; the other connection is tourism demand directly linked with private consumption. The greenhouse gas (GHG) emissions are accounted through both intermediate consumption and the private consumption.

The Danish interregional macroeconomic model provides a modelling framework for both regional tourism accounts and the regional environmental accounts. The modeling results provide both direct impact and total (direct, indirect and induced) impact of the tourism demand on the emissions. Tourism demand in Denmark accounts for approximately 2% of gross output and 10% of private consumption. The analysis shows that tourism direct impact on GHG emissions through production accounts for 1.5% of national emissions; while the total tourism impact on the emissions rises to 5% of the national total. The tourism contribution to the emissions through private consumption is around 14% of national total emissions. The direct and the total impacts from tourism on the emissions through private consumption do not show a significant difference.

The tourism impact on environment concerns both different types of tourism and different tourism destination. Some case studies present some interesting results from different types of tourism and also give a regional overview of tourism impact on environment.

Key words: Regional environmental impact, tourism satellite accounts, regional environmental accounts, greenhouse gas emission.

1. Introduction

We experience now that climate change is having, and will have, strong impacts on our everyday's lives. The general media's information and politicians' participation to the United Nations' climate change conference have drawn much attention onto the issue. Scientists have observed that the climate has changed more rapidly than ever before. Climate change is primarily caused by human activities, the most important part of these being the emission of greenhouse gases and clearing of natural vegetation. By using data and modelling methods, it is possible to identify some of CO2 (and other) emissions that are caused by economic activities through firms' production using the different types of energy, and others emissions that are caused by private consumers who consume also energy-related products, for example, private households use energy, such as electricity, gas, fuel and warm water and other forms of house warming, and people use gasoline for their motor vehicles.

Tourism is one of the economic sectors that involve much into different sectors such as hotels and restaurants, road, water and air transportation, especially the motor vehicle that could contribute much to the CO2 emission. On the other hand, tourism becomes one of important economic engines that create revenues and jobs for many regions. Therefore, there is an urgent need for us, not only looking at the economic contribution of tourism, but also at the environmental impact of tourism. The aim of the analysis is to give suggestions to the regional policy makers to make sustainable tourism policies.

The main purpose of this paper is to assess tourists' contribution to greenhouse gas emissions. To achieve the goal, it is needed to construct the regional environmental satellite accounts for Denmark by using the national environmental air emission data from Denmark statistics. It is also needed to link the regional tourism satellite accounts with the environmental accounts and with the regional economic model.

The Danish interregional macroeconomic model provides a modelling framework for both regional tourism accounts and the regional environmental accounts. The modeling results provide both direct impact and total impact of the tourism demand on GHG emissions. Tourism demand in Denmark accounts for approximately 2% of output and 10% of private consumption. The analysis shows that tourism direct impact on the emissions through production accounts for 1.5% of national emissions;

while the total tourism impact on GHG emissions rises to 5% of the national total. The tourism contribution to the emissions through private consumption is around 14% of national total emission.

2. Background

As the host country for United Nations' climate change conference 2009, the national tourism organization – VisitDenmark feels its obligation to make a report also on the environmental impact of tourism. We have many years of experience in Denmark in analysing regional economic and employment impact of tourism (Zhang, 2001, 2002, 2005 and VisitDenmark, 2006, 2009). The national tourism organisation (VisitDenmark) and a research institute (AKF and CRT) have co-operated for more than ten years to collect the tourism data and visitors information and to make the regional tourism satellite accounts for Denmark. The analysis includes also in applying the interregional economic model, LINE, to analyse the tourism importance on the regional economies.

Clime change is caused by human activities through economic production, public and private consumption (both by residents and tourists) within the region and across regions, such as trade flows and tourist flows between the regions. Investigating only into national CO2 emissions, it will not have enough information to tell the regional difference that both regional economic activities and private consumption in different regions influence the CO2 emissions. There is a need for setting up regionalized environmental satellite accounts for Denmark. The accounts could be able to distinguish in which region and which sector that give highest CO2 emissions. The accounts will also include the private households that also consume energy for house warming and gasoline to their cars.

Traditionally, tourism analysis focuses on the economic and employment impacts, ignoring tourism's environmental impacts on the regions. Now it comes to the time that we put focuses also on the negative side of tourism. Even if tourists bring in some tourism revenue and create jobs to the regions, tourists also create more CO2 and other greenhouse gas emissions through their direct consumption in the region. Tourism environmental impacts on region can only be carried out by a regionalised environmental satellite accounts and by applying a regional economic model to assess the total environment impacts. The regional environmental satellite accounts are an integrate part of the model system, meaning that the accounts will be consistent with present regional tourism satellite accounts that have also been used by tourism authority and regional tourism analysts in Denmark. The regional environmental impact analysis should be conducted as a parallel study as the economic analysis for tourism. It is suggested to make a benchmarking for green destination together with tourism impact analysis on environment.

The results from the project will give concrete assessment of environmental effects from different types of tourism, and also at different tourism destination. We expect that environment effects are

relatively higher by hotel tourists than camping and summer cottage tourism. We expect that the tourism at large cities have higher environmental impact than the tourism in peripheral destinations.

The project is carried out by the following procedures:

- Data inputs: adopt the national environmental air emission data as a starting point for constructing regional environmental satellite accounts. It is assumed that the same types of industries in all the regions have the same CO2 emission patterns; however, different industries have different energy consumption, therefore they release different CO2 emission in different regions.
- Combining supply data with demand: demand for different products is different in regions. Regional demand data, including intermediate consumption, household consumption and tourism consumption are also applied for regional environmental accounts.
- Evaluation on industries: developing a tool or indicators for evaluating the environmental impacts of industries (especially within the tourism industries).
- Evaluation on tourist segments: the above tool will be applied to different tourist segments, in order to evaluate environmental impact of different tourist groups.
- Knowledge transfer: this research has a long-run implication for application. The regional environment satellite accounts and modelling methods could be used for other types of analysis, for example, the evaluation of energy consumption by household related to CO2 emission at municipality level.

One of the supplements to the procedures is that the environment accounts will cover all the tourism industries (by UNWTO definition). Tourist segments are including both same-day and overnight tourism, and including both inbound and domestic tourists in Denmark. Outbound tourism is not included in the analysis.

Notes:

Another note is that the CO2 emission is supply-side concepts. This means that the tourism consumption in this case is transformed into their consumption by different products. Some of these products are certainly produced by domestic producers and others might be produced abroad.

This analysis covers only the greenhouse gas emissions from the domestic production; the imported goods for which the production is carried out in foreign countries are not included, for example the tourism expenditure on air transport by the foreign supplier is not included in the studies.

