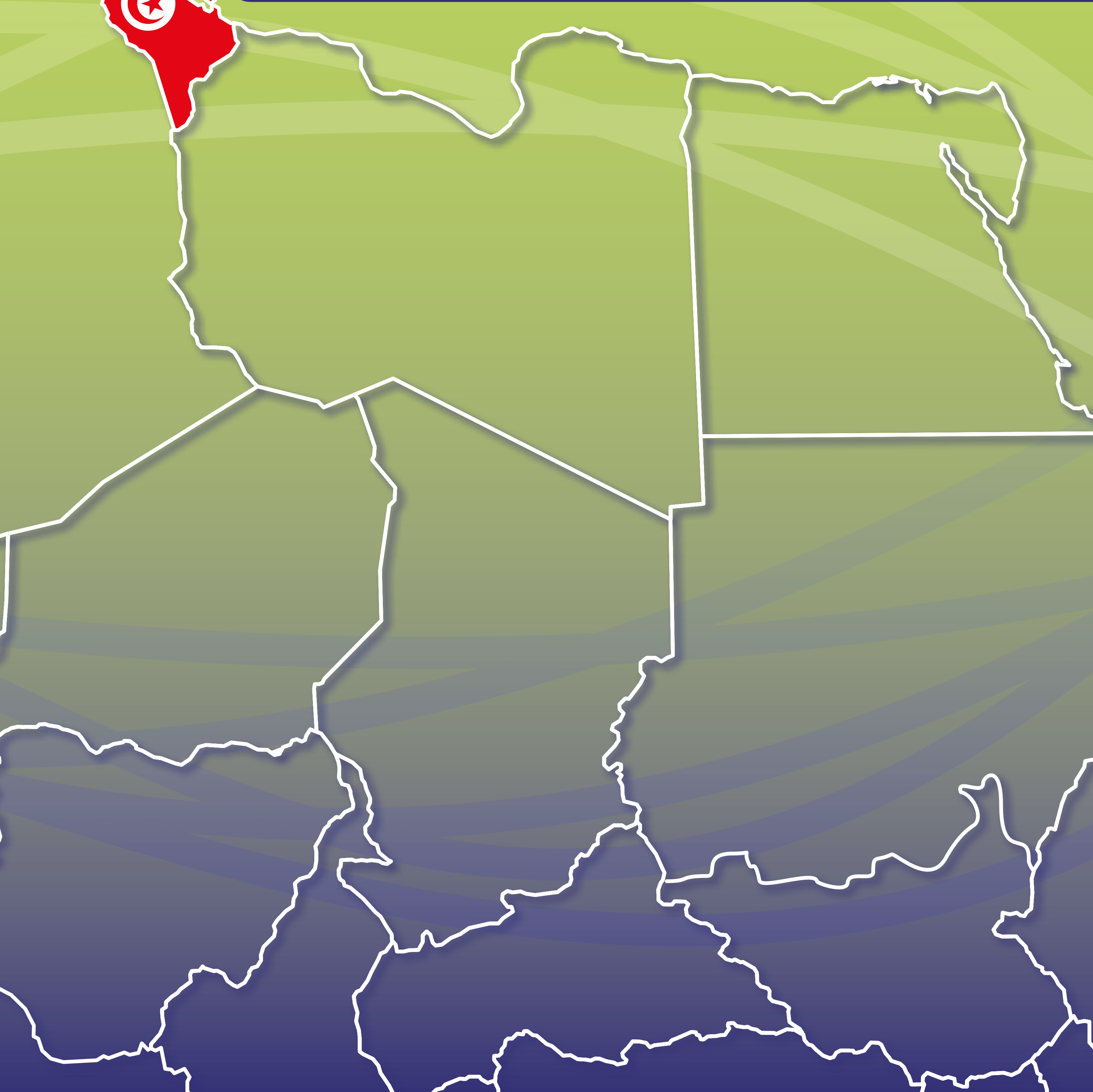
THE GREEN JOBS PROGRAMME

GWS SPECIALISTS IN EMPIRICAL ECONOMIC RESEARCH

International Labour Organization

Green Jobs in Tunisia

Measuring Methods and Model Results



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Background

1

Degradation of the environment, including the pollution of water, soil and air, irreversible loss of biodiversity and depletion of natural resources are global threats to sustainable development. These threats are aggravated by the impact of climate change, which is already being experienced in many developing countries, and have led to calls to make the ways in which we produce, work and travel more compatible with the ecological limits and boundaries of our planet. On the social level, the challenges of widespread unemployment, especially among young people, and the issues of people's inclusion and participation in a better, healthier and safer life seem equally unresolved in large parts of the world. In discussions on the Green Economy,[1] suggestions were made during the RIO+20 conference on how these challenges can be addressed by adopting a harmonized approach.

These suggestions are now being translated into practice[2]. This process requires new data and indicators: firstly, to identify the more pressing needs; secondly, to measure the success of the respective policies, legislation and support mechanisms. To identify progress, a rigorous framework of evaluation has to be established, based on a set of indicators that can be regularly updated. Green employment is an important indicator of the successful transition to a green economy. Analysis of the status of green and decent employment, and of the potential for the future creation of green and decent jobs, is therefore a necessary first step on the pathway to a green economy.

Against this background, the International Labour Organization (ILO) is supporting a series of studies in an attempt to develop a method for the measurement of green and decent employment (the ILO Green Jobs Initiative). This report contributes to the series in two ways: a) methodologically, by proposing rules for constructing a tool to measure direct and indirect jobs resulting from the green transition; and b) by presenting a quantitative analysis based on a case study of Tunisia. The quantitative analysis includes an ex-post evaluation and a simulation model for different future scenarios for green jobs.

The method developed in the study is based upon established economic theory and an established economic tool for analysing structural change. Input-output analysis (IOA), as it is known, is based upon a matrix or table which connects the activities of all industries in an economy within a consistent framework and allow deep insights into the interdependence of all economic sectors. However, industries involved in the green transition produce new goods in new ways, or through new combinations of already existing industries. They often cut across established categories. Existing input-output tables (IOTs) therefore need to be adjusted to these new challenges. Applying Input-Output (IO) analysis opens up the possibility not only of considering direct jobs, but also of tracking employment impacts deeper into the economy and calculating

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[1] *UNEP, 2011, Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication,* www.unep.org/greeneconomy

[2] *For an overview of the UNEP follow-up activities see* http://www.unep.org/greeneconomy/Home/tabid/104269/language/en-US/Default.aspx

indirect jobs. For the analysis of future developments under different scenarios, IO tables are used to forecast future demand with the help of projections of GDP and population growth. Differing uptakes of green products are also allowed for in the demand equations. The result is a macro-driven, IO-based model which serves to estimate employment impacts from greening under different assumptions. The model is called e3.tn and is part of a series of models developed by GWS, a German-based economic research institute which aims to estimate the economic impacts of environmental and green-energy policies. Models have also been created for Austria (e3.at), Russia (e3.ru) and Israel (e3.il). To go even further and take into consideration jobs induced by additional income would require a full economic model with all the economic linkages and interdependences. An analysis of induced effects is not included in the present exercise.

Tunisia, the case study country, has undergone tremendous social and economic changes in the last five years, since the revolution of 14 January 2011. The targets of the transition to a green economy overlap with some of the most pressing economic, environmental and social needs and challenges the country is facing. Tunisia is very much aware of future environmental challenges and has already responded to some of them through legislation and institution building. Tunisia has already made institutional and legislative progress in transforming its energy system (cf. GIZ 2013, GIZ/Alcor 2010). In other environmental fields, new legislation is still being discussed.

In summary, this report answers the following questions

1. where methods are concerned:
   - Can input-output analysis be applied, and IO tables be extended in a consistent way, to create a tool for measuring green jobs?
   - What are the necessary steps towards this goal and what are the data needs?
2. and regarding the Tunisian economy:
   - How many people currently work in green sectors?
   - How many people will work in green sectors under different assumptions for future greening of the Tunisian economy?
   - Are these decent jobs? What about the informal sector?

The report is organized as follows. After this introduction, Chapter 2 is concerned with developing our approach to the work. Chapter 3 elaborates on the identification of green sectors and their production structures. Chapter 4 analyses green jobs in Tunisia ex-post. Chapter 5 describes the model and simulations of future development. Chapter 6 presents our conclusions.

The results of the analysis are exploratory from several perspectives. Firstly, Tunisia is still in transition and the process which began in 2011 is far from finished. The sectors identified as green by stakeholders may be far from comprehensive, but reflect the current expectation of experts for the economic development of the country.

Secondly, the model developed is a simple macro-driven simulation tool. Its strength is the IO core, taking into account not only Tunisian statistics but also technological information on renewable energy and energy efficiency deriving from earlier works (GIZ 2013). The tool is not, however, effective for analysing the effects of price mechanisms and other economic incentives. For this type of net analysis, a full economic model is needed.

Thirdly, the current transition phase in Tunisia has led to an increase in informal labour, which is not typical of the country. All stakeholders therefore tacitly assume that, once the country is on a more stable track, the programmes formally established by the public institutions in charge of managing, for example, the waste sector will lead to decent working conditions.

With these caveats stated, the results of the study are quite encouraging. In 2010, there were almost 110,000 green jobs. This figure declined in 2011 due to the recession that followed the revolution but, according to the latest estimates, has slowly increased again to around 120,000. Assuming massive investment, 8,000 additional people will find work in the waste sector; developments in green energy and energy efficiency can create up to 30,000 additional jobs; and organic agriculture may provide 40,000 additional job opportunities. Taking indirect effects into consideration, a green strategy should yield 272,000 green jobs in Tunisia by 2030. In the remainder of this report, we will show how these figures were arrived at and what assumptions have been crucial.

Methodology – IO analysis and modelling

2

Who has a green job? In an environmental economics framework, anybody whose work improves environmental quality, reduces pollution, increases resource efficiency and protects the ecosystem. Green jobs are jobs directly related to a green activity.

However, if the world wants to achieve greater sustainability and bring about a "green" economy, it is also interesting to ask: How many jobs will result from this process? The answer to this question includes all those who work at some point in the value chain of a green production process or service. It reflects the economic impact of the transition to a green economy.

How can we measure these green jobs? The procedure suggested in the following paper consists of four steps:

1. To estimate existing green jobs:

   a. Identify the "greenness" of each economic sector;

   b. Calculate green employment in each sector, i.e. calculate the number of direct green jobs;

   c. Employ an established economic calculation tool (input-output table, IOT) to estimate indirect jobs for each economic activity. For this it is necessary to:

      i. Construct an IOT which distinguishes between green and non-green activities;

      ii. Maintain consistency with the original IOT;

      iii. Apply the new IOT to the original employment vector.

2. To estimate future green jobs: create a simulation model based upon time series of IOT and macro-economic drivers, such as population and GDP.

The first three steps help to solve the green jobs *identification* problem: green employment is identified using statistical data.

The model referred to in step 4 solves the forecasting problem and makes it possible to estimate green employment under different assumptions about future development. The simulation model is based on earlier research work on the economic effects of the Tunisian Solar Plan (GIZ 2013). The model is called e3.tn (Economy, Environment, and Energy in Tunisia). It comprises Tunisian IO tables extended to capture the effects of increased energy efficiency and additional investment in renewable energy systems. The latter can be understood, at least for the electricity generating systems, as a greening of the electricity sector.

The remainder of this chapter focuses on the construction of a green IO table. It explains the principles and illustrates the method of construction using a numerical three-sector example. The simulation model will be explained in Chapter 4.

2.1 IO tables and IO analysis

According to the findings of the Interagency[3] Workshop on Employment and Social Inclusion in a Green Economy (ITC 2013), input-output (IO) analysis (together with SAM-based modelling) can be "*used to estimate the effects on employment resulting from the increase in final demand for the product or service in a given green industry by estimating direct, indirect and induced jobs. Thus, the model can be used to answer questions such as "How many jobs may result from a given program of investment in sustainable economic areas?" or "For a given level of investment, which sector or sectors would yield the greatest number of jobs?"* (ITC 2013).

Economic sectors produce goods and services for other sectors and for final consumption and, at the same time, use other goods and services to be able to produce their own goods and services. The idea of grouping these kinds of input-output flows in a systematic and symmetric table goes back to Wassily Leontief, who was awarded the Nobel Prize for Economics for his work in this field in 1923. Input-output tables provide information about the production and consumption of intermediate and final goods, and reveal the cost structure of each economic sector. They capture the circulation of products within an economy over a given period, condense the complexity of economic action with all its effects, counter-effects, actions and re-actions, and make it possible to distinguish between the direct and indirect dependences of and between economic agents. Figure 1 illustrates the basic input-output table.

[3] The Partnership for Action on Green Economy, or PAGE, is a response to the outcome document of the United Nations Conference on Sustainable Development (Rio+20), entitled "**The Future We Want"**, which recognizes the green economy as a vehicle for sustainable development and poverty eradication. Four UN agencies (the United Nations Environment Programme (UNEP), the International Labour Organization (ILO), the United Nations Industrial Development Organization (UNIDO) and the United Nations Institute for Training and Research (UNITAR)) participate in this partnership.

■ **Figure 1: Schematic presentation of an IO table**

Demand		Intermediate Demand				Final demand				
Supply		Agriculture	Manufacturing	Services	Total	Household consumption	Fixed capital formation	Increase in stocks	Exports	Production
Intermediate input	Agriculture	IO matrix								
	Manifacturing									
	Services									
	Total									
Value added	Wages									
	Profit									
	Depreciation									
	Indirect taxes									
	Subsidies									
	Sum									
Production										

Source: own design, following Eurostat EU 27 IO.

The rows show the demand for product i, which is needed for the production process of another product j and as a final product for consumption. For instance, agriculture supplies agricultural goods to agriculture in the form of seeds, fodder or fertilizer. It further supplies agricultural products to the food industry or to the energy sector in the form of inputs to bio-energy. Agricultural products are also used directly by private households or are produced for export. The sum of demand for intermediate inputs plus final demand equals final production.

The columns represent the cost structures of production and services: each production sector j needs a different combination of inputs to be able to produce. Again, taking agriculture as an example, the column denotes the inputs from different sectors, such as the energy sector, the chemical industry (fertilizers), the automotive industry (trucks and tractors) and agriculture (seeds and manure), which are necessary for agricultural production. Adding in primary inputs, such as the costs of depreciation, labour and taxes, results in total production by sector. One important feature of this table is that the sums entered in the rows equal the sums in the columns. This feature has to be maintained no matter how the table is manipulated.

2.2 Including green activities in the IO table

When using the IO approach to analyse green jobs, we need to be able to incorporate green activities into this framework. Each economic sector depicted in the IO table potentially has a green part and a non-green part. The result of the analytics described in the following section will be an IO table with twice as many rows and columns as before, each sector being split into a green and a non-green part.

To achieve this, two challenges have to be met:

- The consistency challenge: the economic activities described using the new framework have to yield the same framework data in terms of total production and total employment. The modifications to the scheme concern only activities under the different headings.

- The data challenge: manipulation of the IO table must be data-based. If it cannot be based upon data, axiomatic rules have to be formulated to keep the framework consistent.

For illustration purposes, let us continue with the IO table and give a numerical example, focusing solely on the three sectors of agriculture, manufacturing and services. The numbers are chosen arbitrarily.

Figure 2: Numerical example: IO table with 3 sectors

		Intermediate demand					
		Agriculture	Manufacturing	Services	Total	Final demand	Production
Intermediate Input	Agriculture	10	5	5	20	20	40
	Manufacturing	5	10	2	17	10	27
	Services	5	2	15	22	19	41
	Total	20	17	22	59	49	108
Value added		20	10	19			
Production		40	27	41			

Source: Own graph.

Reading along the rows in Figure 2 yields the following interpretation: agriculture delivers ten units to itself (seeds, manure and feedstock), five units to the manufacturing sector (e.g. the food industry) and five units to services, for instance restaurants and shops. Consumers demand a total of 20 units of agricultural products, so total production amounts to 40 units, the sum total of intermediate and final demand. Manufacturing sells five units to agriculture (tractors and fertilizers), ten units are needed for different manufacturing processes, while services consume two units of manufactured goods (computers, printers etc.), which results in total production of 27 units, including final demand.

Reading the above table along the columns tells us that, for the production of 40 units of agricultural goods, 10 units are needed from agriculture, five units from manufacturing industry and five units from services. Selling the 40 units to consumers and other sectors enables the agricultural producer to buy the necessary inputs, pay employees' wages, pay taxes and make a profit (20 units of value added).

To explicitly identify green activities, each sector needs to be split into two subsectors, a green part and a non-green part. However, total production has to remain the same as before, because we are still describing the same economy, while trying to identify the parts that are green.

Figure 3 takes our example a stage further, showing how to split agriculture into conventional agriculture and organic farming. Let the share of organic agriculture be one fifth. Organic production then contributes eights units to the total of 40 units for agriculture. All the structures in Figure 3 are the same as before: conventional agriculture supplies 25% to itself, 12.5% to manufacturing and 12.5% to services, while final demand consumes half of the sector's output. The same holds true for organic agriculture. Reading along the columns, the cost structures are the same as before: both agricultural sectors record 50% value added and 50% costs; both get half of their inputs from agriculture and the rest from manufacturing and services in equal shares.

Figure 3: IO table expanded for agriculture, simplified version

	Demand	Intermediate Demand						
Supply		Conventional agriculture	Organic agriculture	Manufacturing	Services	Total	Final demand	Production
Intermediate Input	Conventional agriculture	8	0	4	4	16	16	32
	Organic agriculture	0	2	1	1	4	4	8
	Manufacturing	4	1	10	2	17	10	27
	Services	4	1	2	15	22	19	41
	Total	16	4	17	22	59	49	108
	value added	16	4	10	19	50		
Production		32	8	27	41	0		

Source: own calculation

The intra-sector entry on the diagonal of the IO matrix requires special thought, as it often contains the largest entries. Intra-industry transfers are very important for most industries. Agriculture, our example sector, needs a lot of agricultural inputs and the agriculture-to-agriculture entry in the above tables (a total of ten units) comprises all the inputs from the agriculture sector needed to produce agricultural products. Typical examples are seeds, seedlings, manure and unprocessed fodder. By splitting the sector into two parts, organic and conventional, the diagonal element becomes a two-by-two matrix, showing the supply of conventional to conventional, conventional to organic, organic to organic and organic to conventional.

More data are needed than before. The two new elements are conventional transfers to organic and vice versa. Requirements for certified organic agricultural products often contain requirements for inputs: inputs from conventional agriculture may not be allowed in organic agriculture, for example genetically modified seeds. Organic livestock also needs to be fed with organic (certified) feedstock to be acknowledged as organic under international standards.

On the other hand, organic seeds and feedstock may be too expensive to be used in conventional agriculture. These assumptions lead to the result in Figure 3, where the off-diagonal elements in the two-by-two matrix, marked in red, are set to zero.

The share of value added and the input structure for organic agricultural are identical to those for conventional agriculture in Figure 3. Value added is related to profits and payments for labour in the IO framework. The literature often points out that organic farming is more labour-intensive than conventional farming, partly because organic farms tend to be smaller and require more manual labour.

In the light of the above discussion on eco-labels, the input structure has to be reconsidered. Fertilizer, for instance, is replaced by organic fertilizer in green agriculture and a shift in the cost structure is to be expected. In the example, this translates into a shift in input from the chemical industry to other sectors. For instance, mineral fertilizers are replaced by organic manure produced on farms. Note that, despite this shift, the overall production of agriculture and the chemical industry has to remain constant. Figure 4 shows the IOT with the organic/conventional split in agriculture, an adjusted cost structure and a more labour-intensive mode of production.

Figure 4: Shift from fertilizers to organic agriculture and more labour-intensive production

Supply	Demand	Intermediate Demand						
		Conventional agriculture	Organic agriculture	Manufacturing	Services	Total	Final demand	Production
Intermediate Input	Conventional agriculture	7,5	0	4	4	15,5	16	31,5
	Organic agriculture	0	2,5	1	1	4,5	4	8,5
	Manufacturing	4,5	0,5	10	2	17	10	27
	Services	4	1	2	15	22	19	41
	Total	16	4	17	22	59	49	108
	value added	15,5	4,5	10	19	49		
Production		31,5	8,5	27	41	108		

Source: own calculation

The sum of the outputs remains constant. But organic agriculture records a higher share in terms of total output, because organic agriculture produces more of its own inputs, i.e. the organic fertilizers. This shift can be modelled only if sufficient data are available.