3. Tourism Demand and Regional Tourism Satellite Accounts in Denmark

Tourism demand in Denmark refers to tourist consumption within the territory of Denmark. According to UNWTO manual concerning tourism satellite accounts (UNWTO, 2008), tourism consumption is divided into two categories, i.e. domestic and inbound tourist consumption. It can be further divided into same-day visitors' consumption and overnight tourists' consumption. Domestic tourism can be divided into leisure private visitors/tourist consumption and business tourist consumption.

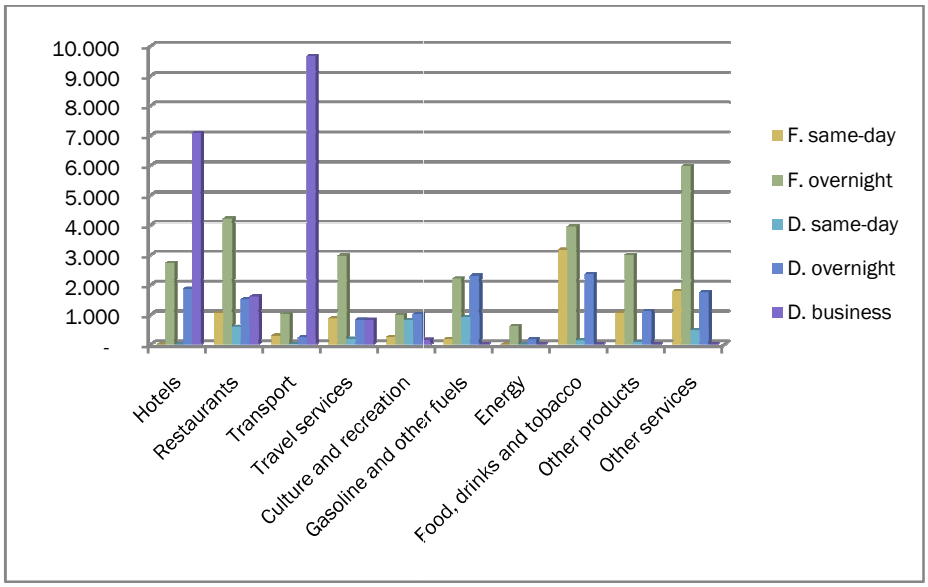
Tourism consumption in Denmark was 72.7 billion DKK (Danish kroner, i.e. approximately 9.8 billion euro) in 2006. Table 1 shows tourism consumption by five types of tourism. From the main product categories, the different types of tourism have quite different consumption pattern. Figure 1 shows a diagram to compare the consumption pattern. It shows that domestic business tourism consumed most at hotels and transport (domestic same-day visitors are also included). Gasoline used by vehicle consumed mostly by domestic same-day and overnight tourists and foreign overnight tourists. Tourists have also direct consumption at energy through rental (or own) of summer cottages.

Table 1 Tourism consumption in Denmark

(2006, in million of DKK)

	F. same-day	F. overnight	D. same-day	D. overnight	D. business	Total
Hotels	-	2,735	-	1,867	7,092	11,695
Restaurants	1,051	4,224	599	1,518	1,610	9,001
Transport	296	1,028	15	242	9,660	11,241
Travel services	874	2,978	193	830	825	5,701
Culture and recreation	253	990	813	1,015	165	3,235
Gasoline and other fuels	187	2,213	911	2,311	-	5,622
Energy	-	619	-	176	-	795
Food, drinks and tobacco	3,178	3,959	143	2,365	-	9,646
Other products	1,064	3,001	87	1,123	-	5,275
Other services	1,795	5,977	478	1,752	-	10,002
SUM:	8,699	27,723	3,239	13,200	19,352	72,211

Figure 1 Tourism consumption by products



Tourism contribution to the regional economies is evaluated by the regional macroeconomic model and the regional tourism satellite accounts. It is estimated that tourism total contribution (including direct, indirect and induced effects) to national gross domestic product was 7.3 billion euro in 2006, which accounted for 4% of national GDP. Tourism created 126 000 jobs in Denmark, which accounted for 4.6% of total employment.

The Danish regional tourism satellite accounts (RTSA) have been set up since 2003 and it has been applied by the national tourism organisation both for estimating the tourism consumption at regional level and for evaluating the tourism economic contribution to the regions. RTSA development has followed the international standard presented in 'Tourism Satellite Account: Recommended Methodological Framework' (UNWTO, 2001, 2008). The definition for tourism according to the above document covering not only the 'leisure travel', but also business and other personal purpose, such as visiting families and friends, medical treatment and religious purposes.

Danish RTSA benefits from rather good data sources in Denmark, both from the regional production accounts and tourism survey data at regional level. The national accounting data provides the tourism consumption with detailed tourism-characteristic or non-tourist specific products, while regional production accounts and tourism survey data make it possible to break down the tourism consumption into regions.

The regional TSA is constructed based on the national accounts and regionalised national accounts data. These two sets of data can be merged in the way that creates regional tourism

satellite accounts. From supply perspective, the regional production accounts provide the detailed information of tourism products produced by sector by each municipality. From the demand perspective, tourism demand is estimated by the tourism survey data and national accounts data. Supply and demand at each product level is balanced and they are consistent with the national accounts.

4. The Danish National Environment Accounts and the Linkage between the Tourism and Environment Accounts

Statistics Denmark adopts NAMEA principle i.e. National Accounting Matrix including Environmental Accounts. It is able to provide cohesive and compact information on the economy, consumption of natural resources and pollution. The Danish environmental accounts are constructed as satellite accounts based on the input-output tables. This implies that all data in the environmental accounts on energy and environment are generally based on the definition and classifications used in the national accounts. Consequently, data on the environment and resources are strictly comparable with the national accounts and the input-output table. It is also possible to conduct on the basis of an input-output model detailed analysis of the relationships between the economy and the environment (Statistics Denmark, 2007; Olsen, 2007).