The result when this analysis is extended to all sectors is shown in figure 5. The split of the diagonal and the changes in cost structures are not so obvious for all sectors as in the case of agriculture. If no obvious split or data present themselves as the empirical basis for the construction of the IOT, it has to be based upon an axiomatic set of rules:

Rule 1: Inputs to green sectors are green.

Rule 2: The input structure of green subsectors is the same as for their non-green counterparts.

Rule 3: Exceptions to Rule 2 have to separately identified, as in this example of organic farming.

■ **Figure 5: Expansion of IOT to all sectors**

Supply	Demand	Intermediate demand								
		Conventional agriculture	Organicagriculture	Non-green manufacturing	Greenm anufacturing	Non-Green services	Green services	Total	Final demand	Production
Intermediate Input	Agriculture conventional	7,5	0,0	4,0	0,0	2,5	0,0	14,0	17,5	31,5
	Organic agriculture	0,0	2,5	0,0	1,0	0,0	2,5	6,0	2,5	8,5
	Non-green manufacturing	4,5	0,0	8,0	0,0	1,0	0,0	13,5	8,1	21,6
	Green manufacturing	0,0	0,5	0,0	2,0	0,0	1,0	3,5	1,9	5,4
	Non-green services	4,0	0,0	1,6	0,0	7,5	0,0	13,1	7,4	20,5
	Green services	0,0	1,0	0,0	0,4	0,0	7,5	8,9	11,6	20,5
	Total	16,0	4,0	13,6	3,4	11,0	11,0	59,0	49,0	108,0
	Value added	15,5	4,5	8,0	2,0	9,5	9,5	49,0		
Production		31,5	8,5	21,6	5,4	20,5	20,5			

Source: own calculation

Rule 1 is necessary for the split of the diagonal elements of the matrix. In the case of organic farming, the distribution of the shares is facilitated by the requirements of organic farming. In other sectors, information and restrictions on inputs are often not available or not necessary. If no information is available, the straightforward and obvious definition is contained in this rule. But rule 1 not only facilitates dealing with the diagonal elements; it also serves as an important defining element for all green sectors. If any sector contributes to a green sector, then this part of its production is labelled green. If manufacturing supplies a tractor to organic farmers, the people who built the tractor are defined as having green jobs. The tractor by itself is not a green product, but this particular tractor would not have been built without the demand for it from organic farming. More generally, the transition towards a green economy yields employment in all sectors. Using IO analysis for calculating the employment effects of measures, strategies and investment in greening the economy, also takes the important matter of indirect employment into account. Additional demand from green manufacturing, for instance, creates additional demand in other sectors, which generates a green employment effect. For this reason, and because otherwise the data requirements would be prohibitively high, rule 1 holds good throughout the analysis presented here.

Rule 2 is an important assumption when we undertake a full-scale IOT with 20, 30 or 70 sectors, because there will not be enough information and empirical data available to complete the individual cost structure for each new green sector. Rule 2 simply assumes, as a first approximation, that green sectors have the same cost structures as their non-green counterparts.

Total output remains at 108 units. Using the new IOT, we can read the input requirements, cost structures, deliveries and production figures of the various green sectors. The next section shows how employment can be calculated using a matrix calculation based on the new IO table.

2.3 Matrix calculation with IO tables

IO tables represent a matrix and a system of equations. The Leontief production function condenses this system. The Leontief-multiplier matrix, or Leontief inverse $(I-A)^{-1}$, is calculated from the matrix of input coefficients A, which relates the intermediate demand by sectors to total production by sectors. The Leontief inverse implicitly includes all inter-industrial production interdependencies. Given domestic final demand (y-m), total production (x) by sectors can be calculated. The index t denotes time and is relevant for time-series analysis or IO projections. Hence, sectoral production is the outcome of both final domestic demand and inter-industrial production processes:

(1) $$x_t = (I - A_t)^{-1} \cdot (y_t - m_t)$$

Based on this equation, production-induced employment effects can be computed using standard input-output analysis (Holub & Schnabl 1994[4]). To this end, the Leontief inverse needs to be left-multiplied with a diagonal matrix of employment coefficients (*b*) so that the resulting matrix can be interpreted as a labour-input matrix W.

(2) $$e_t = \hat{b}_t (I - A_t)^{-1} (y_t - m_t) = W(y_t - m_t)$$

The labour-input matrix reveals the number of persons needing to be employed in sector i to produce an additional unit in sector j. The column sums of that matrix represent the employment multipliers of the 23 industrial sectors. The multiplier subsumes all direct and indirect employment effects in sector j from an additional unit of final demand in the corresponding sector. The diagonal of the matrix shows the direct effects of an additional investment. The sum of the non-diagonal elements of sector j indicates the leverage on indirect employment. The ratio of total employment multiplier to direct employment multiplier is the factor that has to be multiplied by direct employment in order to obtain the additional employment from an additional unit in final demand. If the factor is larger than one, indirect employment is comes from thissector. In general, service sectors have an employment factor close to one, whereas manufacturing industries often show a higher employment factor.

The calculation of direct and indirect employment effects using standard input-output analysis is subject to assumptions and limitations. For instance, IO analysis lacks certain aspects of the supply side of employment. The question of whether the economy is sufficiently endowed with human capital with the qualifications required to match employment demand cannot be answered using the analysis presented here. Extensions to the analysis, which is described above and applied in the following chapters, are of course possible.

4 *Holub, H.-W.&Schnabl, H. (1994) Input-Output-Rechnung: Input-Output-Analyse. R. Oldenbourg Verlag. Munich. Vienna.*

IO analysis is relevant for the analysis of green jobs in a particular country, because it helps to estimate the link between green outputs and the country's sector-specific production structure. Consider, for instance, additional demand for organic agricultural products stimulated by a campaign or a subsidy. This additional demand translates directly into additional production, assuming that the additional products required are not imported. Additional production requires additional workers, for sowing, watering and harvesting in the case of agricultural crops. This employment effect is referred to as "direct employment" in the literature. From the IO table, we can further deduce the additional demand for intermediate inputs. All the sectors affected will experience an additional demand for labour, and this will create additional employment. This is often referred to as the "indirect employment" effect. In the case of agriculture, this effect might extend to the machinery sector, the construction industry, transport and trade.

Identification of Green sectors in Tunisia and construction of the IO table

3

The Tunisian economy is at a crossroads in its development. Currently, more than 15 per cent of overall production is in food and agriculture. The largest industrial sector is the mechanical and electrical industry, which supplies inputs to the European automotive and aircraft industries, as well as products for Tunisian industry and the Tunisian consumer. Textiles and ICT are also significant industrial sectors. The construction industry is important, accounting for more than 7 per cent of total production (2011, INS) followed by commerce and trade, transport and other services (around 5 per cent of total production).

For Tunisia, the transition to a green economy offers opportunities in several sectors, in particular waste management, water management and treatment, eco-agriculture, infrastructure, efforts to improve efficiency in buildings and industry, renewable energy and eco-tourism. An action plan to develop a strategy and set the regulatory framework for promoting green employment is currently in progress.

The ILO provides a definition of green jobs, which has been adopted by the 19th International Conference of Labour Statisticians (October 2013). It is based on the System of Environmental-Economic Accounting (SEEA)[5]. "Jobs are green when they help reduce negative environmental impact ultimately leading to environmentally, economically and socially sustainable enterprises and economies. More precisely green jobs are decent jobs that:

- Improve energy and raw materials efficiency
- Limit greenhouse gas emissions
- Minimize waste and pollution
- Protect and restore ecosystems
- Support adaptation to the effects of climate change" *(ILO 2013d)*

[5] SEEA (2012): System of Environmental-Economic Accounting 2012 Central Framework

To identify the greenness of an economic sector, we have followed the Practitioner's Guide for Assessing Green Jobs Potential in Developing Countries (Jarvis et al. 2011) and have developed it further, taking into account the data available for Tunisia. The "development of new input–output (I-O) coefficients for green sectors is fundamental for assessing the net impact of existing green jobs and for exploring the future impacts of green growth. However, creating new input–output coefficients is not straightforward."(Jarvis et al. 2011).

In particular, the development of new input-output coefficients requires a definition of what counts as environmentally sustainable and decent work. Three approaches are possible: a) a process-based method, which tries to integrate environmentally friendly production processes into the analysis. Typically, a threshold is defined which includes, for instance, the top 10 per cent of water and energy-efficient enterprises (cf. Case study of Mauritius, ILO 2013); b) an output-based method, which identifies green outputs and services and supports the development of an extended IO table; c) a natural-resource-conservation method, which supplements the above approaches by adding sectors which are directly linked to the improvement of environmental quality.

In the case of Tunisia, stakeholder workshops have been held, in December 2013 and in March 2014, to identify green sectors, products and processes of relevance to the Tunisian economy. The list of participants can be found in the Appendix. For the most part, sectors are identified in terms of their products and services. For mining and the chemical industry, processes have been identified which decrease their environmental impact. A full-scale model of the kind mentioned above for Mauritius could not be developed for Tunisian industries due to lack of data.

Application of this definition leads to the identification of green sectors, non-green sectors and in-between sectors. Table 1 gives an overview of the resulting identification scheme. Chapter 3.1, 3.2 and 3.3 look into certain sectors in more detail and explain why they were placed in their respective categories in Table 2.

Table 1: Green sector identification within the Tunisian IO table

Entirely green sectors (no need to split, as already defined in INS classification):	Water sector
	Waste sector
Non-green sectors:	Tobacco, oil refining, oil and gas extraction
Partly green sectors (need to be split from INS classified sectors, because green and non-green activities within the sector classification are lumped together):	
Greener processes with changed input/ production structure:	Mining, chemicals
Green products with changed input/ production structure:	Electricity, agriculture, construction
Providing inputs to green sectors without changed input/production structure:	All others

3.1 Green sectors: Water and waste

3.1.1 Water sector

The water sector supplies drinking water, treats waste water and provides sewerage services. Is it green? Are people who work in the water sector automatically performing green jobs? The sector is not homogenous and comprises different activities. For a full understanding all activities (drinking water supply, sewerage services with a sewerage collection system, services for sewage collection from cesspits and treatment services) are discussed.

When applying the output and process-based definition of green jobs – as introduced earlier – it is helpful to distinguish green products and green processes. Environmental activities protect the environment or increase resource efficiency. Jobs in the water sector involving processes or production which protect the environment or increase resource efficiency are therefore considered green. Table 2 gives an overview of activities in the water sector evaluated with respect to their green aspects.

Table 2: Assessment of water sector services

Output	Environmental protection	Resource efficiency
Drinking water	Yes.	A very small number of jobs in the drinking-water sector are concerned with the protection of water resources. These jobs are typically not at water-operator level but depend more on governmental agencies.
Sewerage services	Yes, if the sewerage system is connected to an operating WWTP or a functional sea outfall. It partly fulfils this criterion if the sewage is discharged into a river, the sea or the dessert without treatment.	
Services for sewage collection from cesspits	Yes, if the sewage is delivered to a functional WWTP* or into the sewerage system (e.g. a functional sea outfall). It only partly fulfils this criterion if the sewage is discharged into a river, the sea or the dessert without treatment.	
Treatment services	The primary purpose is the prevention of pollution, which ensures groundwater protection and health protection.	

** wastewater treatment plants*

If the sector produces, designs or manufactures at least some goods and services for the purpose of environmental protection and resource management, should it be considered "green" in its entirety? The ILO definition challenges us to distinguish between:

- Specialist producers: establishments whose main activity is the production of environmental goods and services;
- Non-specialist producers: establishments that produce environmental goods and services as secondary activity but have a different main activity;
- Own-account producers: establishments that produce environmental goods and services or processes for their own consumption within the economic unit.

Traditionally, the main output of a water and sewerage company is the supply of water to the general population, as well as to non-household users (agriculture, industry, commercial and service enterprises). Sewerage services and wastewater-treatment services are (from the traditional point of view) secondary activities. The main benefits are health protection and groundwater protection. But, if we include sewerage services involving a sewerage collection system, services for sewage collection from cesspits and treatment services in the environmental protection services category, then they are specialist producers and should be fully taken into account.

Employment depends on the technical equipment used and what type of water and sewerage operator is involved. Almost all operators provide drinking water as an output, and most of them provide sewage services. Most sewerage services involve a sewerage system; services in which sewage is only collected from cesspits are fewer in number. In many municipalities in developing countries/emerging economies, there are no WWTPs (wastewater treatment plants) and sewage is only discharged into the dessert, a river or the sea. In other municipalities, a WWTP may exist, and in most of these cases the WWTP is operating properly.

In Tunisia, a healthy and safe water supply has been high on the agenda since 1975. The overarching target of the national water strategy is to ensure access to safe water and economic benefit for all citizens, through well designed and well-managed solutions adapted to the problems of each region. The acceptance of such measures increases with communication on costs and benefits. Wastewater is an important component of the strategy, reflected in the creation in 1975 of ONAS, the National Bureau for Wastewater Treatment. Between 2005 and 2010, the infrastructure was extended and improvements have led to more employment in construction and manufacturing. In addition, various government agencies provide employment in the water sector. It is estimated that 2,000 people are employed outside the water treatment sector itself.

The water sector is reckoned to be 100% green in the following analysis.

3.1.2 Solid waste sector

The waste sector collects waste, treats and disposes of it. It is also involved in recycling. This sector, like the water sector, is not homogenous and comprises different activities. The waste stream consists of non-hazardous wastes[6], hazardous wastes containing substances dangerous to human health and the environment[7], and recyclable wastes, which require dismantling[8]. Further recycling services are the scrapping and shredding of metal waste, including dismantled endoflife vehicles, and electronic waste, the processing of metal and non-metal scrap into secondary raw materials, and the processing of plastic, waste oil and other fluids into usable materials.

In line with our strategy of identifying sector activities as green or non-green, Table 3 gives an overview of waste-related services which are classified as green.

Table 3: **Assessment of the criteria by cost object of the waste sector[9]**

Activity	Environmental protection	Resource management
Non-hazardous waste	Yes. The collection, treatment and disposal of non-hazardous wastes are environmental protection activities, the primary purpose of which is to prevent, reduce and eliminate pollution of the environment.	Yes, if considered as a prerequisite for recycling.
Hazardous waste	Yes. The collection, treatment and disposal of hazardous wastes are environmental protection activities, the primary purpose of which is to prevent, reduce and eliminate pollution of the environment.	Yes, if a prerequisite for recycling.
Recyclable waste	Yes. The collection of recyclable waste can be an environmental protection activity, if it replaces fly-tipping and the harmful dumping of materials and liquids. The recycler has to meet any existing soil, water and air protection standards.	Yes.

There are different waste-collection systems with different levels of sophistication. A relatively underdeveloped (low-level) system might consist in the collection of bins or containers, using a tractor and trailer to transport the solid waste to a simple dump.

6 Solid waste from private households, solid waste from factories, commercial enterprises and public institutions, construction waste (including waste from the demolition of buildings) and textile waste.

7 Explosive, oxidizing, flammable, toxic, irritant, harmful, carcinogenic, corrosive and infectious wastes. Examples include used oil from shipment or garages, batteries, and biohazardous waste from humans and animals, e.g. cadavers or slaughterhouse waste.

8 Cars, railway wagons, ships, electronic waste, refrigerators, washing machines, computers, televisions, mobile phones.

9 Here, as in the preceding text on the water sector, fulfilling one criterion suffices for the sector to qualify as (partly) green.

On the dump, private waste-pickers might search for recyclables. This type of system can be found in villages and suburban areas.

In a more advanced system, the collection of the waste is carried out using garbage collection trucks and the landfill is organized and supervised by the operator. At an even higher level, the collection system might consist of garbage collection trucks, transfer stations and long-distance trucks. In such cases, the system would cover a much larger area, sometimes with a radius of 35 km or more.

Sorting of the collected waste is performed either by waste-pickers, in a material recovery facility (MRF), in a green waste-treatment plant (GWTP) or in a mechanical biological treatment plant (MBT). In an MBT system, most recyclables can be sorted: scrap metal (including beverage cans), plastics, paper, compostable materials, etc. There are also sanitary landfill sites with a layer to protect the environment from the seepage of fluids. These fluids may be collected in basins and (mostly) treated at a WWTP. On more sophisticated sites, the methane emitted is collected and transformed into electricity.

Waste incineration plants also differ in terms of sophistication and efficiency. At the lower end of the scale, the waste is merely incinerated, whereas, in plants with higher standards, electricity or heat is generated. The remaining ash still has to be disposed of, either in a sanitary landfill or sometimes in a decommissioned underground mine.

The waste sector is treated as 100% green in the following analysis.

3.2 Non-green sectors

Having identified the entirely green sectors, the question arises as to whether there are sectors which can be classified as entirely non-green. In more technical terms, the question is: Are exceptions to rule 1 needed? Just to remind you, rule 1 states that all inputs to green (sub)sectors are green. For our highly aggregated example, exceptions do not make much sense, but does the rule hold good for a less aggregated IO table in which we can make a distinction between, say, machinery and oil refining? Can the latter be green?

Returning to the definition of environmental products given above, the outputs of refineries cannot considered green. IOT analysis shows that the largest share of the sector's output goes to the transport sector, while the construction industry uses asphalt and bitumen, the heavy fractions of refining. Most usages cannot be considered green. To simplify our analysis, oil refining, the tobacco industry, mining and oil and gas extraction are considered non-green from the production point of view.

However, the mining and chemical industries have gradually developed strategies either to make their production more environmental friendly (in the case of the chemical industry) or to mitigate the damage done by the industrial process (i.e. restore/cultivate the damaged landscape, in the case of mining).

Are these green jobs? The answer, following the definitions given above, should be "yes". Though the danger of green-washing exists in industries which primarily damage the environment by their mode of production, efforts to improve processes should be acknowledged. Thus, workers employed in these activities are considered to be performing green jobs.

3.3 Sectors in transition: Partly green

The cost structures of fully green and fully non-green sectors do not receive special consideration, because they do not need to be altered. For partly green sectors, consisting of economic activities that are considered both green and non-green, such as electricity generation from oil as opposed to wind, an attempt is made to estimate new cost structures. This is the case for electricity generation, construction and agriculture. For the other partly green sectors, new cost structures are not identified, due to lack of data.

3.3.1 The renewable energy and gas sector

The use of renewable energy to generate electricity and heat can undoubtedly be considered green. Renewable energy plays an important role in Tunisia. At the institutional level, Tunisia is very advanced in its transition to the generation of electricity and heat from renewables. Tunisia was undoubtedly a regional pioneer in the development of the renewable electricity sector: a proactive policy of rational energy use and renewable energy promotion was initiated in the 1990s. Energy efficiency has gradually become one of the pillars of energy policy. According to the latest post-Paris and post-COP 21 strategy (2016), the Tunisian Solar Plan aims to generate 15 per cent of the country's energy from wind, 10 per cent from solar PV and 5 per cent from solar thermal (CSP) by 2030.

The Tunisian Solar Plan additionally aims to achieve an electricity mix of 25 per cent + renewable energy in its electricity generation (1,520 MW wind, 1,930 MW PV (Gafsa, Kebili and Tataouine), 595 MW CSP, making a total of 11,065 GWh). This will require investment of 7.1 billion Tunisian dinars (TND), plus TND343 million a year for operations and maintenance.

These objectives are supplemented by a 37 MW per year increase in CES (the growth in 2008-2010 was 25 MW per year) to reach a target of 700 MW by 2030. In the case of biogas, the target is additional capacity of 3 MW per annum.

Where investment opportunities in the renewable energy segments are concerned, Tunisia has over 25 years' experience in the field of energy management and is an emerging market for equipment and services contributing to energy efficiency and renewable energy.

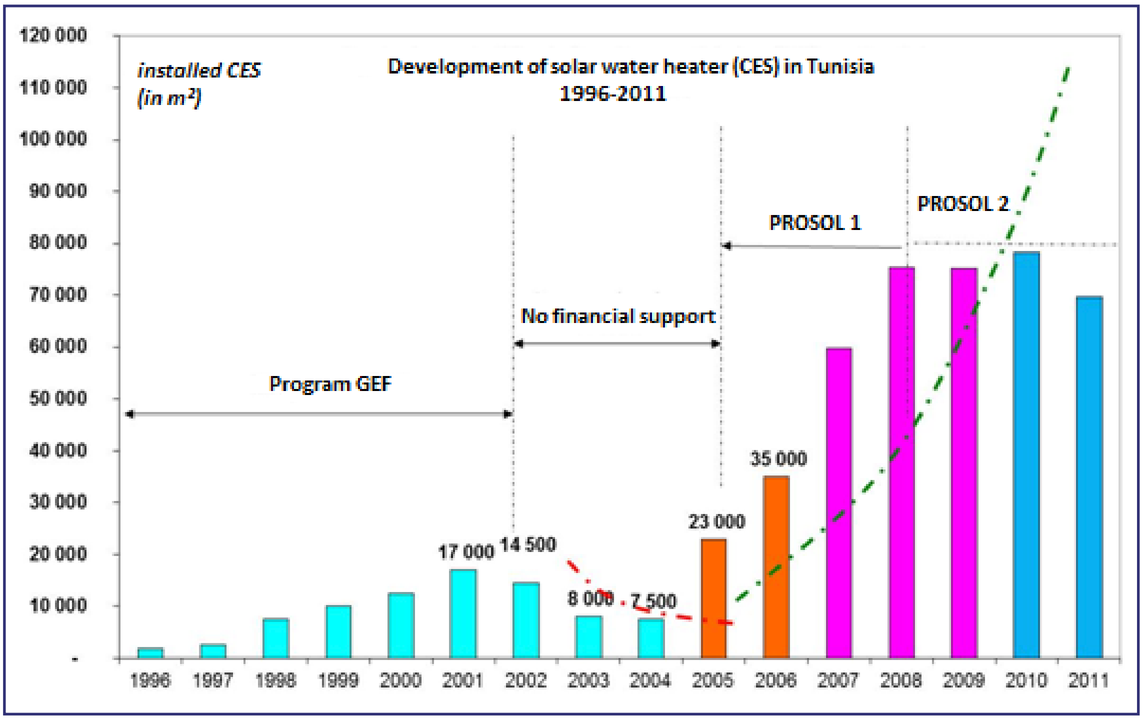
3.3.2 Wind power

Tunisia has an estimated 4,000 MW wind energy potential, according to a study of strategic renewable energy development. At the end of 2005, total installed capacity was 54 MW. A second wind farm generating 191 MW was inaugurated by STEG in September 2010. With it in operation, total installed capacity is now 245 MW and brings the share of renewables in electricity generation to 4.5 per cent. In addition to the STEG projects, the private sector expects to generate 60 MW from wind power for large electricity consumers (EGCE) by 2013, and a further 100 MW for export by 2014.

3.3.3 Solar energy

Solar energy has developed considerably in recent years. The PROSOL solar water heater (CES), launched in 2005, has created a market for CES, with the following results:

■ Figure 6: **Solar water heater market in Tunisia**



A second PROSOL programme, PROSOL Elec, aiming to develop PV energy and feed it into the national electricity grid, has to date installed PV panels generating 5 MW of electricity.

What does this mean for the green IO table? Renewable energy is difficult to integrate into the existing cost structure of electricity generation from fossil fuels. With the exception of biogas, the technologies adopted in Tunisia are free of fuel costs. They shift the costs from fuels to electricity and heat-generating systems, i.e. from raw materials to industrial products, currently often imported. A PV-panel manufacturing plant opened in Tunisia in 2013, and solar water heaters are being assembled, and more recently produced, domestically. To reflect the shift in cost structure, the analysis is based upon the t3e model developed for ANME in 2013, with the IO parameters for solar electricity and heat generation, wind generators and biogas converters included in the model for Tunisia.

3.3.4 The construction sector and energy efficiency

The construction sector plays an important role in the Tunisian economy. It will also play an important role in solving one of the pressing problems of Tunisian society: the high rate of unemployment. What can green activities contribute?

One aim of the Tunisian Solar Plan is to increase energy efficiency. Practical measures for implementing the decree are promulgated in the form of joint ministerial orders by the ministries of energy and housing. Two orders have so far been issued:

- an order setting the minimum technical specifications for energy consumption in residential construction and extension projects;
- an order setting the minimum technical specifications for energy consumption in office construction and extension projects.

Thermal regulations for multi-family residential buildings came into effect as of 1 June 2009. According to the observatory of the ministry in charge of housing, by the end 2010 more than 2,000 new buildings were in compliance with these regulations.

The model developed for GIZ (2013) includes adjusted IO coefficients for this sector, therefore the model proposed in this study, which builds on the works for GIZ, includes the same adjustments. Energy efficiency measures in the construction sector increase the share of value added slightly and to some extent shift the inputs towards imports.

3.3.5 Green agriculture

The agricultural sector has already been mentioned as an example of a sector which employs both conventional and green practices. Identification of a new cost structure for organic farming relies on current experience in Tunisia. Tunisia relies heavily on farming and organic farming is becoming increasingly important, partly to take advantage of new export opportunities. With 330,000 hectares certified organic by the end of 2013, Tunisia has the second largest area devoted to organic farming in Africa and has become the largest producer of organic olive oil.

The area of organic farmland was estimated at 245,000 hectares at the end of 2011 and is forecast to reach 500,000 hectares by 2016. Olive groves currently account for 47 per cent of the total area of organic farmland, followed by organic pasture (18 per cent) and land devoted to aromatic and medicinal plants (15 per cent). The distribution by crop area is shown in Table 4.

Table 4: Data on organic farming in Tunisia (2009)

	Crop Area (ha)
Olives	115,000
Date palms	1,100
Vegetables	210
Field Crops	1,216
Fruit trees	4,313
Aromatic and medicinal plants	408
Fallow	20,975

Source: www.etudier.com

Olives are the dominant crop in organic agriculture. There has therefore not been a significant shift away from mineral fertilizers.

The organic farming movement in Tunisia was started in the 1980s by private initiatives and developed only slowly until 1997-1998. A national strategy was then implemented, based on several components: regulation, research, training, extension, organization, structure and encouragement. This has contributed to the development and growth of the sector.

3.3.6 Other sectors

Machinery and electrical appliances are the most important sectors providing inputs to green sectors and can thus be defined as partly green. For waste treatment and collection, for instance, a list of technical equipment reads as follows:

- Textile filters for waste treatment
- Compost silos made of wood
- Chemicals, materials, preparations for waste management
- Plastic waste containers
- Facilities for plastic waste landfills, e.g. landfill liners or covers
- Products made from glass, ceramics, stones and earth or concrete for waste management, e.g. dried clays for landfill
- Waste containers made of metal
- Waste screens and metal grilles
- Waste dryers
- Machinery and equipment for grading , separating, sifting and sorting waste
- Dismantling and shredding facilities for waste
- Facilities for agglomerating, pelletizing, pressing and mixing waste
- Measurement and analysis instruments for waste
- Control technology for waste treatment, e.g. metering equipment
- Structures for waste collection vehicles
- Sweepers and vacuum sweepers

A similar list exists for suppliers to the water sector, for noise reduction and for soil protection. The domestic share of these products, and their share of overall production, has been determined by interviewing experts.

3.4 Construction of the extended IO table based on identified green industries

The Tunisian Statistical Bureau (INS) publishes IO tables for Tunisia. The Tunisian IO tables comprise 23 (earlier versions 19) economic sectors (cf. Table 5). The older classification included 19, until the INS published a new set of updated input-output tables for the years 2006 to 2010 (INS 2011[10]). These differ from the old IO tables (INS 2009[11]) not only in their time coverage and base year but also in the following respects:

- The tobacco industry has been separated from the food processing industry;
- The repair and maintenance sector has been given a separate heading;
- Transport and telecommunication have been divided into two separate sectors;
- The gas sector has been reallocated from petrol to electricity.

The earlier version of the IO tables (NIS 2009) covers the years 2004 to 2008. Since the data in the IO tables have not been revised, they have to be adjusted to take into account the revised economic drivers. More information on this is given below, in the description of the model. The extension of the table to cover green sectors is based on Tunisia's most recent IO table (Table 5).

Table 5: Sectors of the Tunisian IO table

1 Agriculture	9 Mechanical and electrical industry	17 Hotel services
2 Food industry	10 Extraction of oil and gas	18 Transport
3 Tobacco industry	11 Mines	19 Posts and telecommunications
4 Textiles	12 Electricity and gas	20 Financial services
5 Other industries	13 Water	21 Other market services
6 Oil refining	14 Construction	22 Public administration
7 Chemical industry	15 Repairs	23 Other services
8 Construction materials	16 Trade	

As explained above, most sectors contain activities that are partially green, either because they produce a green product for the consumer or because they supply inputs to green subsectors. In addition, the partly green sectors supply indirect inputs to the entirely green sectors of waste and water or to organic agriculture.

[10] *NIS (2011) Les comptes de la nation – nouveau système – base 1997. Agrégats & tableaux d'ensemble 2006-2010. Statistiques Tunisie. Décembre 2011.*

[11] *NIS (2009) Les comptes de la nation – Agrégats et tableaux d'ensemble 2004-2008. Statistiques Tunisie. Décembre 2009.*

Referring back to the initial set of rules proposed on page 16, our discussion of green, non-green, and partly green sectors leads us to propose a fuller and more open set of rules:

Rule 1: Some sectors are entirely green, some are entirely non-green, and some are partly green. (Use ILO definition for identification.)

Rule 2: Producers of inputs to green (sub)sectors are green.

Rule 3: The input structure of green subsectors is the same as that of their brown counterparts.

Rule 4: Exceptions to Rule 3 have to be separately identified. In this study: organic farming, construction, RE.

Rule 5: Entirely non-green sectors are an exception to rule 3 as well; their inputs to green (sub)sectors do not create any green production in their own sectors.

This set of rules can be translated into a (two times number of columns) x (two times number of rows) transition matrix, which can be applied to the hypothetical matrix in which all sectors are doubled. The illustration given is of the Tunisian IO table, aggregated to seven sectors:

1. Agriculture
2. Food industry
3. Electricity generation
4. Tobacco, mining, chemicals
5. Other manufacturing
6. Water and waste
7. Services

The aggregation is intended to provide examples for the application of each rule. Agriculture has an adjusted cost structure, while all other green production is based on production shares. Electricity is partly green and we can draw on additional knowledge. The waste and water sectors are entirely green. Services are an interesting case, differing in their input structure and shares of value added. The food industry is an important demand determinant for agriculture and has been included for this reason.

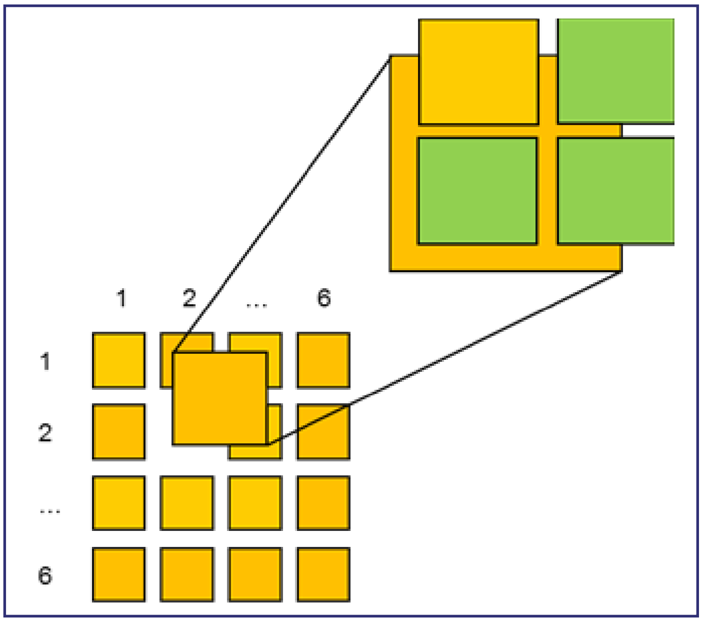
Table 6 gives an overview of the seven-sector IOT for Tunisia. The table shows the inputs supplied by the seven sectors and the inputs demanded from each sector. The diagonal elements are the largest in most sectors. The final output of each sector typically exceeds the sum of the inputs supplied. In the table we show only domestic production; imports, exports, value added and final demand are incorporated in the model, as described in the next chapter.

Table 6: Aggregated IO table for 2010 – Seven-sector IOT

2010	IOT							Sum of inputs supplied
	Agriculture, fisheries	Food industry	Brown (Tobacco, mining)	Greenable Industries	Water	Electricity	Services	
Agriculture, fisheries	266	4926	221	198	0	0	627	**6238**
Food industry	810	1446	89	39	0	0	1625	**4009**
Brown (Tobacco, mining)	377	629	5738	2066	30	795	2787	**12422**
Greenable Industries	63	681	628	15260	14	340	6442	**23427**
Water	7	13	30	21	0	1	71	**143**
Electricity	5	218	198	454	24	7	476	**1382**
Services	35	420	994	1775	8	49	7000	**10280**
Sum of inputs demanded	**1564**	**8332**	**7898**	**19811**	**77**	**1191**	**19028**	

The next step is to add the green dimension. Figure 7 shows the principle: each sector is "doubled", so that we have a green and a non-green sector under each sector heading. The result is an artificial fourteen by fourteen matrix, which has the same entries in each doubled row and column. In applying the rules for the construction of the green IO matrix, the easiest approach is to define a transition matrix and use cell-by-cell multiplication. The transition matrix also has fourteen by fourteen cells, the number of cells in our final green IO table.

Figure 7: Adding the green dimension



Source: GWS

■ **Figure 8: The transition matrix for the seven-sector IOT**

2010	1 Agricul-ture, fishery	2 Organic agricul-ture, fishery	3 Food industry	4 Organic food industry	5 Brown (Tabac, Mining)	6 Green part of brown	7 Green-able indus-tries	8 Green part of green-able industry	9 Water	10 Green water	11 Electricity	12 Green elec-tricity	13 Services	14 Green services
1 Agriculture, fishery	0,80	0,00	0,99	0,00	1,00	0,00	0,99	0,00	0,00	0,00	0,85	0,00	0,99	0,00
2 Organic agriculture, fisher	0,00	0,20	0,00	0,01	0,00	0,00	0,00	0,01	0,00	1,00	0,00	0,15	0,00	0,01
3 Food industry	0,98	0,00	0,99	0,00	1,00	0,00	0,99	0,00	0,00	0,00	0,90	0,00	0,99	0,00
4 Organic food industry	0,00	0,02	0,00	0,01	0,00	0,00	0,00	0,01	0,00	1,00	0,00	0,10	0,00	0,01
5 Brown (Tabac, Mining)	1,00	0,00	1,00	0,00	1,00	0,00	1,00	0,00	0,00	1,00	1,00	0,00	1,00	0,00
6 Green part of brown	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
7 Greenable industries	0,98	0,00	0,99	0,00	1,00	0,00	0,99	0,00	0,00	0,00	0,85	0,00	0,99	0,00
8 Green part of greenable ir	0,00	0,02	0,00	0,01	0,00	0,00	0,00	0,01	0,00	1,00	0,00	0,15	0,00	0,01
9 Water	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
10 Green water	0,98	0,02	0,99	0,01	1,00	0,00	0,99	0,01	0,00	1,00	0,90	0,10	0,99	0,01
11 Electricity	0,95	0,00	0,95	0,00	1,00	0,00	0,95	0,00	0,00	0,00	0,98	0,00	0,98	0,00
12 Green electricity	0,00	0,05	0,00	0,05	0,00	0,00	0,00	0,05	0,00	1,00	0,00	0,02	0,00	0,02
13 Services	0,98	0,00	0,99	0,00	1,00	0,00	0,99	0,00	0,00	0,00	0,85	0,00	0,99	0,00
14 Green services	0,00	0,02	0,00	0,01	0,00	0,00	0,00	0,01	0,00	1,00	0,00	0,15	0,00	0,01

The shares within the four quadrants of any one sector have to add up to one, to keep the sums of total inputs supplied and received at the same values as in the original IO table. For five of the seven sectors, the cost structure for the green and non-green parts of each sector is identical. The exceptions are organic agriculture and green electricity.

In the case of green agriculture, demand for inputs from the chemical industry (fertilizers) has shifted to demand for organic fertilizers from the agricultural sector. The greening of electricity generation has more far-reaching implications: demand for fossil fuels has shifted towards demand for investment goods, produced by the machinery sector. Biological inputs are taken into consideration as well, reflecting the use of biogas. Services also contribute to a larger extent in the planning, operation and repair activities associated with renewable energy electricity generation. The data are taken from international studies, such as Lehr et al. 2015.

By multiplying the above transition matrix with the conventional IO matrix published by the INS, we obtain the total intermediate demand from conventional and green sectors in Tunisia for 2010. One important feature of this approach is that production, intermediate input/output, demand and value added by industries remain unchanged in the sector total (conventional plus green).

The sums of the rows and columns are equal to the values given in the 2010 IOT. Our construction is therefore consistent with the data published by the INS.

■ Table 7: **Intermediate demand in millions of TND**

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Agriculture, fishery	Agriculture, fishery	Food industry	Food industry	Brown (Tabac,	Green part of brown	Greenable Industries	Green part of	Water	Water	Electricity	Green Electricity	Services	Green services
1	Agriculture, fishery	213	0	4901	0	221	0	197	0	0	0	0	0	619	0
2	Agriculture, fishery	0	53	0	25	0	0	0	1	0	0	0	0	0	8
3	Food industry	794	0	1438	0	89	0	38	0	0	0	0	0	1604	0
4	Food industry	0	16	0	7	0	0	0	0	0	0	0	0	0	22
5	Brown (Tabac, Mining)	377	0	629	0	5738	0	2066	0	0	30	795	0	2787	0
6	Green part of brown	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Greenable Industries	62	0	677	0	628	0	15171	0	0	0	289	0	6356	0
8	Green part of greenable indus	0	1	0	3	0	0	0	89	0	14	0	51	0	85
9	Water	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Water	7	0	13	0	30	0	21	0	0	0	1	0	70	1
11	Electricity	5	0	207	0	198	0	431	0	0	0	7	0	467	0
12	Green Electricity	0	0	0	11	0	0	0	23	0	24	0	0	0	10
13	Services	34	0	418	0	994	0	1764	0	0	0	41	0	6907	0
14	Green services	0	1	0	2	0	0	0	10	0	8	0	7	0	93
	sum of inputs	1492	72	8283	49	7898	0	19688	123	0	77	1133	58	18809	219

3.5 Final demand and production shares of green industries

Apart from the breakdown of intermediate supply and demand to/from environmental goods and services, three further assumptions were necessary to embed green products in an input-output context. These concern the distribution of environmental goods and services in terms of final demand, the production share of these goods, and price developments for green products.

What is the final demand for green goods? For organic produce this is easily understood: final demand derives from the consumer who wants to buy organic products. In Europe, for instance, the turnover of organic products in 2011 was €21.5 billion, a 9 per cent increase on the previous year (FIBL 2013). The largest market for organic products was Germany and the highest market shares, of 5 per cent or more, were recorded in Denmark, Austria and Switzerland. Organic products are produced partly by organic agriculture and partly by the food industry, using intermediate inputs from organic agriculture. Note that very few agricultural products are sold directly to the end consumer.

Final demand for other green products is harder to determine. To model the breakdown of earlier data into green and non-green sectors, and to maintain consistency, we therefore apply the reversed Leontief equation:

(3) $$y_t = \cdot (I - A_t) \cdot x_t$$

Final demand in the historical model is thus calibrated on the basis of the input coefficient matrix corresponding to the estimated flow matrix and estimated sectoral production. Table 8 shows the resulting structure for final demand.