National greenhouse gas emissions

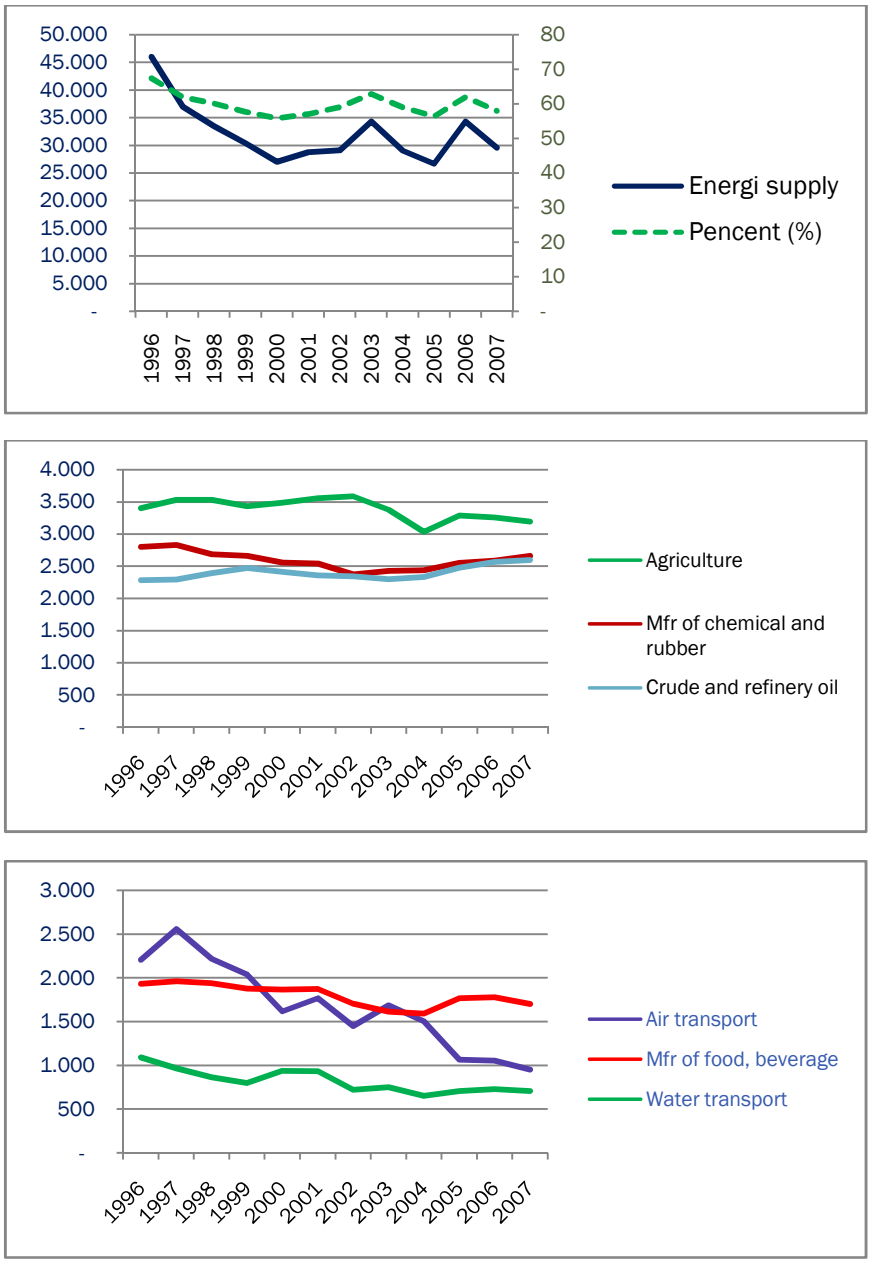
The national satellite accounts for air emission provide with 8 types emissions from industries and households. The 8 types of emissions are including such as CO_2, SO_2, N_2O, CO, CH, etc. (Statistics Denmark, 2007). The greenhouse gas emissions typically take three types of emissions into consideration, by transforming N_2O and CH into equivalent CO_2 emission unit with transforming factors. The air emission data are hence presented by GHG tons.

Figure 2 gives an overview of greenhouse gas emissions from industrial sectors. The selected sectors are presented here. Around 60% of the emissions come from energy supply, including electricity, gas, heating and water supply. The figure shows that the emissions from energy supply are decreasing, as it is shown the shares in the total emissions in Denmark. This sector accounted for 79% of total emissions in 1996; it was reduced to around 61-64% in recent years. Agriculture sector accounts for 6% of the emissions. Manufacturing sectors totally contributed around 10-12% of the emissions. The figure gives one major manufacturing sectors i.e. manufacturing of chemical products and rubber, in comparison with agriculture and crude oil and refinery oil sectors. It shows a quite stable trend in these three sectors, except that oil refinery has slightly increased from 3-4% to around 5% of the total emissions. Tourism sectors such as hotels and restaurants accounted for very small shares of the emissions. The figure shows that hotels accounted for 0.05% and restaurants accounted for 0.18% of the total emissions. Tourism closely related sectors, such as air

transport (2%), water transport (1.3%) and manufacturing of food and beverage (3%), accounted also for small shares of emissions.

Figure 2 Greenhouse gas emissions of intermediate consumption – main sectors

(In 1000 tons)



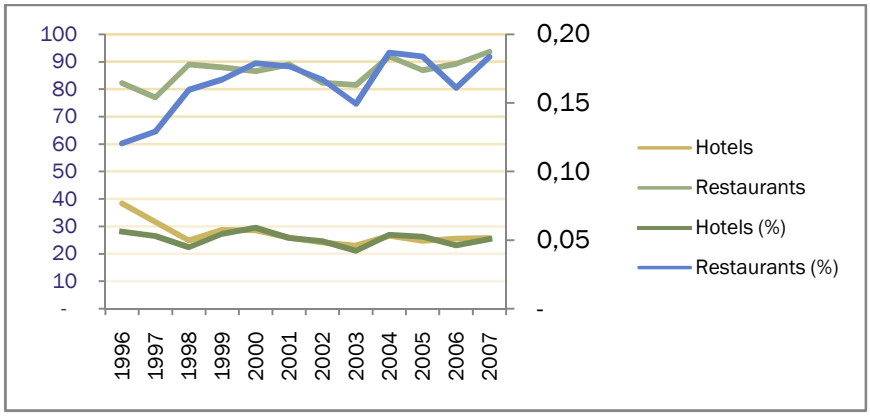
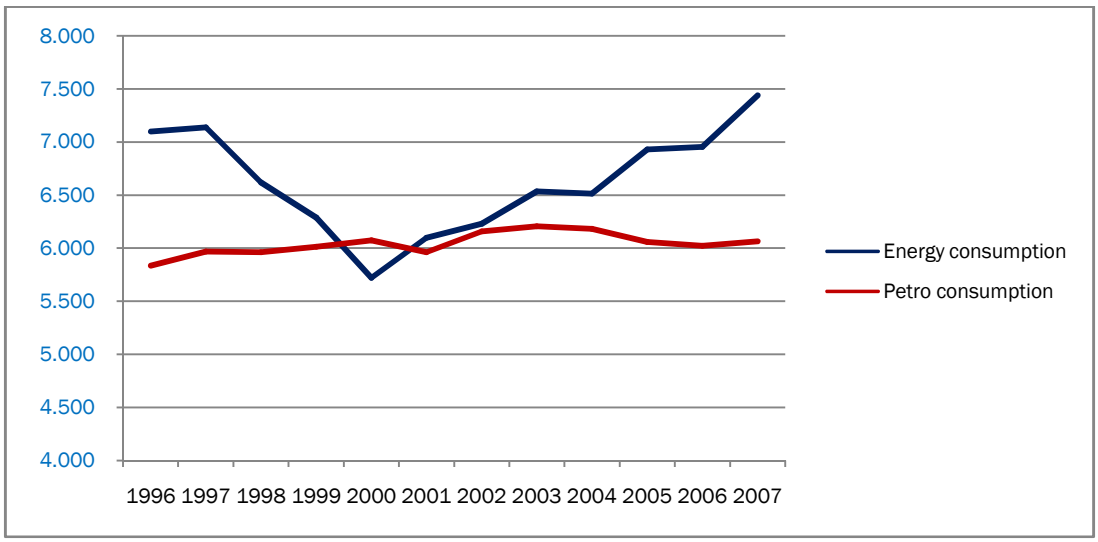