■ Table 8: **Final demand matrix, green and non-green sectors**

	2004	2005	2006	2007	2008	2009	2010
Total	**33688**	**38571**	**43007**	**47126**	**52917**	**55019**	**60039**
Agriculture and fisheries (conventional)	1387	1299	693	97	-310	113	-645
Agriculture and fisheries (green)	319	345	300	284	279	324	303
Food industry (conventional)	4223	5089	4432	4940	5626	5813	6336
Food industry (green)	-12	-14	-10	-12	-7	-15	-14
Tobacco industry (conventional)	792	785	799	794	876	852	937
Tobacco industry (green)	0	0	0	0	0	0	0
Textiles, clothing and leather (conventional)	4154	4064	3265	3753	3982	3591	3791
Textiles, clothing and leather (green)	1	1	0	1	1	-1	-3
Other industries (conventional)	624	485	50	16	78	63	34
Other industries (green)	34	32	22	24	32	28	33
Oil refining (conventional)	-187	-273	-1244	-1340	-2460	-1779	-3546
Oil refining (green)	0	0	0	0	0	0	0
Chemicals industry (conventional)	579	376	-33	-153	1521	217	764
Chemicals industry (green)	125	128	90	108	205	161	198
Construction materials, ceramics and glass (conventional)	145	141	53	98	130	-3	-11
Construction materials, ceramics and glass (green)	-1	-1	-1	-1	-1	-1	-2
Mechanical and electrical industries (conventional)	473	390	-736	-853	-89	-232	933
Mechanical and electrical industries (green)	-3	-2	-5	-6	4	2	6
Oil and gas extraction (conventional)	409	1104	1298	2613	3083	1790	3199
Oil and gas extraction (green)	7	11	12	17	22	15	20
Mining (conventional)	-41	-202	-283	-292	-1201	-343	-268
Mining (green)	14	11	9	12	24	14	18
Electricity and gas (conventional)	365	421	453	441	569	577	598
Electricity and gas (green)	17	22	23	27	37	32	43
Water (conventional)	0	0	0	0	0	0	0
Water (green)	118	130	141	146	155	163	150
Construction and civil engineering (conventional)	5371	5916	6466	6889	7420	8406	8726
Construction and civil engineering (green)	4	4	4	5	5	6	6
Maintenance and repairs (conventional)	0	0	215	327	346	369	375
Maintenance and repairs (green)	0	0	-1	-1	-1	-1	-1
Commerce (conventional)	0	0	4795	4968	5950	6745	7310
Commerce (green)	0	0	0	0	0	0	0
Hotels and catering (conventional)	3595	3864	4139	4339	4701	5027	5487
Hotels and catering (green)	-2	-3	-3	-3	-3	-4	-4
Transport (conventional)	781	922	2779	3123	3784	3624	4168
Transport (green)	-8	-8	-3	-2	-1	-3	-1
Posts and telecommunications (conventional)	691	812	984	1138	1279	1571	1799
Posts and telecommunications (green)	-11	-12	-12	-13	-10	-12	-14
Financial services (conventional)	393	471	871	889	902	894	907
Financial services (green)	-5	-5	-5	-6	-7	-7	-8
Other market services (conventional)	4589	5022	5425	6056	6646	6854	7384
Other market services (green)	-1	1	4	13	12	10	11
Public administration (conventional)	6487	6954	7461	8094	8703	9473	10276
Public administration (green)	-1	291	312	338	364	396	430
Other services (conventional)	0	0	228	238	253	270	289
Other services (green)	0	0	19	20	21	23	24

Negative figures are found in sectors where demand exceeds domestic production and the excess demand has to be covered by imports. Hence, the capability of the economy to replace imports with domestic production is limited. Generally, economies with low endowments of raw materials such as oil, gas or iron ore report negative final domestic demand in those sectors that use raw materials for primary production processes. In other industries, a negative figure for final demand might be an indicator of, for instance, a highly concentrated production structure or limited technological progress within the economy.

The model is calibrated using data for historical development from 2005 to 2010. This development is described in the next chapter. The analysis focuses on the water sector, the waste sector, agriculture and the energy sector, because these are the sectors exhibiting the most important changes. Most changes have been driven by policy strategies and developments in regulation. Following the Tunisian revolution, some of the targets had to be postponed. In some cases, therefore, changes that should already have taken place are part of the scenarios for future development. This is to show that the targets, for instance in the waste and water sectors, have not been abandoned and the underlying strategies are still valid.

The Tunisian model, *e4tn*, represents a simple numeric projection/forecast and simulation model for the Tunisian economy, adopting a top-down approach. It is based on a time series of IO tables that represent production interdependences between sectors, satisfying final demand for goods and services and their respective productions structure. The economy is broken down into 23 distinct sectors.

The employment structure by industries is aligned to the IO classification of sectors. Sectoral employment forecasts are obtained by linking employment to real production growth rates in the corresponding sectors, whereby a total productivity increase of 3.8 per cent per annum was assumed. The upper limit of the supply side of the labour market was defined by the population forecast provided by the NIS. Considering only the active working population (aged 14 to 65), unemployment was calculated by definition as a residual from the active workforce.

Production-induced employment effects can be computed by applying standard input-output analysis (Holub & Schnabl 1994[12]). The labour input matrix reveals the number of persons employed in sector i that are needed to produce an additional unit in sector j. The column sum of the matrix represents the employment multiplier from all 23 industrial sectors. The multiplier includes all direct and indirect employment effects in sector j induced by an additional unit in final demand. The diagonal of the matrix shows the direct effects of additional investment. The sum of the non-diagonal elements of sector j indicates the leverage on indirect employment. The ratio of total employment multiplier to direct employment multiplier is the factor which must be multiplied with direct employment to obtain the additional employment triggered by an additional unit in final demand. In general, service sectors have an employment factor close to one, whereas the employment factor for manufacturing industries is often higher.

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12 *Holub, H.-W.&Schnabl, H. (1994) Input-Output-Rechnung: Input-Output-Analyse.R. Oldenbourg Verlag. Munich. Vienna.*

The calculation of direct and indirect employment effects using standard input-output analysis is subject to some important assumptions and limitations that have to be kept in mind when interpreting the results:

- Employment productivity is endogenously constant. Employment and production develop proportionally, which means that technological advancement or factor substitution does not follow from the Leontief equations. Also, a constant product/process mix is assumed.
- The approach implies that there is only one type of employment per sector, which means that differences in employment structure – for instance by qualification – are neglected.
- With respect to employment policies, it is important to remember that the model lacks important aspects of the supply side of employment. The question of whether the economy is sufficiently endowed with human capital with the qualifications needed to match employment demand cannot be answered using the analysis presented here.

The distribution of production between conventional and green products is based on a survey of green employment conducted in Tunisia in 2005 and subsequent developments until 2010. The shares add up to 100 per cent within any one production unit. In the case of agricultural products, 94 per cent are classified as conventional, 6 per cent as green (2010).

- The intermediate demand matrix is derived from this distribution parameter. The explicit path to the extension of the input-output matrix has been explained previously.

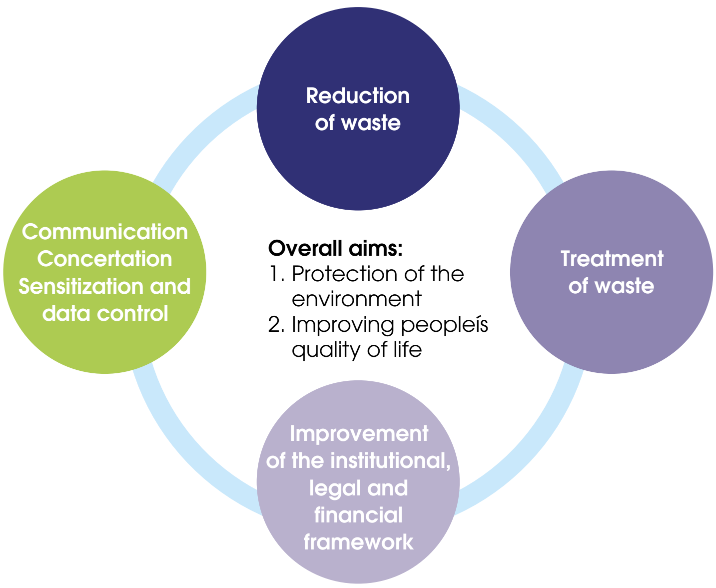
Green jobs in Tunisia - Today and in the future

4

Tunisia has opted for a comprehensive and progressive policy of environmental protection in order to cope with the state of affairs caused by significant economic growth and rapid urban expansion in recent years. This policy is fully developed, with an integrated strategy based on the principles of sustainable development.

The national strategy focuses primarily on the preservation and rational use of natural resources, combatting pollution and increasing overall life quality.

■ **Figure 9: Waste management strategy in Tunisia**



Waste management has received special attention in recent years. Initially under the terms of the Basic Act on Commons, the sector has seen significant change, reflected in the early 1990s by the implementation of a National Waste Management Programme. This development was followed in 1996 by a framework law on waste management and, finally, the creation of the National Agency for Waste Management in 2005.

The waste management system has evolved in recent times with government support. There have been many new projects. For example, more than 15 landfills and 50 transfer stations have been developed in large cities and important coastal and tourist areas. Management systems have also been established for the recovery and recycling of certain types of hazardous waste (see Appendix for detailed policies, plans and achievements in waste management).

Due to different levels of technical development, the employment situation in this sector is very variable. The following table gives a rough estimate of the allocation of employment in a medium-level system and a high-level system. In both cases all employees belong to Category (A) because the operators produce environmental services, i.e. waste collection and waste disposal.

Table 9: Rough estimate of the allocation of employees in the solid waste sector, in a high-level system and in a medium-level system

General cost objectives and related positions	High level system		Medium level system	
	Total (Shares of employment)	(A) Employment in production of environmental outputs	Total (Shares of employment)	(A) Employment in production of environmental outputs
unit	%	%	%	%
Administration	25	25	20	20
Collection				
Bins and containers for solid waste				
Tractors with trailers	--	--	--	--
Garbage collection truck	16	16	15	15
Transfer stations	3	3	--	--
Trucks (for long distance transport)	4	4	--	--
Repair and Maintenance	3	3	5	5
Sorting of collected waste				
Sorting by private waste pickers on the landfill	--	--	53	53
Sorting unit (MRF, WTP or MBT)	35	35	--	--
Repair and Maintenance	2	2	0	0
Waste disposal				
Landfill	--	--	6	6
Sanitary landfill	10	10	--	--
Repair and Maintenance	2	2	1	1
Total	100	100	100	100

For the employment projection in the next chapter and for Scenario 1, which deals with the development of the waste sector until 2030, this distribution is used as a benchmark for the allocation of investment as it impacts different economic sectors.

4.1 Jobs in waste and water management

The waste and water management sectors in the Tunisian IO table are aggregated into a single sector. This makes it somewhat difficult to isolate structural changes (see chapter on scenario development). However, the above analysis shows that the waste and water management sectors can be treated as entirely green.

A study of green employment conducted by the National Agency for Protection and Environment in 2005 found that jobs in waste and water businesses accounted for roughly 23 per cent of total green employment. In 2005, 10,000 people were employed in potable and industrial water treatment, and 12,000 worked in the area of waste treatment. Given a total of 96,000 green jobs in Tunisia at that time, water management (10 per cent) accounted for a slightly lower percentage of green jobs than the waste business (12 per cent). Altogether, the survey suggests that the aggregate figure in the IO table can be more or less equally distributed between the waste and water industries.

4.2 Ex-post analysis - Green jobs in Tunisia 2005 - 2010

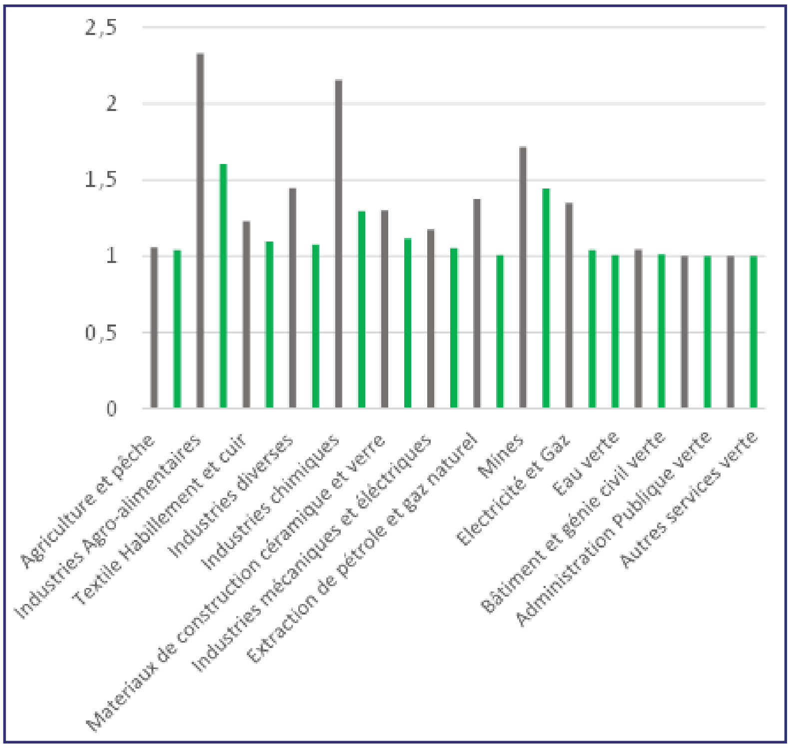
Table 10: Green jobs in Tunisia 2005 – 2010, in thousands

	2005	2006	2007	2008	2009	2010
Agriculture	32.09	34.00	33.44	33.09	34.30	34.00
Other industries	1.59	1.60	1.71	1.60	1.50	2.18
Chemical industry	3.33	3.35	3.49	3.88	3.60	3.82
Machinery and electronics	0.68	0.69	0.71	0.80	0.74	0.79
Mining	3.02	3.10	3.37	5.21	4.16	4.60
Electricity and gas	0.40	0.41	0.40	0.32	1.20	1.3
Water and waste	28.13	28.87	26.00	23.15	27.44	26.29
Public administration	27.18	27.67	28.64	29.04	29.92	30.35
Other services	4.17	4.25	4.35	4.81	5.00	5.28
Other sectors	1.42	1.39	1.56	1.58	1.50	1.31
Total	**102. 01**	**105.331**	**103.67**	**103.48**	**109.355**	**109.92**

Source: own calculation.

There were almost 110,000 green jobs in 2010. The largest share was in agriculture, followed by public administration and the water and waste sector. In terms of labour intensity, there are differences between the green and conventional sectors.

Figure 10: Ratio of direct to indirect jobs



Source: own calculation.

Figure 11 compares direct with indirect jobs, showing how many indirect jobs are created per direct job. In agriculture, for instance, the ratio is smaller in the green part of the sector. This is due to the fact that material inputs have been replaced by labour in this sector. The chemical industry exhibits the same pattern to a large extent: the green part of the chemical industry stems from environmental protection measures which are more labour-intensive and less capital-intensive.

The same holds true for the mining industry, though to a lesser extent, because the green parts are in landscape re-cultivation, which calls for inputs from the construction sector and from a variety of services.

4.3 Decent jobs?

The green jobs created between 2005 and 2010, particularly in the area of liquid and solid wastes, are considered decent and sustainable, because the creation of these jobs was in the context of the programmes formally established by the public institutions responsible for managing these sectors. The jobs must meet the following requirements:

- No child labour: collectors and recyclers of waste have to follow the rules and requirements of the ECOLEF, ECOZITT and ECOPiles mechanisms implemented by the National Agency for Waste Management (ANGeD). These rules are established and followed within the specifications of the industry and trades.
- No health risks: collection points as per ECOLEF are managed by ANGeD and collection and recycling operations are known to be well organized.
- No informal activities: during the period 2005-2010, collection points were well organized and formally linked to the ANGeD. The amounts collected are transported for recycling as organized by the ANGeD.
- Jobs created in the context of micro-enterprises in the development of recycling are considered to be decent jobs.

The situation underwent a transformation in 2011, due to the revolution of 14 January 2011, which led to distortions in the waste collection and recycling systems. These distortions and abuses, originating in the relative deterioration of living standards, have led to the growth of informal labour, particularly in recycling and collection. The proportion of informal activity, which will diminish as formal monitoring picks up and circumstances improve due to economic growth, is difficult to estimate today. The situation is considered provisional and therefore treated in a special way within the scope of the post-revolution phase of democratic transition. This situation does not affect the character of the decent green jobs created in the waste and water sector.

4.4 Forecast until 2030 – Assumptions and drivers

Basically, e4.tn is constructed top-down, which means that the initial driver of the projection depends on the exogenously given GDP forecast to 2030. When constant shares are applied, domestic final demand from46 sectors grows each year by the same factor as total GDP. In the baseline scenario, green final demand grows in line with its conventional counterparts.

Baseline GDP growth rates are based on targets published by the Tunisian government. Given the current situation where economic development is concerned (the growth rate for 2013 was 2.5 per cent), they might seem optimistic. However, with the constitution adopted and institutional changes bedding in, the economy should pick up speed in the near future.

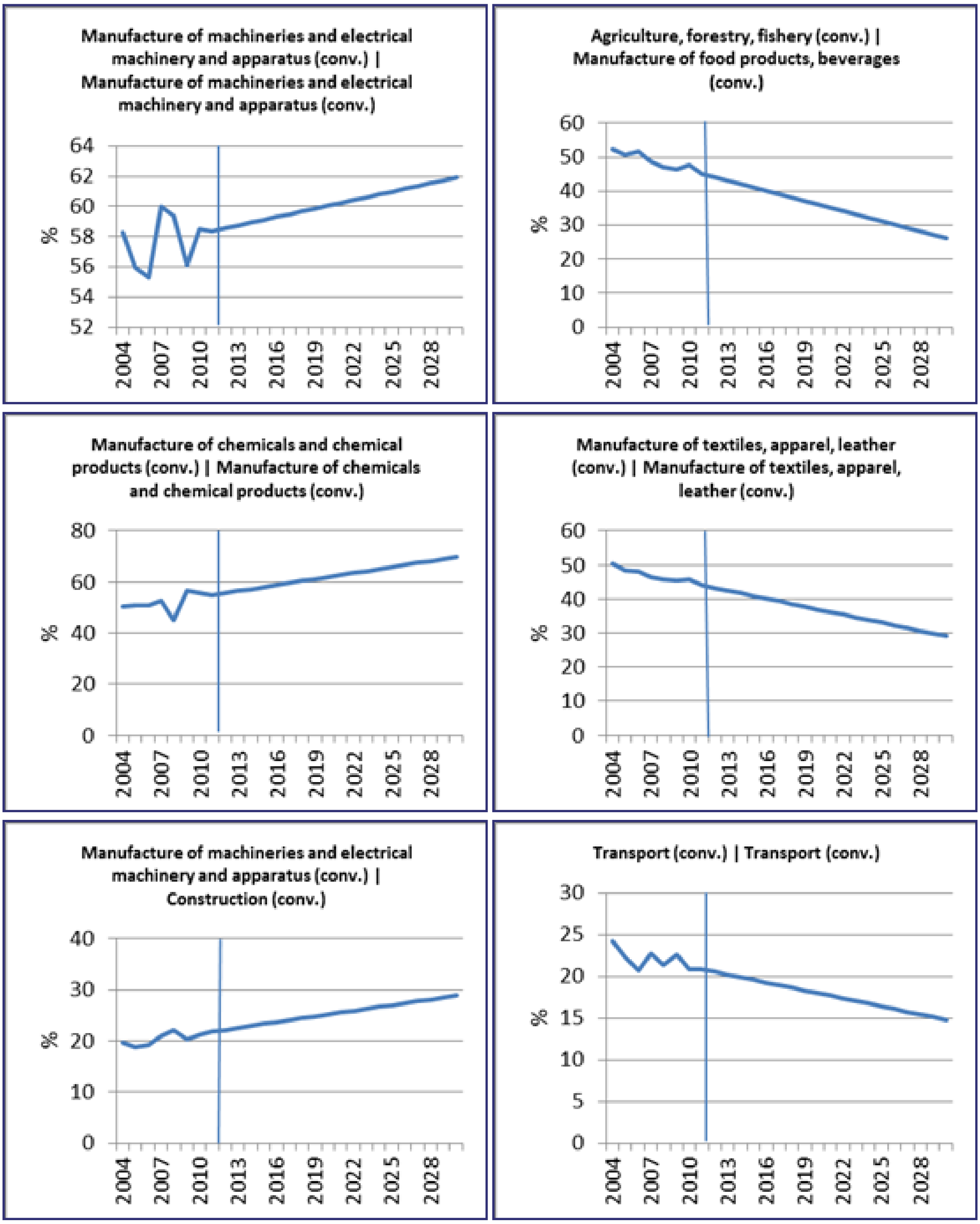
The Leontief production function yields the production figure necessary to satisfy demand. Generally, this function assumes a fixed proportion of input factors, which means that technological change is limited. By making input coefficients time-dependent, technological change can be integrated into the model.

In e4.tn, the nominal input coefficients of the ten largest production sectors are extrapolated by applying a simple trend forecast. The results are shown in the following set of figures. An increasing input coefficient implies that more inputs are needed to produce the same amount of products. On the other hand, a declining input coefficient indicates that fewer inputs are needed for the same amount of production. For instance, the food processing industry shows a declining input demand for agricultural products. There may be many reasons for this, e.g. more efficient machinery or equipment being used in production, which lowers the amount of "lost" inputs.

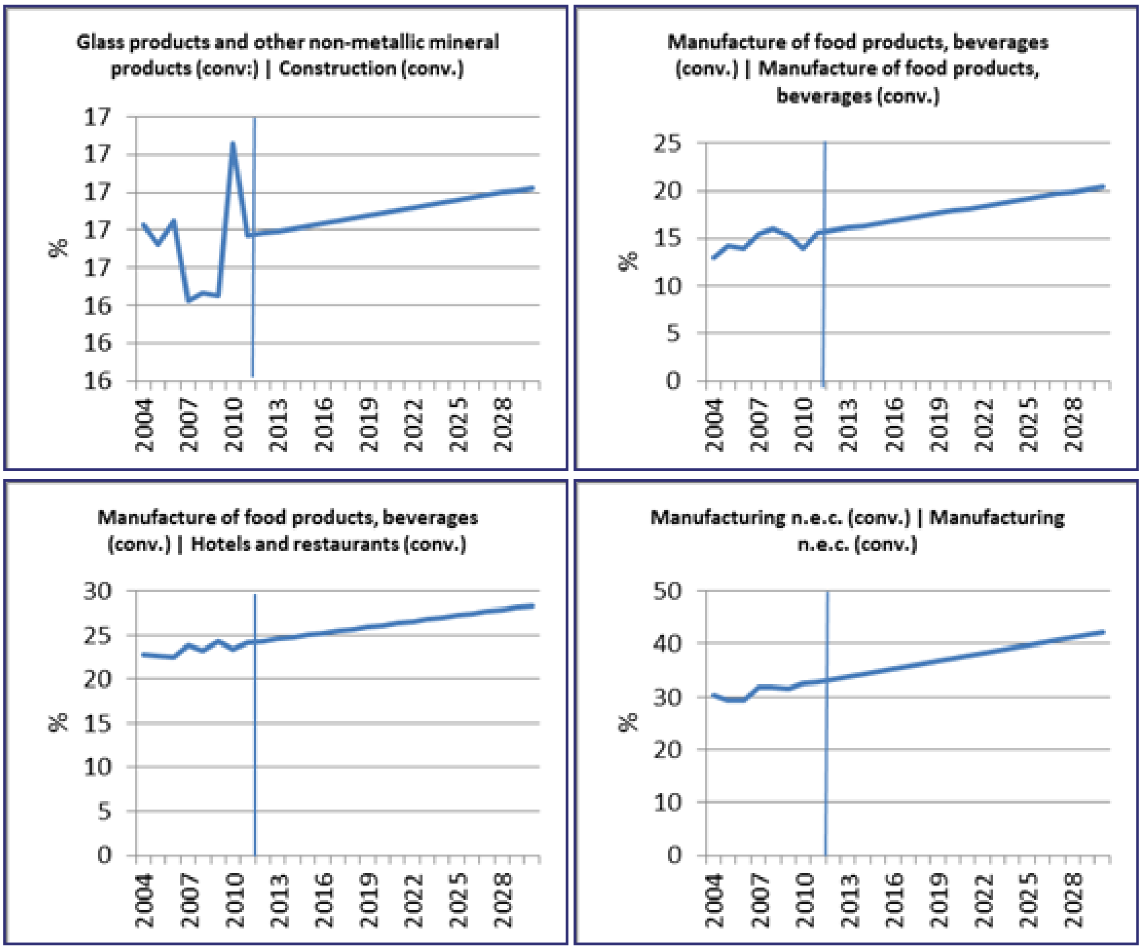
Increasing nominal input coefficients may be induced by either a slow quantitative reaction to price increases or an overall change in the product mix. For example, the chemistry industry faces faster growth in oil prices than in demand. Additional costs cannot be transferred to consumers immediately, because of intense competition or slow economic growth.

A change in the product mix also leads to increasing input coefficients. This is especially true if the labour coefficient is declining, as in the machinery and chemical industries, where labour is increasingly being replaced by technological input. Alternatively, high-quality products may be increasingly used in production, replacing other technology.

■ Figure 11: Variable input coefficients of the ten largest production sectors of Tunisia



Source: own calculation.



For the calculation of employment, two more assumptions are necessary: regarding the development of the active labour force and the development of labour productivity.

In the first place, the numbers in the active labour force – which is defined as people aged between 15 and 65 – depends on an exogenous given population forecast, according to which the total active labour force will increase on average by 2 per cent per annum until 2030.

Secondly, from 2013 onwards the forecast assumes an average labour productivity increase of 0.038 per annum. The employment growth rate is therefore reduced proportionately[13].

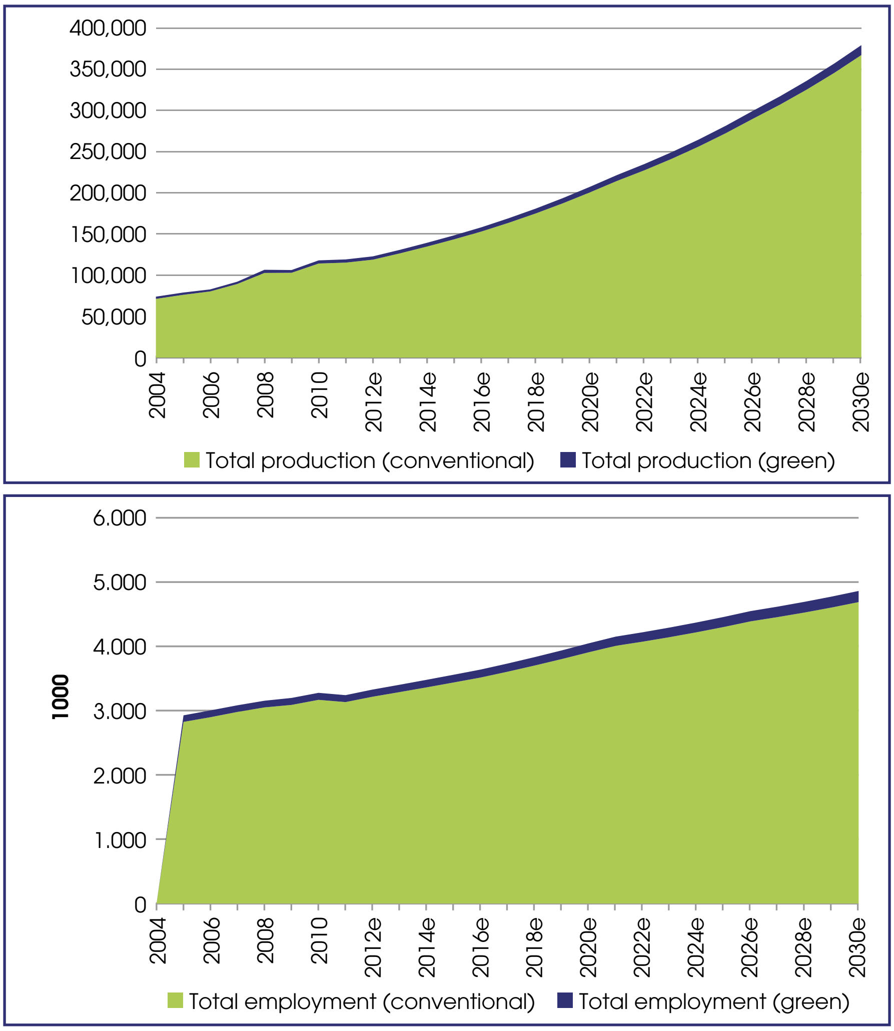
[13] *One participant at the stakeholder workshop proposed adjusting productivity for each sector in accordance with the sector growth rate: sectors with higher growth should increase in productivity faster than sectors which are growing slowly or decreasing in importance. This idea has not been put into practice due to time constraints.*

4.5 The baseline scenario (0 – Basis)

The baseline scenario is a scenario which is driven by GDP alone. GDP is forecast to follow the exogenous growth path shown in Figure 12; no additional assumptions on green growth are made. Hence, all sectors grow at the same rate as GDP. Production is determined by using the Leontief production function. Employment, in turn, is driven by sector-specific production growth. Direct and indirect employment is determined by applying the Leontief-multiplier. Note that the Tunisian Solar Plan is not included in the baseline scenario.

Total employment and production are illustrated in Figure 14. The green and conventional parts are shown in different colours. This reveals that green employment has accounted for and, all things being equal, will continue to account for a rather low portion of total employment. By 2030, total employment will stand at roughly 5 million persons, of whom 97 per cent will be employed in non-green industries. The value of total production is forecast to reach TND386 billion by 2030, most of which will be conventional. Only 1.5 per cent will be classified as green.

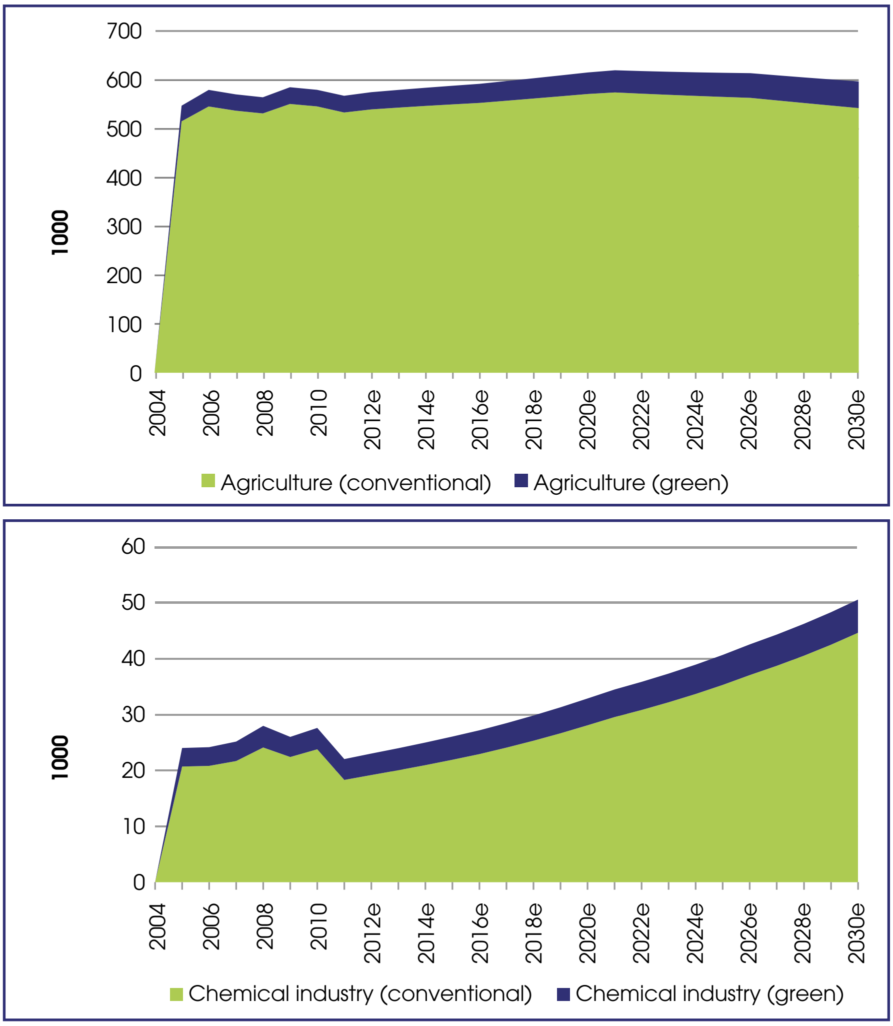
■ **Figure 12: Total employment and production (BASIS) – green and conventional**



Source: own calculation.

The only sectors exhibiting visible green employment are agriculture, waste and water, and administration. And even these sectors exhibit only limited additional dynamics in the business-as-usual world characteristic of the Baseline.

Figure 13: Conventional and green production by sectors



Source: own calculation.

Where direct employment is concerned, we find that differences in labour intensity increase in the projection.

Table 11: Labour-intensity comparison of green and conventional parts of sectors, 2030 (employees/millions of TND)

Agriculture	59.74 60.68
Food industry	4.06 4.07
Textiles	18.22 18.37
Other Industries	13.26 13.29
Machinery and electronics	4.60 4.67

Source: own calculation.

As one would expect, agriculture is the most labour-intensive sector. More than 50 per cent of Tunisian green agricultural production is from olive trees, and this weighs heavily in the results. In terms of inputs, organic olive-growing does not differ significantly from non-organic, and the difference in employment levels is not as great as it might be with other organic crops. Nevertheless, the change in value added and labour intensity is the largest across all sectors.

In the food industry, as well as in textiles, machinery and other industries, higher labour intensities may be due to the smaller size of green companies. The niche effect therefore brings about a scale effect, with green businesses more labour intensive. The effect becomes greater as the green (sub)sectors of the economy increase in importance.

4.6 Scenario 1: Energy efficiency and renewable energy

4.6.1 Scenario description – EE + RE

This scenario assesses the potential for green job creation from programmes and strategies in the areas of energy efficiency and renewable energy. Investment in renewable energy and energy efficiency is combined with the baseline scenario and the baseline GDP growth rates.

In accordance with the strategy for Tunisia's electricity mix to 2030, installed capacity is expected to reach 11,000 MW. Under the Tunisian Solar Plan, electricity will be provided from the following mix of technologies:

- 15 per cent wind
- 10 per cent solar PV
- 5 per cent solar thermal (CSP)

The Tunisian Solar Plan will also help to achieve the following quantitative objectives:

- + 25 per cent RE in electricity generation business as usual (30 per cent total)
- 1,520 MW wind
- 1,930 MW PV south (Gafsa, Kebili and Tataouine)
- 595 MW CSP south
- Total: 11,065 GWh of electricity
- TND7.1 billion investment
- TND343 million a year for operations and maintenance

These objectives are supplemented by:

- 37 MW / year CES (2008-2010: 25 MW / year), goal : 700 MW in 2030
- 3 MW / year biogas

Where energy efficiency is concerned, the scenario anticipates savings of 17 per cent accumulated in the national primary balance by 2020 and 34 per cent by 2030.

Strengthening policies and measures for the rational use of energy will reduce primary energy consumption, as compared to the baseline scenario, by 19 per cent by 2020 and 33 per cent by 2030. Thus, compared to current trends, energy savings in 2030 will amount to 6.5 Mtoe, or TND9,500 million every year. Accumulated energy savings to 2030 therefore add up to TND75,000 million.

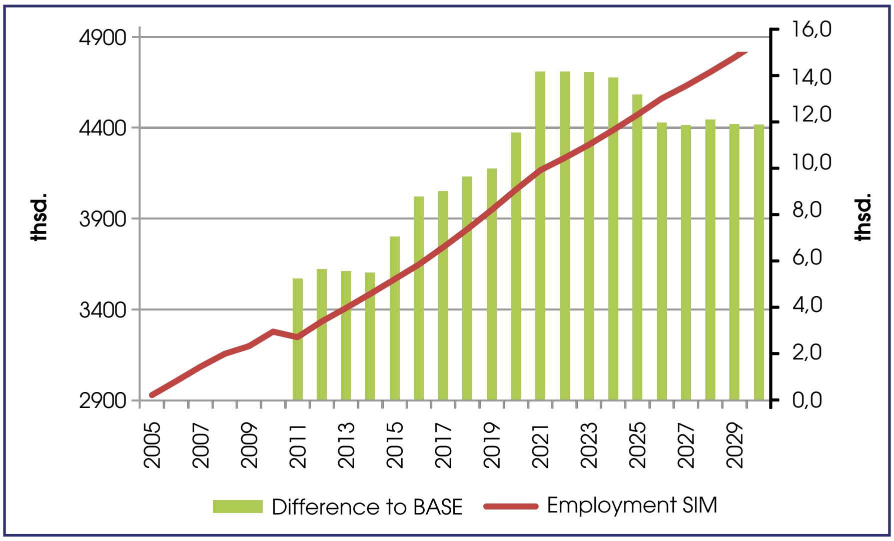
Over the period 2014-2020, the funding requirements for the energy efficiency action plan are estimated at TND2,500 million[14], with TND390 million of incentives coming from the energy transition fund.

4.6.2 Simulation results – EE + RE

The results of this simulation as compared to the baseline are similar to those obtained in GIZ (2013). Up to 10,000 additional jobs can be expected from the Tunisian Solar Plan if large parts of the systems have to be imported. However, if the Tunisian economy achieves higher integration rates and manages to produce most parts of the RE systems within the country, employment may increase by almost 30,000 jobs. Figure 14 illustrates the situation assuming more optimistic import assumptions than GIZ (2013). Employment follows the pattern of investment and rises to 14,000 (read from the scale on the right in the graph).

[14] Study of restructuring of the national Fund for energy conservation - ANME, 2013

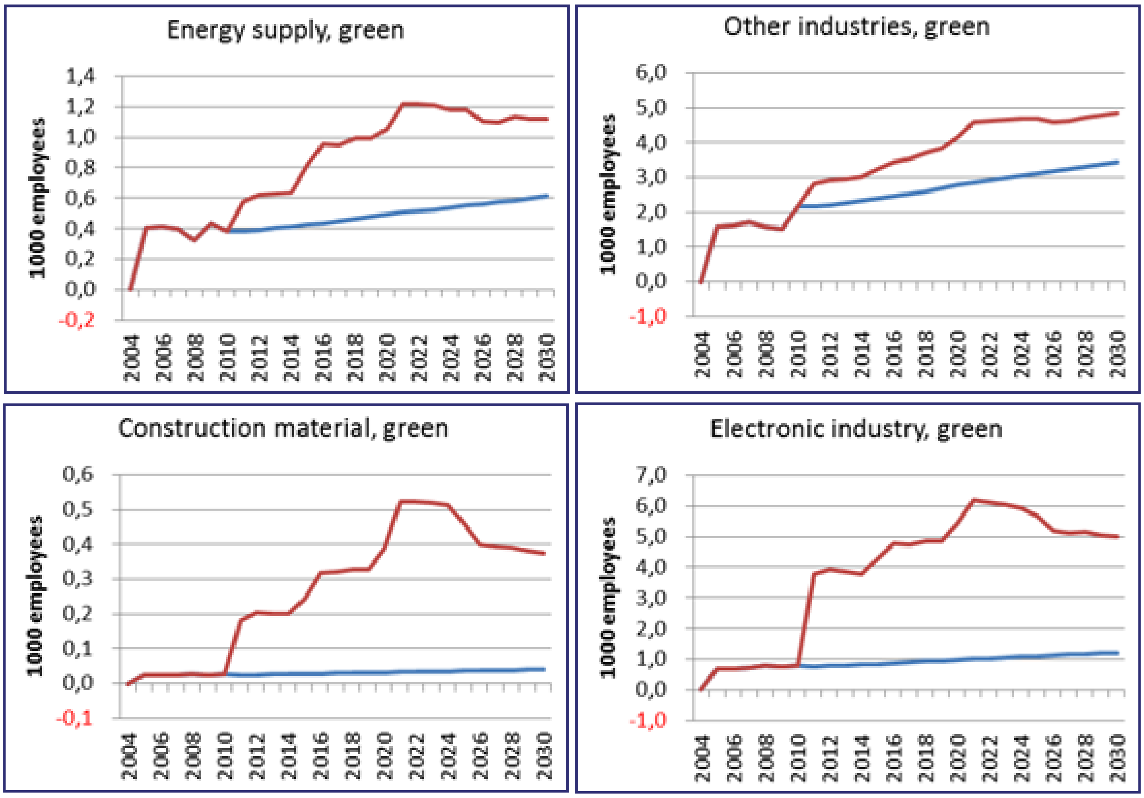
■ **Figure 14: Total employment - difference as compared to the baseline scenario**



Source: own calculation.