Figure 3 shows the trends in greenhouse gas emissions from private consumption. Two major consumption components in private consumption have direct linkage to greenhouse gas emissions. The figure shows that the emission from petroleum consumption is rather stable, around 6 million tons, while the emission from energy consumption decreased from 7000 million tons in 1996 to the lowest point at 5700 million tons in 2000, then it rises again from 2001-2007 with 3.9% of annually average growth rate.

Figure 3 Trends in greenhouse gas emissions from private consumption

(In 1000 tons)



Linking the two satellite accounts: tourism and environment

Tourism satellite accounts are made to be consistent with the national accounts. Inbound and domestic tourism consumption is a part of private consumption, while the domestic business tourism consumption is a part of intermediate consumption. TSA tables present the inbound and domestic tourism consumption by tourism characteristics, specific and non-specific products.

However, the industries who supply mainly to tourists and travellers are called tourism related sectors, such as hotels, restaurants, travel agencies and air transport, etc.

Environment account is also made within the national accounts and input-output system providing CO2 and other emissions by the industrial sectors or private consumption components. Therefore, the joining point must be the national accounts. It is also possible to link the two satellite accounts at regional level. Tourism satellite accounts are already regionalised; an important procedure here is to regionalise the national environment accounts.

It is assumed that the CO2 and other emissions are the same across the country by assuming all the regions using the same inputs for making electricity or other kinds of energy. In a long run perspective, when data is available, it will allow the regional differences in CO2 emission due to applying the different technologies (or inputs). It is also assumed that energy use by private household give the same CO2 and other emission across the regions.

The CO2 and other types of emissions are distinguished between the emissions from the intermediate consumption and from the private consumption. The emission released through the process of production by sectors that linked to the use of different kinds of energy in the intermediate consumption. The emissions released from the private consumption are linked to the consumption components by household.

From regionalised input-output tables, data are available for intermediate consumption by sector and municipalities. Private consumption data is also broken down into municipalities with consumption components. The national CO2 emission data is distributed into each municipality by applying the regionalised intermediate consumption and regionalised private consumption. In the other word, sizes of regional CO2 depend on the size of intermediate consumption and private consumption in each municipality.

Evaluating greenhouse gas emissions from tourism

To evaluate the tourism's contribution to emissions, we have to understand how tourism demand is related to greenhouse gas emission.

The diagram 1 in the appendix explains how tourism demand is related to greenhouse gas emissions. Tourism demand from the five types of tourism is the basis for the regional tourism satellite accounts. The demand is broken down into different tourism characteristic, specific or non-specific tourism products. These products are linked to the industrial suppliers, as a number of industries directly involve in supplying the products and services to tourists, such as hotels, restaurants and other catering businesses, different kinds of transport sectors, travel agencies, and tourist attractions and other cultural services. These industries must purchase raw materials and other services from other economic sectors in order to satisfy the tourists' needs. For example, hotels need to buy food from food processing businesses for preparing breakfast / dinner to their customers; they might also use external services for the laundry. Hotels certainly need electricity and other energy types for their operation. Transportation sectors require and other energy stuffs for

operation. This is so-called backward linkage – the intermediate inputs that are the causes for greenhouse gas emissions.

Tourism demand is also directly related to private consumption, for example tourists consumed electricity and other forms of energy in the rented (or self own) summer cottages. Tourists purchased gasoline at tank stations for motor vehicles. The Statistics Denmark estimated the consumption of gasoline and fuel by cars, which is compiled on the basis of the quantity of fuel sold in Denmark. This implies that purchase of gasoline and fuel in Denmark by foreign tourists is included by the statistics on the direct emissions. On the other hand, purchases of gasoline and fuel by Danish tourists in foreign countries are excluded from the statistics on emission (Statistics Denmark, 2007).

Evaluating tourism impact on environment through a regional economic modelling

Regional tourism impact analysis is carried out by the Danish interregional macroeconomic model, the LINE Model. The model has been applied in different practical projects in Denmark, including regional tourism analysis (Zhang, Madsen and Jensen-Butler, 2007; Madsen and Zhang, 2009).

LINE model is a general equilibrium type model, following a social accounting matrix (SAM) and the two-by-two-by-two principles. The interregional model allows a distinction between the regions as place of production, at place of residence and at place of demand (see diagram 2 in the appendix). SAM has given detailed accounts for the different matrices, for example, the make matrix has industrial sector with the commodity dimension; the use matrix such as intermediate consumption has both sectors and commodity and private consumption has consumption components and commodity. The production factor (i.e. labour market) has age, gender and education groups; and household has different household types.

The two-by-two-by-two-principle includes the following three basic dimensions in a local economy: First, two actors in the local economy - producers and households – can be identified. Second, two markets (a commodity market and a factor market) link the two actors together. Third, interaction between markets and actors involve information on origins and destinations of flows between actors and markets, such as trade, commuting, shopping and tourist flows, etc.

The quantity model corresponds to a demand driven Keynesian-type model and moves sequentially and clockwise as shown in the diagram. Starting in the upper left corner (Pj), production generates intermediate consumption demand and employment by sectors (j) at the place of production (P). The employment is transformed from sectors (j) to age, gender and educational groups (g) and from place of production (P) to place of residence (R) through a commuting model. Labour force at the place of residence (R) depends upon population and labour force participation rates by age, gender and education (g). Labour force and employment determine the unemployment by age, gender and education (g) at place of residence (R).