Which sectors will benefit? Employment from efforts to improve energy efficiency and develop renewable energy cuts across the whole economy. The following figures show some sectors which particularly benefit from the scenario.

■ **Figure 15: Employment impacts in different sectors (in 1000s of employees)**



Source: own calculation.

Green jobs are created in construction, the electronics industry, construction materials and the electricity sector itself. The impact on construction derives from investment in wind farms and other RE-based electricity generation systems, as well as from the increased energy efficiency of homes.

4.7 Scenario 2: Investment in the waste sector

4.7.1 Description of the scenario - Waste

This scenario assesses the potential for green jobs deriving from programmes targeting the waste sector. GDP growth is maintained as in the previous scenarios.

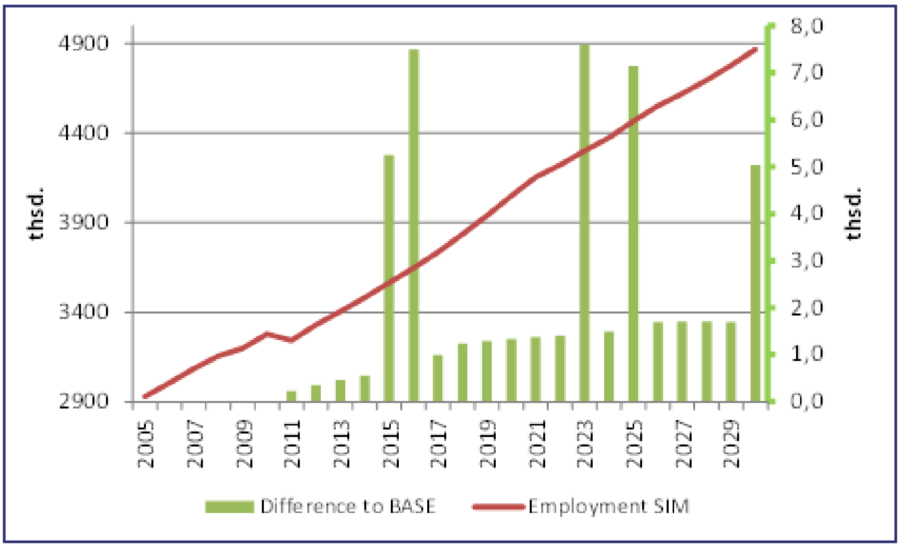
For the solid waste sector, the targets are:

- To create five additional controlled landfills in areas without such landfills. The necessary investment for these measures was originally scheduled for 2015. The landfills will process approximately 750,000 tons of additional waste. These measures will improve the environmental quality of the communities concerned and overall quality of life. The total investment in small and medium-sized landfills is forecast to be TND76 million;
- To create three centres for storing and transferring special and industrial wastes, for an estimated investment of TND35 million;
- The costs of operating landfill infrastructure are estimated at TND250 million, while the costs of operating hazardous and industrial waste infrastructure are expected to be TND25 million;
- To renew infrastructures that have reached their end of life, which is 15 years for landfills, according to the state of the art in the year when renewal is due. The necessary investment amounts to TND490 million for all structured landfills.

4.7.2 Simulation results - Waste

The impact of the planned measures on employment is quite significant, mostly deriving from the steady investment involved. It is augmented by additional employment from the operation and maintenance of the new landfills, the newly established collection systems and overall monitoring.

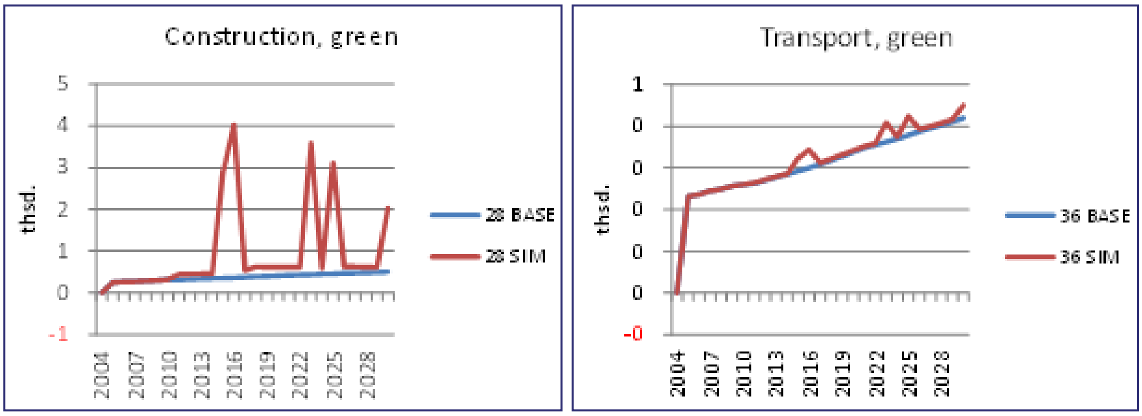
■ **Figure 16: Overall additional employment from waste management measures**



Source: own calculation.

In the peak investment phases, employment is created for almost 8,000 people, while operation and maintenance account for almost 2,000 additional jobs.

■ **Figure 17: Additional employment by sector**



Source: own calculation.

Jobs are also created in the transport sector, as waste needs to be is transported to the new sites.

4.8 Scenario 3: Water sector

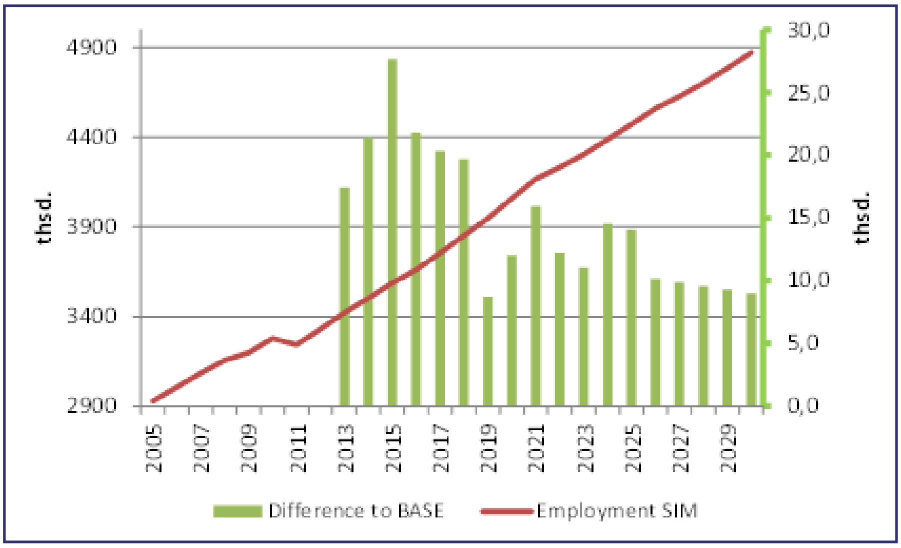
4.8.1 Scenario description - Water

For the water sector, the scenario includes:

- Investment by SONEDE of approximately TND1,000 million in water desalination in the south of Tunisia over the period 2015 to 2026;
- Estimated expenditure of TND200 million for operation and maintenance of the desalination infrastructure over the period 2015-2030;
- Investment of approximately TND1,200 million in infrastructure for pumping and treating drinking water;
- Estimated costs of TND103 million for operating and maintaining the drinking water pumping and treatment infrastructure;
- Investment of approximately TND2,610 million in sewage and wastewater infrastructure, including operating and maintenance costs.

4.8.2 Simulation results – Water

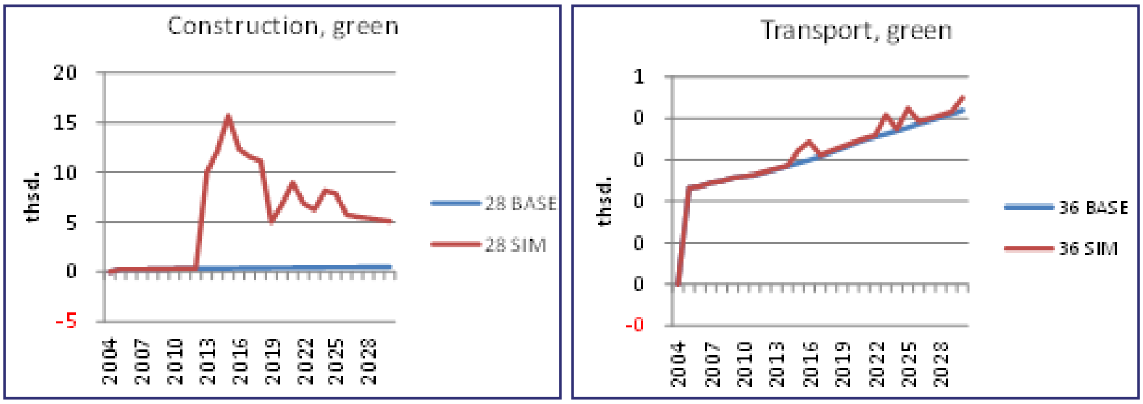
Figure 18: Additional employment from measures in the water sector



Source: own calculation.

A significant impact on employment is to be expected, given the high level of investment. Again, most of additional employment comes from the construction sector, with up to 30,000 new jobs created during the peak investment phase. As many as 5,000 new jobs can be expected from operation and maintenance.

■ **Figure 19: Employment changes in water sector**



Source: own calculation.

The additional employment from operation and maintenance can be read on the right side of the graph. This employment is generated within the sector itself, which will have to employ up to 5,000 additional people.

4.9 Scenario 4: Organic agriculture

4.9.1 Scenario description – Organic agriculture

A programme is currently being developed with a view to achieving the national strategy targets that were set for 2016: to double exports of Tunisian organic products and achieve a turnover of TND120 million per annum; to have 500,000 hectares of land certified as organic; and to achieve national consumption of organic products in excess of 1 per cent. Each of these objectives will contribute directly to the development of rural job creation for young graduates and rural women, as well as to the preservation of the environment and human health.

This scenario assesses the potential for green jobs deriving from programmes and strategies in organic agriculture, while maintaining GDP growth on the trend path (GDP growth rate equals the corresponding baseline).

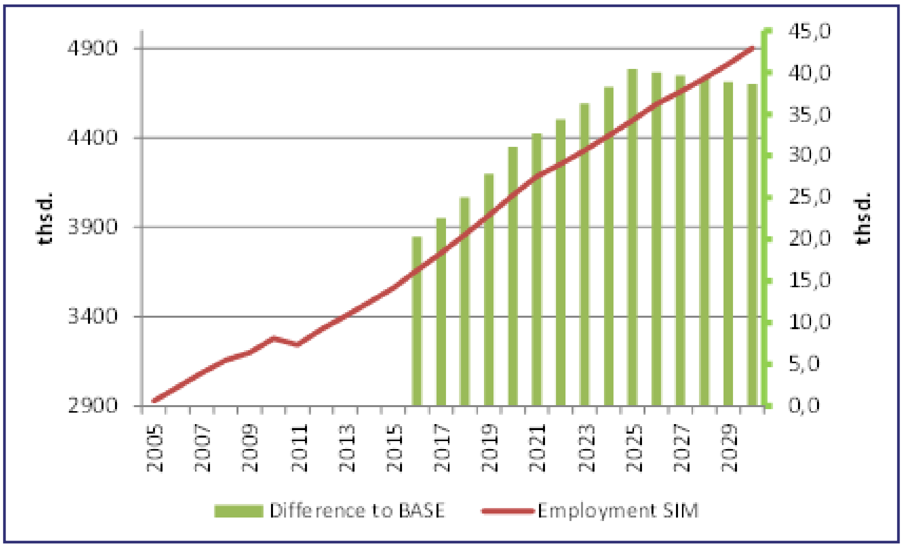
Under this scenario, given that approximately 50 per cent of the land is currently used for olive-growing, the total organic land area will reach 1.5 million ha, of which 1 million ha is reserved for olives and 500,000 ha for other crops.

Additional demand will be generated by domestic demand and increasing exports to the EU. Organic agricultural produce will fulfil EU labelling criteria and will be certified as organic (see discussion on organic agriculture in Tunisia, above).

Given the limited amount of irrigated land, the scenario further assumes that some the organic agriculture will be the result of a shift from conventional agriculture. This means that not all organic agricultural production will be additional; the scenario assumes that half of it is accounted for by a shift from the conventional sector.

4.9.2 Simulation results – Organic agriculture

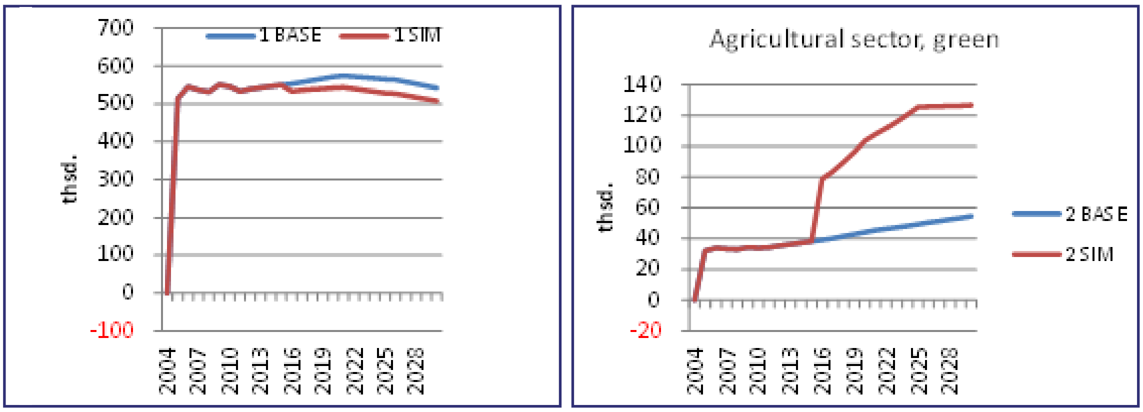
■ **Figure 20: Additional employment from organic agriculture**



Source: own calculation.

Organic agriculture is the sector with the highest impact on the economy. It is expected to create up to 40,000 additional jobs, mainly in the sector itself. As explained above, organic agriculture does not need as much input of materials as conventional agriculture, but is more labour-intensive.

■ **Figure 21: Employment changes in the agricultural sector**



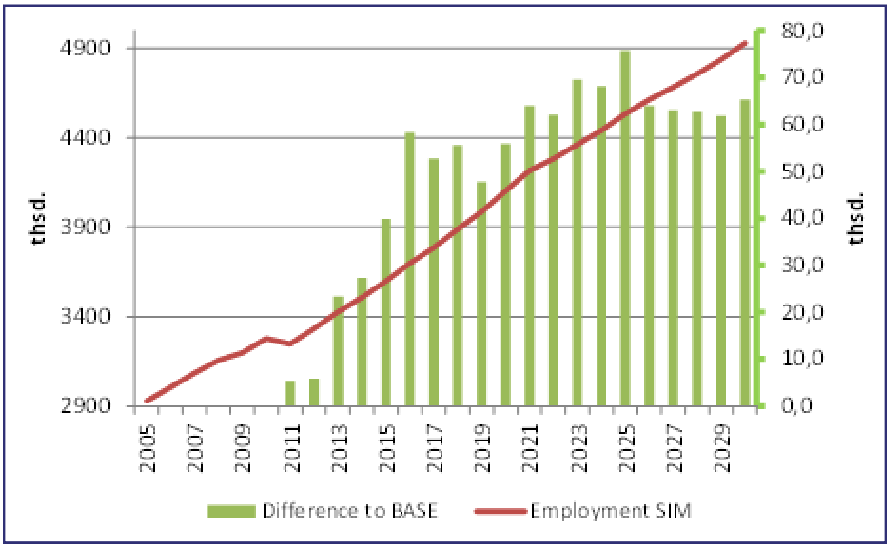
Source: own calculation.

Figure 21 shows the shift from conventional agriculture to organic agriculture. Other sectors, such as trade and transport, also benefit slightly from the additional activity in the organic agricultural sector.

4.10 Scenario 5: Greening Tunisia

In the following scenario, we show the combined effects of the green measures and strategies. The underlying assumption is that Tunisia will develop a vision for a more sustainable and healthier form of economic development, with green jobs being created in this transition process.

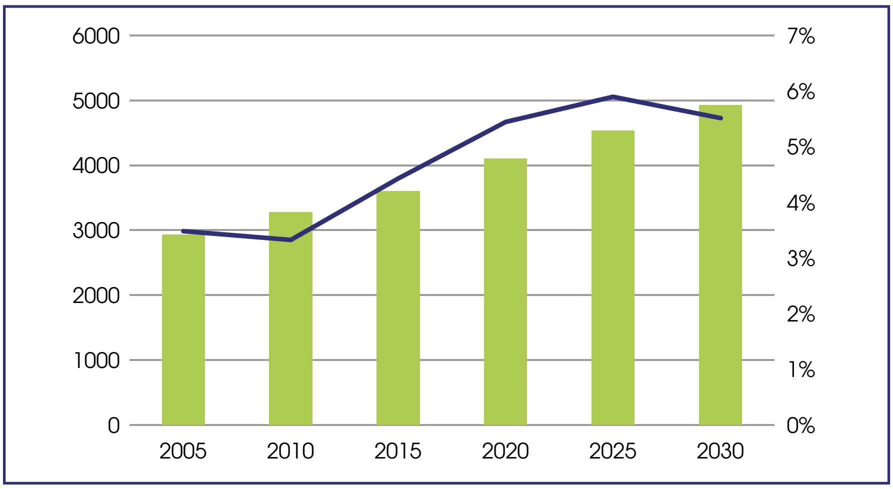
■ **Figure 22: Additional employment from the green economy**



Overall additional employment from Tunisia's vision for a green economy amounts to80,000 people. Note that this is a very conservative estimate, because the vision does not foresee new measures in the waste sector. A future rigid and stringent strategy in the waste and water sector, in energy and efficiency and in the agricultural sector will lead to this additional employment creation and to a healthier and safer environment.

As a result, the overall national employment figure increases to almost 5 million people, and green jobs to 272,000. The share of green employment increases to more than 5 per cent of the total.