The starting point for regional tourism model is the tourism demand at place of demand. The foreign tourism demand originated from abroad is an exogenous demand, while domestic tourism is

taken as endogenous demand in the tourism model. Domestic tourism demand depends on household's disposable income. The initial changes in tourism demand give a rise/fall for the tourism products in the commodity market. The demand at tourism destination will be satisfied by the local supplier, imports from other regions, and imports from abroad. Through a trade model exports abroad and to other regions and production for the region itself is determined. Gross output by commodity is determined by this demand. Through a reverse make matrix the model circle returns to production by sector at place of production.

In the second round, the production at place of production (increase or decrease) will influence demand both for the intermediate consumption and employment. The increase/decrease in employment will give rise/fall for the disposable income at households. The household income will influence private consumption, both the local private consumption and domestic tourism consumption. This will continue give changes in each of links through shopping/tourism model and trade model back to the place of production.

The environmental impact is calculated by the environment coefficients directly linked to both the intermediate consumption and private consumption by the regions. The direct effects are the products of environment coefficients multiplying with the changes in intermediate consumption and private consumption at the first round; while the total effects are the results of adding all the changes in each of model iterations on environment, in the other word, the total effects are adding up direct, indirect and induced effects together.

5. Tourism impacts on greenhouse gas emissions

Tourism impact analysis on greenhouse gas emissions is carried out by the Danish interregional macroeconomic model LINE. The model results provide many variables including the GHG emissions and the economic variables like gross output, employment and gross value added. The calculations are made by each type of tourism, i.e. foreign same-day visitors, foreign overnight tourists, domestic same-day leisure visitors, domestic leisure overnight tourists, and domestic business travellers. It has made two calculations for each type of tourism expenditure, i.e. the direct effects and total effects by setting the modelling to conduct a single iteration and ten iterations.

This section presents the results from the modelling. Firstly, it presents the tourism direct and total impacts on greenhouse gas emissions by the five types of tourism. Secondly, it compares the tourism impact on GHG emissions with its impacts on the economies. The GHG emissions caused by tourism consumption are also compared with emission caused by other final demand. Finally the results from the two scenarios' analysis are shown in order to see the effects from the different consumption groups.

Tourism's direct and total impacts on greenhouse gas emissions

Table 2 gives a summary report from the scenario analysis for the five types of tourism through intermediate consumption. Greenhouse gas emissions directly caused by tourism consumption within the Danish territory is estimated to be 775 thousand tonnes, which is accounted for 1.5% of total emissions in Denmark. The direct, indirect and induced effects (i.e. total effects) caused by tourism is estimated to be 2,653 thousand tonnes, which is accounted to nearly 5% of national total emissions. The total effects are 3.4 times of direct effects. Table 2 also shows GHG emissions by sector. The sector for energy supply, including electricity, gas, fuel and hot water supply is accounted a half of the total GHG emissions. It is followed by transport, food and crude and refinery oil sectors.

Table 2 Tourism impact on greenhouse gas emissions through intermediate consumption

(GHG emission in 1000 tonnes)

Sectors	Direct effects	(%)	Total effects	(%)	Total as % of direct
Accommodation	21.9	2.8	22.7	0.9	3.4
Restaurant	20.5	2.6	22.3	0.8	9.2
Local transport	111.8	14.4	190.0	7.2	69.9
Water transport	8.5	1.1	13.4	0.5	58.4
Air transport	107.3	13.8	160.0	6.0	49.1
Travel services	19.2	2.5	25.5	1.0	32.7
Culture services	6.4	0.8	13.9	0.5	117.1
Agriculture and food	40.9	5.3	345.8	13.0	744.7
Manufacture	10.6	1.4	183.9	6.9	1,641.4
Crude and refinery oil	17.1	2.2	189.1	7.1	1,007.5
Energy supply	367.3	47.4	1,392.5	52.5	279.1
Others	7.3	0.9	44.8	1.7	513.8
Trade margins	36.4	4.7	49.3	1.9	35.4
Total:	775.2	100.0	2,653.3	100.0	242.2

Table 3 shows a summary report from the scenario analysis for the five types of tourism through private consumption. Greenhouse gas emissions caused by tourism consumption through private consumption is estimated to be 1,768 and 1,815 thousand tonnes from the direct and total effects respectively. They are accounted for 13.7% and 14.1% of national total greenhouse emission. In comparison with the GHG emission via intermediate consumption, the GHG emissions via private consumption between the direct and total effects do not show much difference. The reason is that the private consumption is a part of final demand; it will not give further multiplier effects like the intermediate consumption. Two major tourist consumption groups directly connected to GHG emissions via private consumption are energy consumption and gasoline consumption by tourists for their vehicles. Energy consumption is connected with the tourists' energy consumption in the summer cottages and holiday apartments. From table 3, it can be seen that 93% of GHG emissions is caused by the consumption on gasoline.

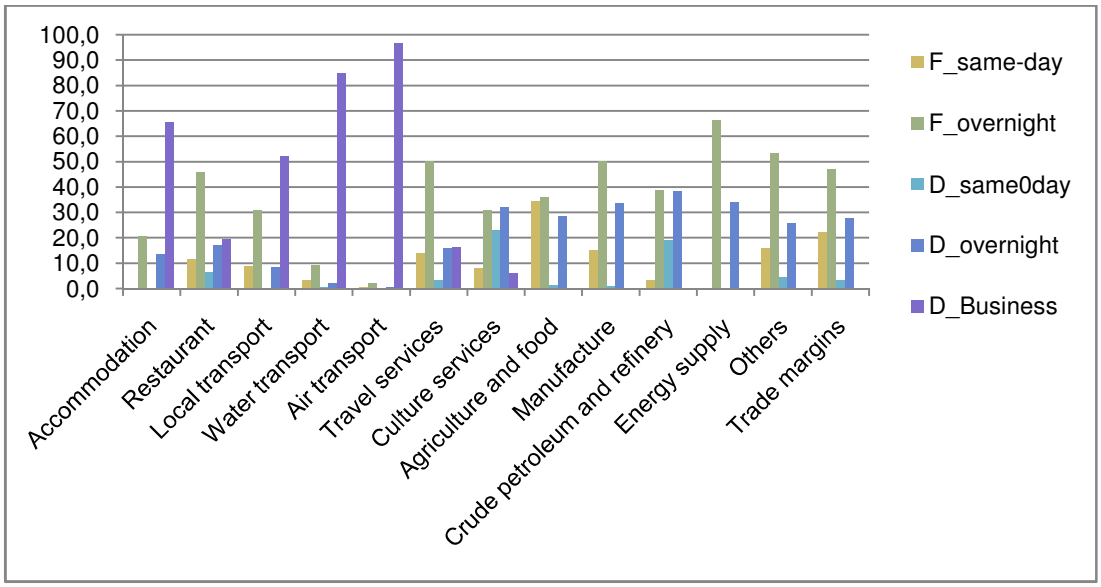
Table 3 Tourism impact on greenhouse gas emissions through private consumption