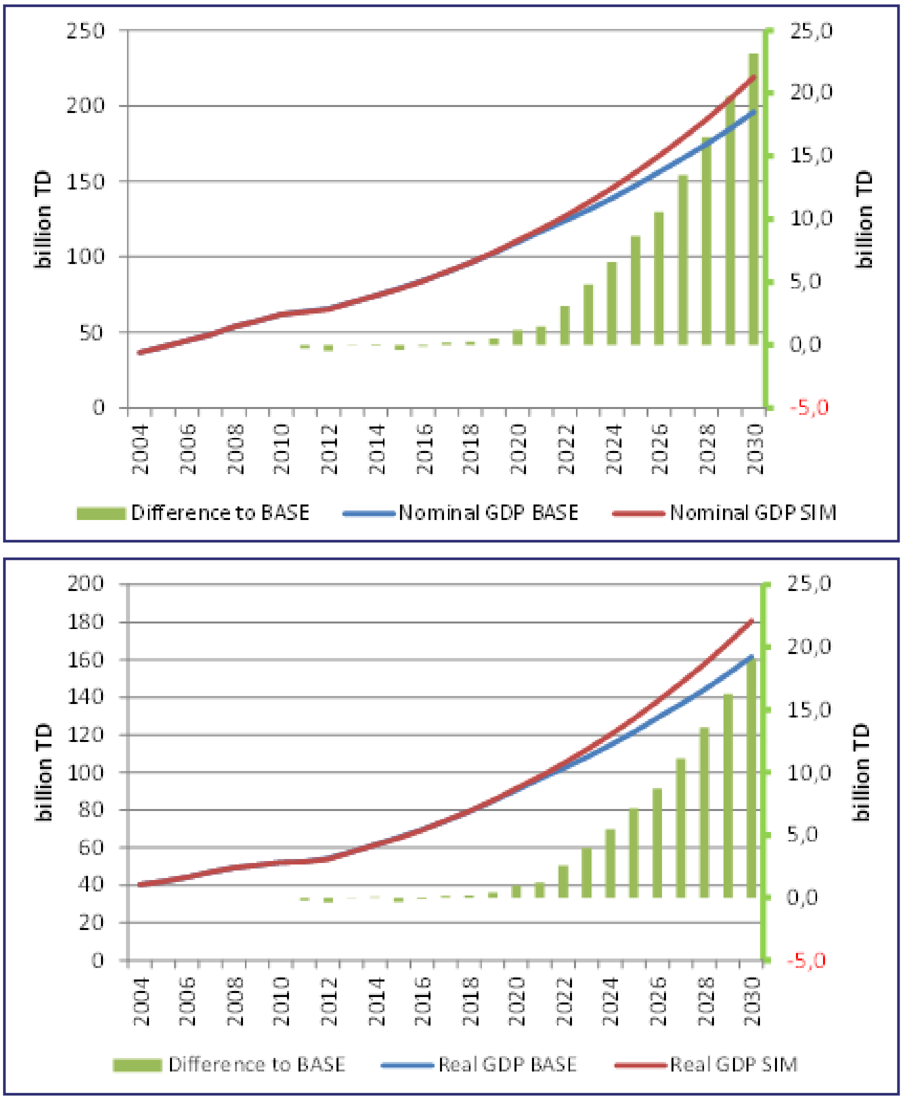
■ **Figure 23: Employment and the share of green jobs in Tunisia by 2030**



4.11 Scenario 5: Greening a growing Tunisia

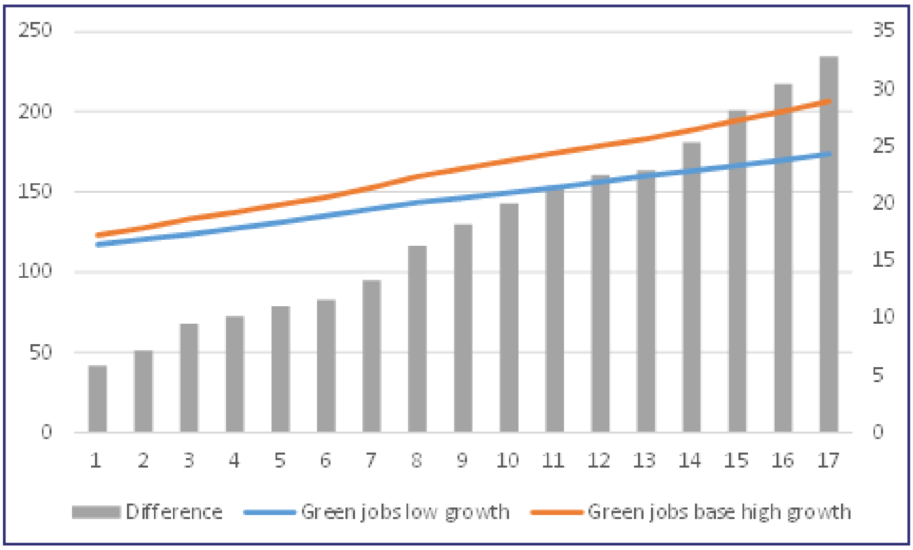
Stakeholder workshops were part of the study. They revealed interest in the effects on a higher GDP growth rate baseline. Basically, the effects as such do not change. Higher GDP growth – here we assume 7 per cent – results in a difference of nominal GDP in 2030 of about TND25 billion.

■ **Figure 24: Nominal and real GDP**



Overall employment is higher than in the scenario with the lower growth path. All the other scenarios shift accordingly.

Figure 25: Additional employment from additional growth



Green jobs are also positively affected by higher growth. The higher growth scenario yields more than 30,000 jobs. Comparing the two scenarios, high growth plus all green impacts yields more than 110,000 jobs more than low growth with no green policy measures.

Conclusions and outlook

5

This report set out to answer the following questions about Tunisia and the Tunisian economy:

1. How can the established economic tool of input-output analysis (IOA) be applied to the measurement of green jobs?

2. What are the characteristics of green sectors?

3. Are the jobs derived from the green IOA all decent?

4. What about the informal sector?

We arrived at the following conclusions:

5.1 Input-output analysis

We developed a 46 by 46 matrix from the Tunisian 23 by 23 input-output table (IOT), which is consistent with the original data. It was calibrated with historical data and enabled us to calculate green jobs in Tunisia by making moderate additional assumptions. The data requirements were high and it proved difficult to find available data for green products. We therefore employed the Leontief equation for the historical data model, deducing green demand from the data on green production.

To estimate future development, we projected green demand in line with GDP growth and employed the Leontief equations to estimate future green production and thus employment.

To model a more challenging scenario of green growth, we augmented sectoral demand with estimates of programmes and strategies in the waste and water sector, in renewable energy and in organic agriculture. According to this scenario, the Tunisian economy is likely to generate more than 80,000 additional jobs.

5.2 Typical features of green sectors

Green sectors lower environmental pressures and create better and healthier living conditions. This holds true for the waste and water sector, for energy from renewable sources, for the construction sector when it creates energy-efficient homes and buildings, and for the agricultural sector if it moves to organic production.

All the other sectors also contribute: the machinery sector produces material inputs for the electricity sector and for agriculture, while services contribute to all the sectors mentioned.

Some green sectors are more labour-intensive. This is due either to different production processes, as in agriculture, or to the smaller size of production units.

The costs of an additional job in most green (sub-)sectors are not much higher than in their conventional counterparts. In other countries, green construction has proved to be only one or two per cent more expensive than conventional building, while green agriculture is characterised by lower spending on materials and higher labour costs.

Renewable energy currently involves additional costs, but developments over the last two years have shown how rapidly costs can come down.

The costs of the measures envisaged in the waste and water management sector are mostly comparable with conventional investment elsewhere. More high-tech applications, such as CSP desalination, require additional investment.

5.3 Decent jobs and the informal sector

Tunisia has high standards governing the protection of workers, children and vulnerable groups. However, data on the current situation (i.e. in the third year following the revolution) are not obtainable. Our estimates therefore focus on the formal labour market; thoughts on the informal sector can be found in the appendix.

5.4 Future work

The simulation model and approach proposed here should be regarded as explorative. To simulate complete strategies with monetary incentives, the approach would need to be complemented by a system covering national accounts and budgets, as well as demand equations estimated from time series. Within such a framework, it would be possible to analyse reactions to price changes, and produce estimates of green job creation and the transition to a green economy, on a more secure basis.

References

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- Abdih, Yasser & Medina, Leandro (2013): Measuring the Informal Economy in the Caucasus and Central Asia. IMF Working Paper WP/13/137. International Monetary Fund. May 2013.
- Albrecht, James; Navarro, Lucas; Vroman, Susan (2006): The effects of labour market policies in an economy with an informal sector, IZA Discussion Papers, No. 2141
- Bacchetta, Marc; Ernst, Ekkehard; Bustamante, Juana P. (2009): Globalization and informal jobs in developing countries. A joint study of the International Labour Office and the Secretariat of the World Trade Organisation.
- Boughzala, Mongi (2013): Youth employment and economic transition in Tunisia. Global Economy and Development at Brookings. Working Paper 57. January 2013.
- Boughzala, Mongi; Kouki, Mokhtar (2003): Unemployment Persistence and the Informal Sector. ERF Working Paper Series No. 0326. Economic Research Forum for the Arab Countries.
- Duchene, Gérard; Seghir, Sonia (2009) : Le développement du secteur informel en Tunisie: Une politique de libéralisation en trompe-l'oeil. Proceedings of the First Conference of the GDRI DREEM, "Inequalities and development in the Mediterranean countries ", 21-23 May 2009, Istanbul, Turkey. Preliminary version.
- Eurostat (2008): Eurostat Manual of Supply, Use and Input-Output Tables, Eurostat Methodologies and Working Papers.
- Governing Council (2011) Tunisia: A country fact sheet on youth employment.
- Hussmanns, Ralf (2004): Measuring the informal economy - From employment in the informal sector to informal employment. International Labour Office. Working Paper No. 53. December 2004. Geneva.
- ILO (2000): Resolution concerning statistics of employment in the informal sector, adopted by the Fifteenth International Conference of Labour Statisticians (January 1993); in Current International Recommendations on Labour Statistics, 2000 Edition; International Labour Office, Geneva, 2000.
- ILO (2013a): Measuring informality - A statistical manual on the informal sector and informal employment. International Labour Organization. Geneva.
- ILO (2013b): Decent work and the informal economy. International Labour Organization. Geneva.
- ILO (2013c): Growth strategies and quality employment generation. International Labour Organization. Geneva.

- ILO (2013d): What is a green job? http://www.ilo.org/global/topics/green-jobs/news/WCMS_220248/lang--en/index.htm
- Jarvis et al. (2011)
- Maloney, William F. (1999): "Does Informality Imply Segmentation in Urban Labor Markets? Evidence from Sectoral Transitions in Mexico", World Bank Economic Review, 13, 275-302.
- Schneider, Friedrich; Buehn, Andrease; Montenegro, Claudio E. (2010): Shadow Economies all over the World - New Estimates for 162 Countries from 1999 to 2007. World Bank. Policy Research Working Paper WPS 5356.
- Sengenberger, Werner (2005): Beschäftigung und Arbeitsmarkt in Entwicklungsländern im Kontext wirtschaftlicher Globalisierung. Hintergrundspapier zur Herbstsitzung der Sektion Arbeits- und Industriesoziologie der DGS am 4. und 5. November 2005 in Mannheim. Arbeitspapier 9. November 2005.
- Singh, Anoop; Jain-Chandra, Sonali; Mohommad, Adil (2012): Out of the Shadows. In Finance & Development. Pp. 42-45. June 2012.
- Tansel, Aysit&Kan, ElifOznur (2012): Labor mobility across the formal/informal divide in Turkey: evidence from individual level data. Department of Economics, METU.
- Vuletin, Guillermo (2008): Measuring the Informal Economy in Latin America and the Caribbean. IMF Working Paper WP/08/102. International Monetary Fund. April 2008.

Appendix I – The informal labour market

7

In the light of the above analysis of the greening potential of the Tunisian economy, this chapter focuses on the informal sector in Tunisia, which we first describe in more detail.

7.1 The informal labour market

Shadow economy, black economy or unreported economy are terms often used as synonyms for the informal economy. The reference is to unregistered activities that are hidden from the state, the tax system, the social security system and legal regulation. In 2000, the ILO developed an international definition of employment in the informal sector (ILO 2000), according to which a job within an enterprise is characterized as informal if (i) the enterprise is private and unincorporated; (ii) all or the majority of the goods are meant for sale or barter; (iii) the enterprise and its employees are not registered; (iv) the enterprise has only a small number of employees and (v) is not engaged in agricultural activities (Hussmanns 2004 p. 3).

In general, it is possible to identify two strands of drivers for the informal economy. On the one hand, the informal sector is associated with market inefficiency and lack of reform and, on the other, with the motivation to evade mandated protections (Maloney 1999 p. 275). Depending on the state of development of an economy, some drivers of informality are more important than others. The following non-exhaustive list of such drivers begins with those that are especially dominant in developing countries. Those relating to taxation and regulation are more applicable to industrialized economies.

- Poverty fosters the informal sector as it represents the only source of employment and source of income for the poor (ILO 2013a p. 3);
- Overall (formal) economic performance is negatively correlated to the size of the informal economy. The better the performance of the formal economy, the smaller the informal sector (Schneider et al. 2010 p. 8) and vice versa;
- Trade-induced pressure on industries increases formal sector demand for services from the informal sector (ILO 2013b p.8).

In developing economies, the first of these points is the major driver. Informal activities include, for example, the repair of tools and other equipment, shoe-shining, street vending or the picking and reutilization of waste (Sengenberger 2005 p. 5). The more developed the economy, the more the motivation for informality shifts towards tax evasion and cost minimization. As a means of maintaining or gaining (international) competitiveness, these activities are also often tolerated by national administrations (Sengenberger 2005: p.5). Hence, the degree of economic development is not in itself sufficient to explain informality, but rather a determinant of the effective drivers of informality.

The informal part of the economy is generally viewed negatively, as workers often lack social security schemes and labour rights. It implies a loss of tax revenues and therefore adversely affects the state's budget and capacity for expenditure. The result is a vicious circle, whereby low economic prospects lead to further growth of the informal sector and to a further decline in state expenditure. In addition, policymaking is highly ineffective in countries with large informal sectors because the informal sector is, by definition, beyond the reach of regulations and law enforcement strategies. However, the informal sector also acts as a back-up system to compensate for recession and underdevelopment in the formal sector. Especially in developing countries, the informal sector offers a source of livelihood and means of subsistence to those living on the margins (Singh et al. 2012 p. 42).

Firms active in the informal sector are characterized by inefficiency, which is mostly the result of their non-registered status. Informal enterprises have only limited access to modern technologies and government support / subsidies, and their capital endowment is mostly very low (Boughzala & Kouki 2003 p. 2). People who work in the informal sector are mostly low-paid and perform labour-intensive tasks.

Measuring the size of the informal sector is challenging because of the nature of the sector itself: because its activities are unregistered, no reliable statistics exist. However, it is important to try to quantify the size of the informal sector for various reasons:

- It is characterized by tax evasion and loss in tax income (Vuletin 2008 p. 3);
- It impacts the social security system and its capacity to provide services (Vuletin 2008 p. 3);
- It undermines the effectiveness of policy instruments (Vuletin 2008 p. 3);
- It is a potential driver of anger and frustration (Abdih & Medina 2013 p. 3; Boughzala 2013 p.8);
- It has implications for the formal sector (Albrecht et al. 2006 p.1).

There are direct and indirect methods for estimating the extent of the informal economy, both of which have their advantages and disadvantages. The direct method relies on surveys and questionnaires, with the associated risk of biased answers; the indirect approach uses estimation techniques, with all the problems of choosing correct indicators. (Schneider et al. 2010 p.8ff)

According to the ILO (2013a, p. 3), informal enterprises contribute a large share of gross added value. Many studies have used estimation techniques to try to assess the size of the informal economy, e.g. Vuletin for Latin America and the Caribbean (2008) or Abdih et al. for the Caucasus and Central Asia (2013). Schneider et al. (2010) have calculated the size of the informal sector for 162 economies. Their study confirms the notion that the less developed the economy, the greater the size of the informal sector.

Policymaking is difficult in economies with large informal sectors, as the policies concerned apply only to the formal sector. There are, however, spill-over effects between the formal and informal sectors, and these may have important implications for policymakers. The formal and informal sectors coexist in most countries but are not independent to each other. Moreover, the formal sector often depends on the existence of the informal sector for sub-contracting or home-based work. The informal sector, for its part, is reliant on the existence of the formal sector (ILO 2013a p. 5). Empirical research on mobility between the formal and informal sectors supports this observation (Albrecht et al. 2006; Maloney 1999). The main drivers for switching from the formal to the informal sector can be summarized as: (i) inefficiency in formal sector protections and (ii) low levels of labour productivity (Maloney 1999 p. 275).

In Turkey, Tansel & Kan (2012) examined the situation of informal workers with respect to such attributes as gender, education, age, occupation and sector of economic activity. They found that women especially are more often informally employed than men and that young and elderly persons are more often active in the informal sector than the middle-aged. The higher his or her educational level, the less likely a person is to be in informal employment. Professionals, technicians and clerks are mostly formal workers, while skilled agricultural workers, service workers and those performing elementary operations are more commonly found in the informal sector. Agriculture and construction are the sectors with the highest degree of informal employment. In contrast, mining, utilities, finance, education, health and public administration sectors are characterized by greater formality.

7.2 The case of Tunisia

In a table of 151 countries, Tunisia ranks 97th (Schneider et al. 2010 p. 27, Table 3.3.6).

Table 12: Ranking of 151 countries according to the size of their informal sectors (measured as percentage of official GDP)

No. Country	1999	2000	2001e	2002e	2003e	2004e	2005e	2006e	2007e	Ø
1 Switzerland	8.8	8.6	8.6	8.6	8.8	8.6	8.5	8.3	8.1	8.5
97 Tunisia	**38.7**	**38.4**	**37.8**	**37.8**	**37.4**	**36.9**	**36.7**	**35.9**	**35.4**	**37.2**
151 Bolivia	67.0	67.1	67.6	67.7	67.7	66.9	64.3	62.8	63.5	66.1

(Schneider et al. 2010 p. 37-30, Table 3.3.6)

In terms of GDP, these figures suggest that the informal sector in Tunisia is of average size. Relative to other developing economies, its position is better: out of 88 developing economies, Tunisia ranks 50th. Even so, the size of its informal sector is far from insignificant.

The Governing Council (2011, p. 2) estimates that 40 per cent of the Tunisian labour force is absorbed by the informal sector. This figure is supported by Duchene & Seghir (2009), who estimate the absorption rate of the informal sector at 42.2 per cent of total employment. A slightly higher rate has been estimated by Boughzala & Kouki (2003, p. 9): based on survey data for 1997, they reckon the informal proportion of non-agricultural employees to total labour force to be 49.9 per cent.

The informal sector in Tunisia is likely to decrease with the greening of the economy, which implies a transition to a higher and more dynamic growth path for the economy as a whole. Greater economic growth improves employment prospects in the formal sector: there are more opportunities for switching from the informal to the formal sector, and higher incomes and more job opportunities reduce the informal workforce. The economic sectors that will profit most from a greening economy are agriculture, waste collection and water distribution, and service sectors involved in general cleaning and repairs. The construction sector, the electricity and gas industries and other services related to manufacturing are also likely to benefit from green growth. In all of these sectors, growth prospects are likely to improve, which in turn increases the demand for labour and, eventually, leads to higher formal employment levels. The construction sector, in particular, will benefit from developments in the field of renewable energy and, as this sector probably employs the highest proportion of informal labour, this should also lower the number of informal workers.

Economic growth is important in overcoming informality, but it is not in itself the solution to the problem (ILO 2013c p. 3; Bacchetta et al. p. 9). The greening of the Tunisian economy will help to reduce the size of the informal sector, but will not be sufficient to eliminate it. In the worst case scenario, economic growth might merely lead to a reshuffling of the composition of the informal sector: .

A combination of economic growth and accompanying policy strategies, such as the introduction of regulatory frameworks, the strengthening of institutions and support for entrepreneurship and development, may therefore be necessary to ensure the effective downsizing of the informal sector (ILO 2013c p. 12). A combined approach to tackling informality is even more important, as the transition to a green economy will primarily increase the demand for highly skilled workers. The large pool of unskilled and low-skilled workers that represent the majority of the informal sector are likely to be unaffected by this process. Moreover, because of their poor efficiency, low productivity and high labour intensity, firms active in the informal sector may well stand aside during the greening process. It is firms that are capable in increasing efficiency and productivity that will prosper in this process.

Appendix II – Sectoral case studies

8

8.1 Agriculture, forestry and fishing

In the first part of this section, we present an overview of the sector, listing the contents of the sector and the related subsectors. We also indicate the products that are produced in the sector and its subsectors, as reported in the Statistical Yearbook of Tunisia.

The agriculture, forestry and fisheries sector comprises the following subsectors:

- 01 Crop and animal production, hunting and related services
- 02 Forestry and logging
- 03 Fishing and aquaculture

The distribution of the country's arable land by categories gives an overview of land use and therefore a first indication of the products grown there. The following table indicates the areas of arable land used for growing different crops. The total area of Tunisia is 162,155 km^2 and the arable area is 49,530 km^2, which is 30.5 per cent of the total. Of this total area, 9 per cent is planted with cereals and almost 1 per cent with vegetables. Fourteen per cent is used for growing fruit trees.