(GHG emissions in 1000 tonnes)

Components	Direct effects	(%)	Total effects	(%)	Total as % of direct
Electricity and fuel	111.9	6.3	139.5	7.7	24.7
Gasoline to vehicles	1 656,5	93.7	1,675.7	92.3	1.2
Total	1 768,4	100.0	1,815.2	100.0	2.6

Figure 4 shows the greenhouse gas emissions generated by different sectors from the five types of tourism. As shown, the transport sectors, such as air transport and water transport, and accommodation sector are dominated by the domestic business tourism. This is due to the fact that tourism consumption on international airport transport is not included in the Danish tourism satellite accounts and also the global effects of the greenhouse gas emissions are not included in this analysis. Looking at other economic sectors, the GHG emissions in energy supply, crude petroleum, and as well as shopping of food and manufacturing goods are contributed most by foreign and domestic overnights tourism.

Figure 4 Greenhouse gas emissions by sector generated by tourism types (%)



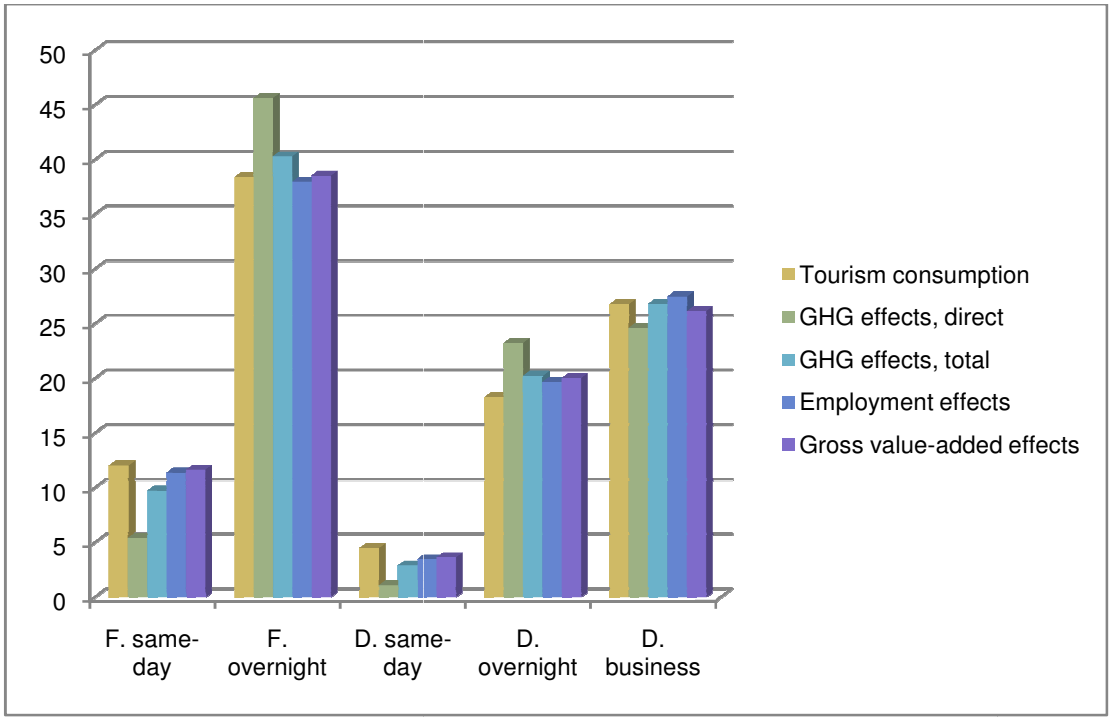
Comparing the tourism contribution on greenhouse gas emissions with its contribution on economies

Tourism consumption in Denmark is accounted for 1.9% of gross output and gross value added (GVA). By using the regional macroeconomic model, we obtained the tourism impacts with both direct and indirect/induced effects on the regional economies. It is estimated that amount of 54.6 billion DKK in gross value-added was generated by tourism

in 2006, which is accounted for 3.9% of total GVA. Approximately 75 000 jobs were directly created by tourism demand and 126 900 jobs are created if it is including tourism's direct, indirect and induced effects on the economies. Tourism total employment creation is accounted for 4.6% of total employment in Denmark.

It is interesting to compare the tourism contribution to the economies and to GHG emissions by different types of tourism. Figure 5 presents the five key variables, i.e. tourism consumption, GHG emissions by direct effect, GHG emissions by total effect, the total employment effects and the total gross value-added effects. The foreign tourism consumption (both the same-day visitors and overnight tourists) accounted for a half of total tourism consumption, hence, it also accounted for a half of contribution to the GHG emissions and employment. Among the five types of tourism, foreign overnight tourism accounted for about 40% of these five variables, while domestic business tourism accounted for 27% and domestic leisure overnight tourism accounted for 20% of total tourism consumption and also the contribution to the GHG emissions and to the economies. The figure shows that these five variables are highly related with each other.

Figure 5 Tourism contributions to the economy and GHG emissions by tourism types (%)



Comparing the GHG emissions caused by tourism with emission caused by other final demand

Another way for comparing the results is to calculate the greenhouse gas emissions per million Danish kroner of tourism consumption. The results can be directly compared with the greenhouse gas emission from other final demand. Table 4 shows the GHG emissions by one million DKK of tourism consumption. The table is the results from the calculation from the table 1, 2 and 3.

From table 4, it shows that every million DKK of tourism consumption directly gives 35 tons of GHG emissions on average basis. In the column of the total effects, every million DKK of tourism consumption gives 62 tons of GHG emissions. The column presents also GHG emissions at each categories of consumption. The GHG emissions are the highest in the energy consumption; it is followed by the consumption on gasoline and other fuels.

Table 4 Greenhouse gas emissions per million DKK of tourism consumption

(In tons)

	Direct effects	Total effects
Hotels	1.9	1.9
Restaurants	2.3	2.5
Transport	20.2	32.3
Travel services	3.4	4.5
Culture and recreation	2.0	4.3
Gasoline and other fuels	297.7	331.7
Energy	602.7	1,926.8
Food, drinks and tobacco	4.2	35.9
Other products	3.4	43.4
Other services	3.6	4.9
SUM:	35.2	61.9

The greenhouse gas emission created by tourism can be compared with the results from other final demand. Table 5 shows the direct and direct plus indirect CO2 emissions generated by some consumption components of final demand. The table shows, for example, that one million DKK of consumption on food gives 31 tons of CO2 emission, on accommodation gives 22 tons. Electricity, gas and other fuels give 523 tons and transport service in general gives 88 tons. In comparison, tourism has mixed consumption components, it creates 62 tons seems to be reasonable.

Table 5 Direct and indirect CO2 emission effects by final users

(In ton by a million DKK of consumption)

Consumption categories	Direct	Direct and Indirect
Food		31
Beverage and tobacco		15
Clothing and footwear		11
Electricity, gas and other fuels	184	523
Fuels and lubricant	357	372
Transport service		88
Recreation and culture		18
Catering		25
Accommodation		22
Tourism*	35	62

Note: data source is Statistics Denmark (2005): Danish Input-Output Table and Analysis 2005.

* Tourism data is from above Table 4 in GHG measurement.

Results from two scenario analysis

In order to compare the GHG emissions by different tourist groups, especially, to evaluate which groups of tourists give relative higher emissions, we have carried out two scenario analyses.

Table 6 Compare the two scenarios: Hotel leisure tourism and summer cottage tourism

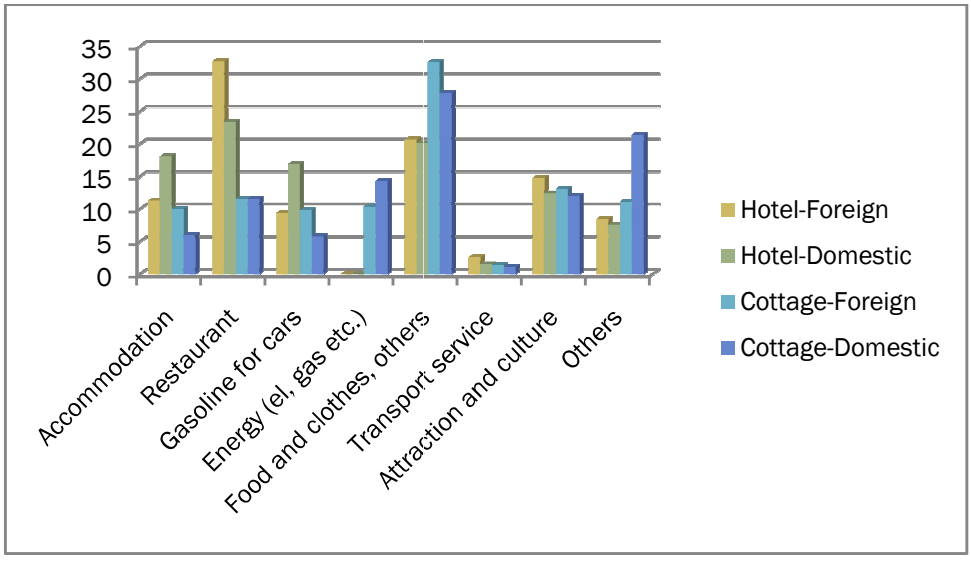
	Hotel leisure	summer cottage
Number of nights (1000)	5,384	17,843
Tourism revenue (mil. DKK)	5,662	7,529
Daily consumption (DKK)	1,052	422
Job creation per million DKK:		
Direct	1.48	1
Total	2.45	1.79
Gross value added per million DKK:		
Direct	0.48	0.45
Total	0.98	0.86
Total CO2 emission:		
Direct (tonnes)	304,776	367,071
Total (tonnes)	309,129	371,826
CO2 emission per million DKK:		
Direct (tonnes)	60.4	90.9
Total (tonnes)	95.1	118.2

One scenario is to implement the analysis on closing down hotel leisure tourism, both inbound and domestic tourism. Another scenario is to close down the summer cottage tourism, also both inbound and domestic tourism.

The results are presented in Table 6. The number of nights by hotel leisure tourists is 5.38 million, while the number of night stays by summer cottage tourists is 17.84 million, which is more than three times of the former. Tourism revenue from hotel leisure tourists is 5.66 billion DKK, while the revenue generated from summer cottage tourists is 7.53 billion DKK. This is only the 1.3 times of the revenue by hotel leisure tourists. The reason is that the daily consumption of summer cottage tourists is much lower than the daily consumption of hotel tourists. The comparison of economic impacts between the two types of tourists is seen from the job and income creation per million tourism revenue. The table shows that per million DKK of tourism revenue from the hotel leisure tourists created directly 1.48 jobs, while the summer cottage tourists created one job. The total impact can be seen that the hotel tourists give 2.45 jobs, while the summer cottage tourists give 1.79 jobs per million DKK of consumption. The income generation by million DKK consumption shows that hotels give slightly higher than the summer cottage tourists.

Evaluating the contribution to CO2 emissions, it can be seen that summer cottage tourists give more CO2 than the hotel tourists. The summer cottage tourists generated 91 tons of CO2 emissions per million DKK of tourist consumption, while the hotel tourists generated 60.4 tons in the direct effects. In the total effects, the summer cottage tourists generated 118.2 tons of CO2 emissions per million DKK of tourist consumption, while the hotel tourists generated 95.1 tons. The explanation for the summer cottage tourists give more CO2 than the hotel tourists is that summer cottage tourists consumed more energy than the hotel tourists. The consumption of gasoline by summer cottage tourists is also relatively intensive than the hotel tourists. The consumption of energy give more CO2 emission than the consumption on hotel rooms and restaurants.

Figure 6 Percentage of GHG emissions in consumption groups by four types of tourism



The scenario analysis provides the results not as we expected. We expect the hotel tourists who are normally the high spending groups contribute more CO2 emissions than other groups of tourists. The scenario results showed that consumption from the summer cottage tourists gives more emissions than the hotel tourists. The explanation is that patterns of consumption components influence the CO2 emissions. In case of tourists consumed more energy-intensive products and services, such as electricity, hot water and gasoline, they will generate more CO2 emission than they consumed other products.

6. Conclusion

The paper presents the data from both regional tourism accounts and the national environment accounts. The main topic of the paper is the methodology of constructing the regional environment accounts and evaluating the tourism impacts on environment. It is also needed to make a linkage between the tourism satellite accounts and environmental accounts. As shown in section 4, the join point for two accounts is the national accounts as both accounts are connected to the national accounts. It is required to regionalize both tourism satellite accounts and environment satellite accounts. The regional tourism satellite accounts have already been implemented in Denmark. This paper presents the method for constructing regionalizing the environment accounts. The national CO2 emission data is distributed into each municipality by applying the regionalised intermediate consumption and regionalised private consumption. In the other word, magnitudes of regional CO2 emissions depend on the sizes of intermediate consumption and private consumption in each municipality.

The Danish interregional macroeconomic model provides a modelling framework for both regional tourism accounts and the regional environmental accounts. The modeling results provide both direct and total impacts of the tourism demand on GHG emissions. Tourism demand in Denmark accounts for approximately 2% of output and 10% of private consumption. The analysis shows that tourism direct impact on the emissions through production accounts for 1.5% of national emission; while the total tourism impact on the emissions rises to 5% of the national total. The tourism contribution to the emissions through private consumption is around 14% of national total emission.

The results from tourism impacts on environment are also presented by the CO2 emission by million DKK of tourism consumption. We found that per million DKK of tourism consumption gives 62 tons of the emissions. In comparison with results from the national input-output model, the national results shows that per million DKK of consumption from the final demand on accommodation gives 22 tons of the emissions and on restaurants gives 25 tons of the emissions.

The paper also presents the results from two scenario analyses. The conclusion from the scenario analysis draws an attention to the tourist consumption patterns. When a group of tourists tends to consume more energy intensive products, the tourist consumption will release more CO2 emissions.

With regards to tourism policy aspects, we make suggestions into two considerations: 1) we should put tourism marketing on the tourist groups that are more CO2 neutral than the high CO2 emission tourist groups. This is in consideration of which groups of tourists are more preferable to other groups. 2) Tourism policy maybe should put more attentions on the green destination development. For example, government regulations are made in the way to encourage the local community for further developing the CO2 neutral energy provider and a better energy environment, such as using a wind miller as energy suppliers and widely application of electrical cars.

The limitation of this study is that we assumed the same CO2 coefficients across the regions. In the absence of detailed information of regional CO2 emissions by industry, this is the best way to assume that all the regions use the same inputs for making electricity or other kinds of energy. When data is available, it is possible to improve the regional environment accounts. Another limitation is that more investigation is needed to concentrate on tourism branches, especially for the tourist attractions and other tourism intensive branches. For example, it is required to conduct a survey for the main tourist attractions (like Tivoli, Legoland and Lalandia, etc.) to obtain detailed information of energy consumption of businesses. It is suggested from this study that the regional environment accounts should be applied to evaluate the tourism destinations and make a benchmarking for the municipalities. The environmental impact concerns not only the tourism consumption, it is also a general question of which source of energy the industries apply for their inputs to the production and what sources of energy private households use in their daily lives. Finally, we like to draw attention to the fact that environment issue is a global issue; pollution does not only affect one country, it has global effects on the world environment. In the long run, the global factors of CO2 and other emissions should also be added to the analysis.

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Appendix:

Diagram 1 for linking regional tourism satellite accounts and regional environment accounts and evaluating greenhouse gas emissions from tourism

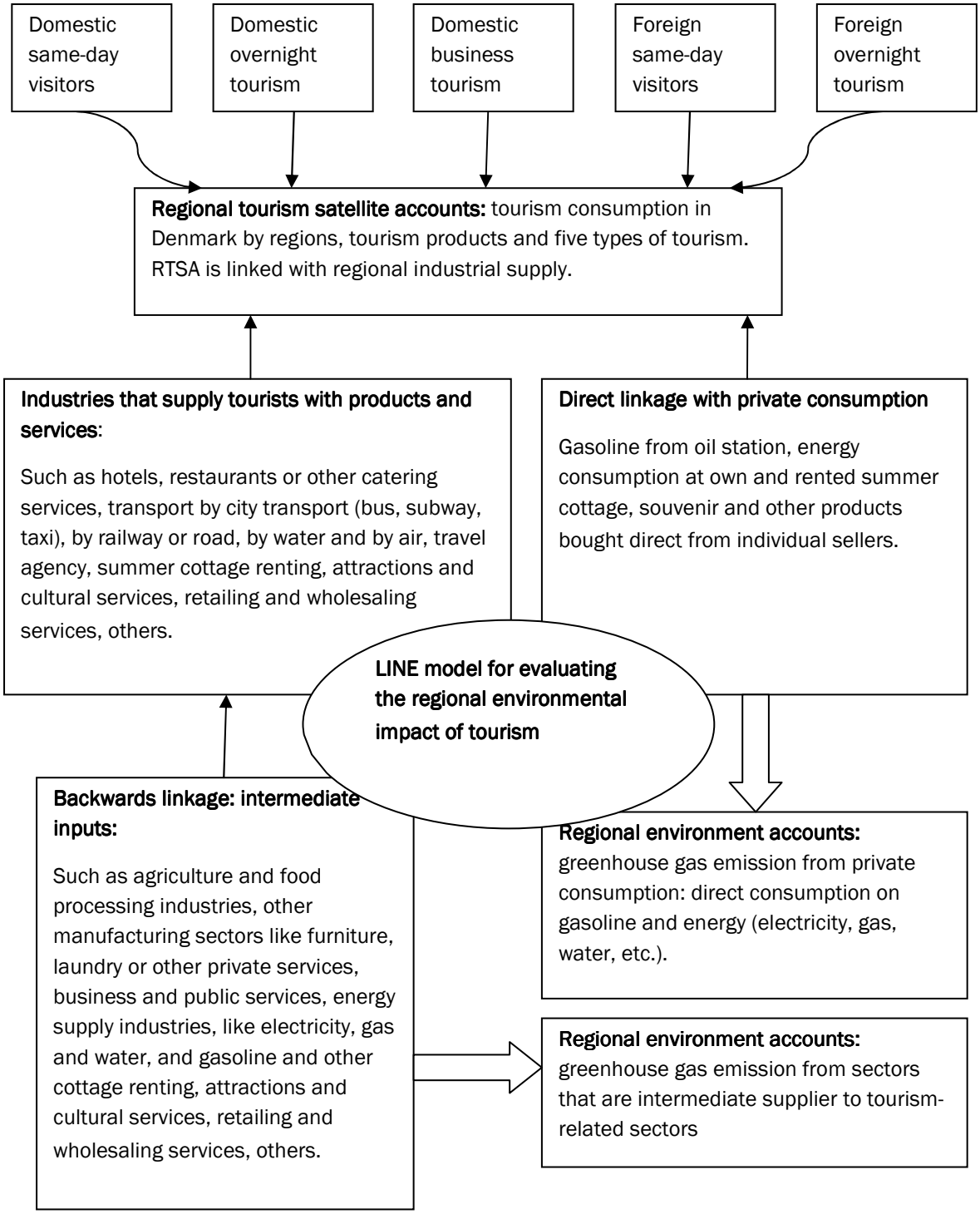

Diagram 2 the presentation of LINE model