Table 13: Distribution of land area by categories in km^2, 2011[15]

Arable area	49 530
Fallow	5 942
Other land (cultivated)	41 384
Range land (pasture), esparto grass, scrub	48 391
Wood and forest	6 661
Cereal	14 796
Fodder	4 414
Annual	*3 024*
Multiannual	*1 390*
Vegetables	1 564
Dry legumes	875
Dried beans and févroles	*603*
Small weight and poichiches	*191*
Other land (grown)	*81*
Tree fruits	22 560

[15] *National Institute of Statistics - Tunisia: Annuaire Statistique de la Tunisie 2007-2011. 2012 edition. Page 122.*

In the following paragraphs, we present a complete breakdown of the crop and animal production, hunting and related services subsectors, with all the related positions and sub-positions.

For cereals, some production data are available in the Statistical Yearbook of Tunisia. Cereals are classified under position 01.1 (Non-perennial crops) and sub-position 01.11 (Cereals (except rice)). It can be seen from the following table that wheat is the main cereal cultivated in Tunisia. In the period from 2000 to 2011, the production of cereals grew by 7.1 per cent per annum. The reasons for this growth are not analysed here, because this is not the focus of our study. The reasons for higher outputs could be a larger area under cultivation, more adequate irrigation, more or better fertilizers, better use of machinery, or economic reasons, such as higher prices or higher subsidies.

The value of this production in Tunisian Dinars, which is much closer to the values of the Tunisian input-output table, is not available in the Statistical Yearbook. It may be available in some documents on the agricultural sector published by the Statistical Office of Tunisia.

Table 14: Cereal production per variety in 1000 Mg[16]

Year	1990	2000	2005	2009	2010	2011	Annual average growth rate in percent 2000-2011
Durum wheat	897	706	1291	1354	671	1321	5.9
Common wheat	225	136	336	300	151	284	6.9
Barley	477	241	465	855	237	681	9.9
Triticale	34	3	5	25	21	24	20.9
Total	**1633**	**1086**	**2097**	**2534**	**1080**	**2310**	**7.1**

Sub-position 01.13 (Vegetables and melons, roots and tubers) is another group of products for which data are available in the Statistical Yearbook. The following table shows that potatoes, tomatoes and watermelons account for a large share of production. Here again, output has increased since the year 2000. The values in Dinars, which are relevant for the input-output table, are not given in the Statistical Yearbook.

16 *National Institute of Statistics - Tunisia: Annuaire Statistique de la Tunisie 2007-2011. 2012 edition. Page 121.* http://www.ins.nat.tn/en/serie_annuelle.php?Code_indicateur=2001020 *Durum wheat or macaroni wheat is the wheat of commercial importance that is most widely cultivated today.* http://en.wikipedia.org/wiki/Durum_wheat *Triticale is a hybrid of wheat (Triticum) and rye (Secale) first bred in laboratories during the late 19th century.* http://en.wikipedia.org/wiki/Triticale1

Table 15: Vegetable production in 1000 Mg[17]

Year	1990	2000	2005	2009	2010	2011	Annual average growth rate in percent 2000-2011
Potatoes	217	290	310	324	370	367	2.2
Tomatoes	530	950	960	1135	1296	1284	2.8
Pepper / Paprika	175	190	256	281	304	268	3.2
... Melons, watermelons	450	370	446	475	498	470	2.2
... Other vegetables	532	559	594	721	736	731	2.5
Total 1000 tons	1904	2359	2566	2936	3204	3120	2.6

Compared to the other products grouped under position 01.1 (Non-perennial crops), the tobacco crop is very small: the other tables are expressed in 1000 Mg, whereas this table is expressed in Mg. Furthermore, the land area on which tobacco is grown (12.6 km²) is tiny compared to the area used for growing cereals (14,796 km²).

Table 16: Tobacco production in Mg and related area in km² [18]

	year unit	1990	2000	2005	2009	2010	2011	Annual average growth rate in percent 2000-2011
Snuff tobacco	Mg	1336.0	393.0	228.0	126.0	147.0	113.0	-10.7
Smoking tobacco	Mg	5512.0	3043.0	2820.0	1496.0	1476.0	1517.0	-6.1
Snuff tobacco	km²	5.3	2.1	1.3	0.8	0.8	0.8	-8.5
Smoking tobacco	km²	48.7	30.3	21.1	11.9	11.3	11.8	-8.2

The production of beans is also presented in the Statistical Yearbook, under position 01.17 (Leguminous crops and oil seeds). Production increased enormously in the period from 2000 to 2011.

[17] *National Institute of Statistics - Tunisia: Annuaire Statistique de la Tunisie 2007-2011. 2012 edition. Page 123.* http://www.ins.nat.tn/en/serie_annuelle.php?Code_indicateur=2001060

[18] *National Institute of Statistics - Tunisia: Annuaire Statistique de la Tunisie 2007-2011. 2012 edition. Page 126.* http://www.ins.nat.tn/en/serie_annuelle.php?Code_indicateur=2001030 http://www.ins.nat.tn/en/serie_annuelle.php?Code_indicateur=2001040

Table 17: Beans in 1000 Mg[19]

Year	1990	2000	2005	2009	2010	2011	Annual average growth rate in percent 2000-2011
Beans and horse beans prod.	23.4	26.5	47.9	70.2	47.8	72.6	9.6
Green peas and chick peas prod.	25.6	15.7	17.1	19.5	19	23.8	3.9

A number of permanent crops (position 01.2) are presented in the following table. These are classified under sub-positions 01.21 (Grapes), 01.22 (Date palms), including dates and figs, 01.23 (Citrus fruits) and 01.26 (Olives). There has been a remarkable increase in the cultivation of oil olives, which reached a peak in 2000, and also of dates, production of which has grew by 5.5 per cent per annum.

Table 18: Crop production in Tunisia

Year	1990	2000	2005	2009	2010	2011	Annual average growth rate in percent 2000-2011
Oil olives	650	1125	650	800	750	600	-5.6
Dates	81	105	113	162	174	190	5.5
Citrus fruit	237	226	243	297	308	352	4.1
Grapes	80	141	122	137	-	-	-
Figs	27	21	23	28	26	26	2.0
Other fruits	242	435	517	454	-	-	-

Position **01.4 (Animal production)** is the next main heading. The following table provides figures for the production of milk, which comes under sub-position **01.41 (Dairy cattle)**, and the eggs, which come under sub-position **01.47 (Poultry)**.

Table 19: Animal production in Tunisia

	Year Unit	1990	2000	2005	2009	2010	2011	Annual average growth rate in percent 2000-2011
Eggs	Million pieces	1000	1476	1538	1684	1673	1687	1.2
Milk	1000 Mg	400	887	920	1030	1054	1088	1.9

Position 01.4 (Animal production) also includes animals destined for slaughter. Production of these animals, classified under sub-positions 01.42 (Cattle), 01.45 (Sheep and goats) and 01.47 (Poultry), is presented in the following table. Production of all these animals increased slightly in the period under consideration.

[19] *National Institute of Statistics - Tunisia: Annuaire Statistique de la Tunisie 2007-2011. 2012 edition. Page 123.* http://www.ins.nat.tn/en/serie_annuelle.php?Code_indicateur=2001050

Table 20: Animal production by type (intended for slaughter) in 1000 Mg[20]

Year	1990	2000	2005	2009	2010	2011	Annual average growth rate in percent 2000-2011
Bovine	65	100	88	99	107	110	0.9
Sheep	75	105	103	109	111	113	0.7
Goats	14	19	22	23	22	23	1.5
Poultry	62	116	134	137	151	144	2.0

Also important in Tunisia are activities in subsector 02 (Forestry and logging), of which the following table gives an overview. The products concerned are classified under sub-positions 02.10 (Silviculture and other forestry activities - wood), 02.20 (Logging - wood), 02.31 (Esparto grass / alfa grass) and 02.32 (Cork). Production of these products decreased significantly in the period under consideration.

Table 21: Forest and silviculture production (Products of Sub-sector 02 - Forestry and logging)[21]

	Year Unit	1990	2000	2005	2009	2010	2011	Annual average growth rate in percent 2000-2011
Alpha	Mg	47.5	45.0	40.0	42.0	3.3	12.4	-11.1
Cork	Mg	8.4	6.5	6.8	8.5	6.3	5.3	-1.8
Wood	1000 m^3	274.5	270.0	248.5	-	168.0	20.2	-21.0

The following table lists products in subsector 03 (Fishing and aquaculture). These are classified mainly under sub-position 03.11 (Sea fishing), with a few under sub-position 03.21 (Offshore aquaculture).

20 *National Institute of Statistics - Tunisia: Annuaire Statistique de la Tunisie 2007-2011. 2012 edition. Page 121.* http://www.ins.nat.tn/en/serie_annuelle.php?Code_indicateur=2001080

21 *National Institute of Statistics - Tunisia: Annuaire Statistique de la Tunisie 2007-2011. 2012 edition. Page 126.* http://www.ins.nat.tn/en/serie_annuelle.php?Code_indicateur=2001100

Table 22: Fishing in 1000 Mg[22]

Year	1990	2000	2005	2009	2010	2011	Annual average growth rate in percent 2000-2011 (2005-2011)
Trawling	17 473	25 264	24 846	20 675	23 159	23 368	-0.7
Light	26 779	36 986	48 854	49 038	44 208	50 863	2.9
Coastal	40 511	26 086	26 979	22 611	26 430	24 705	-0.5
Tuna			3 779	2 296	1 937	1 924	-10.6
Crustacean (Lobster)			39	36	38	27	-5.9
Lagoon & aquaculture			3 399	5 112	5 841	7 563	14.3
Sponges			33	10	10	15	-12.3
Corals			4	5	10	5	3.8
Shells			766	473	433	690	-1.7
Total			108 699	100 256	102 066	109 160	0.1

Table 23: Inputs to the agriculture, forestry and fishing sector in the year 2010

No.	Name	Amount in million Dinar	Amount in %
1	Agriculture and fisheries	286.6	17.0
2	Food industry	871.3	51.8
4	Textiles, clothing and leather	0.4	0.0
5	Other industries	29.2	1.7
6	Oil refining	150	8.9
7	Chemical industry	254.1	15.1
8	Construction materials, ceramics and glass	0.1	0.0
9	Mechanical and electrical industries	38.1	2.3
10	Oil and gas extraction	1.2	0.1
12	Electricity and gas	5.9	0.4
13	Water	7.8	0.5
14	Construction and civil engineering	2.5	0.1
18	Transport	1.3	0.1
19	Posts and telecommunications	4.3	0.3
20	Financial services	7.2	0.4
21	Other market services	22.3	1.3
22	Public administration	0	0.0
23	Other services	0	0.0
	Total (without value added)	**1682.3**	**100**

[22] *National Institute of Statistics - Tunisia: Annuaire Statistique de la Tunisie 2007-2011. 2012 edition. Page 127.* http://www.ins.nat.tn/en/serie_annuelle.php?Code_indicateur=2001110

The following comments need to be made regarding inputs to the Agriculture, Forestry and Fishing sector:

- The agricultural sector receives inputs of TND1.68 billion, whereas its outputs (see table below) amount to TND5.57 billion.
- The main inputs (52 per cent) are supplied by the agriculture and food industry. At the current stage of the project, the details are not clear. Compared to the German IOT for the year 2009 (10 per cent) this figure seems high.
- The next-ranking inputs (17 per cent) are from the sector itself. This seems to be quite normal. The German IOT referred to above records 30 per cent.
- The third-ranking sector (15 per cent) is the chemical sector, which accounts for only 3 per cent in the German IOT.
- The fourth biggest sector (9 per cent) is oil refining, in particular diesel fuel and gasoline, which again accounts for only 3 per cent in the German IOT.
- the remaining sectors deliver inputs amounting to 7.2 per cent.

Table 24: **Outputs from the agriculture, forestry and fishing sector to other sectors, without final consumption, in the year 2010**

No.	Name	Amount in million Dinar	Amount in %
1	Agriculture and fisheries	286.6	5.1
2	Food industry	4359.3	78.3
4	Tobacco industry	54.7	1.0
5	Textiles, clothing and leather	82.6	1.5
6	Other industries	104.0	1.9
7	Chemical industry	34.9	0.6
8	Construction materials, ceramics and glass	0.2	0.0
9	Mechanical and electrical industries	0.3	0.0
10	Construction and civil engineering	1.8	0.0
12	Maintenance and repairs	0.0	0.0
13	Commerce	393.9	7.1
14	Hotels and catering	193.9	3.5
18	Financial services	0.6	0.0
19	Other market services	8.8	0.2
20	Public administration	47.7	0.9
21	**Total (without value added)**	**5569.3**	**100.0**

Where outputs from the Agriculture, Forestry and Fishing sector are concerned, there is nothing extraordinary to report at the current stage of the analysis. However, the following comments can be made:

- The main outputs (78 per cent) go to the agriculture and food industry
- This is followed by outputs to the commercial sector (7 per cent).
- Then to the corresponding (i.e. own) sector (5 per cent).
- Then to the hotels and restaurants sector (3.5 per cent).
- The above mentioned sectors receive 94 per cent of the sector's total outputs.
- The remaining sectors account for 6 per cent (e.g. miscellaneous industries 1.9 per cent, textiles and leather 1.5 per cent, tobacco 1.0 per cent).

The following table shows the main products of the agro-food industries in Tunisia. The various values are expressed in miscellaneous units, without prices as required by the input-output table. The table therefore gives only an overview of the main products of the agro-food industry, with no clear indication of the inputs required for the IOT.

Table 25: Production of Tunisia's agro-food industries[23]

	Year Unit	1990	2000	2005	2009	2010	2011	Annual average growth rate in percent 2000-2011
Pasteurized milk	10^3 hl	1865	3244	3797	-	-	-	-
Flour	1000 Mg	564	878	875	814	822	861	-0.2
Semolina	1000 Mg	466	613	561	658	664	728	1.6
Pasta	1000 Mg	86	144	183	-	-	-	-
Couscous	1000 Mg	36	48	61	-	-	-	-
Bread flour	1000 Mg	503	646	690	622	609	635	-0.2
Olive oil	1000 Mg	130	225	130	150	120	180	-2.0
Tomato concentrate	1000 Mg	70	127	130	120	132	121	-0.5
Harissa	1000 Mg	8	13	20	24	25	25	5.6
Preserved fish	1000 Mg	3	6	11	14	13	16	8.7
Powdered sugar	1000 Mg	68	103	120	98	93	114	0.9
Wine	10^3 hl	267	413	300	250	222	244	-4.7
Beer	10^3 hl	426	1066	1034	1249	1327	1464	2.9

23 *National Institute of Statistics - Tunisia: Annuaire Statistique de la Tunisie 2007-2011. 2012 edition. Page 127.* http://www.ins.nat.tn/en/serie_annuelle.php?Code_indicateur=2002010

Article 12 of the EU definition of organic agriculture explicitly states the following plant production rules[24]:

1. In addition to the general farm production rules laid down in Article 11, the following rules shall apply to organic plant production:

   a. organic plant production shall use tillage and cultivation practices that maintain or increase soil organic matter, enhance soil stability and soil biodiversity, and prevent soil compaction and soil erosion;

   b. the fertility and biological activity of the soil shall be maintained and increased by multiannual crop rotation including legumes and other green manure crops, and by the application of livestock manure or organic material, both preferably composted, from organic production;

   c. the use of biodynamic preparations is permitted;

   d. in addition, fertilizers and soil conditioners may be used only if they have been authorized for use in organic production under Article 16;

   e. mineral nitrogen fertilizers shall not be used;

   f. all plant production techniques used shall prevent or minimize any contribution to the contamination of the environment;

   g. the prevention of damage caused by pests, diseases and weeds shall rely primarily on protection by natural enemies, the choice of species and varieties, crop rotation, cultivation techniques and thermal processes;

   h. in the case of an established threat to a crop, plant protection products may only be used if they have been authorized for use in organic production under Article 16;

   i. for the production of products other than seed and vegetative propagating material, only organically produced seed and propagating material shall be used. To this end, the mother plant in the case of seeds and the parent plant in the case of vegetative propagating material shall have been produced in accordance with the rules laid down in this Regulation for at least one generation, or, in the case of perennial crops, two growing seasons;

   j. products for cleaning and disinfection in plant production shall be used only if they have been authorized for use in organic production under Article 16.

The above-mentioned Article 16 then states that lists of eligible products are issued.

[24] *Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91*

8.1.1 Green jobs in agriculture, forestry and fishing

Activities in agriculture, fisheries and forestry can be considered green if environmentally sustainable technologies and practices are adopted, such as organic farming. For agricultural production to be considered green:

i. it must be organic by intent and not by default (non-sustainable production systems that do not use synthetic inputs are not considered organic);

ii. the produce must be mainly for sale, not for own-consumption;

iii. where relevant, the produce must be labelled or otherwise recognized by consumers as organic.[25]

This criterion also means that:

- a farmer who produces in an organic manner without fertilizers cannot be considered green unless his produce is labelled or can be otherwise recognized as organic;
- the farmer has also to produce his goods for sale and not only for own-consumption;
- the farmer must aim to produce in an organic manner; it must not happen by chance or by accident.

8.1.2 Two different kinds of olive farming, olive oil production and distribution

For a better understanding of the classification of green and non-green jobs in agriculture, let us examine two different examples of olive-oil production and distribution.

In the first (simpler) example, the owner of an olive grove harvests his olives when they are ripe. He delivers the olives to an olive mill, where the olive oil is produced, and takes it back to the original farm. The oil is sold to customers in the village – private households, restaurants or even hotels – which, due to their proximity to the producer, supervise the quality of the product.

Provided the producer intended to sell the main parts of his olive-oil production, criterion (ii) above is fulfilled. Provided he intentionally produced the olives and olive oil in an organic manner, criterion (i) is also fulfilled. These criteria can be verified by his customers in his village, which are in daily contact with him.

The remaining question is: Does the product fulfil criterion (iii)? As long as the producer does not label his product, he does not fulfil the first part of the criterion (… where relevant, the produce must be labelled or …). But is this product "… otherwise recognized by consumers as organic"? This question cannot be answered definitively in this study. The authors' intention is simply to present some difficulties associated with the approach.

[25] *See file : ILO Conference Document Green Jobs* Def.pdf

The approach also raises the following questions:

- Why should the farmer label his product?
- Will he earn more if the olive oil is labelled?
- Will the quality of the oil become better if the olive oil is labelled?

It seems that the farmer in this example has no reason to label his product, as his product will be "otherwise recognized by consumers as organic".

In a second example, several olive groves are owned by different owners. All of these farmers deliver their olives to a wholesale trader. He takes charge of the olives, if necessary put the olives through the olive mill, and adds the olive oil to his stocks. He then sells the olive oil to wholesale traders or supermarkets. They sell it on to private households and individual consumers. International food traders deliver the olive oil – with some steps in between – to private households and individual customers. It is plain from the diagram that there is no direct connection between the olive grove owners and the wholesale trader, on the one hand, and the private households and individual consumers, on the other.

If this example is also analysed in the light of the above criteria, we find that criterion (ii) is fulfilled because, at each stage, the olives and oil are produced mainly for sale, not for own-consumption. Provided that the olives are intentionally produced in an organic manner, the production process also satisfies criterion (iii). If all the farmers' olive groves are labelled, then criterion (i) is also fulfilled. In this example, there is no expectation that criterion (i) might be satisfied under the second part of the stipulation. In other words, it is not expected that the olives might be "otherwise recognized as organic".

Nevertheless, this example raises the following questions:

- What is the motivation for the farmers to label their olives?
- What is the motivation of a wholesale trader to buy / sell labelled products?
- What is the motivation of a supermarket to buy / sell labelled products?
- What is the motivation of a consumer in a private household to buy labelled products?
- What is the motivation of a non-household consumer (e.g. a restaurant or hotel.) to buy labelled products?
- Are labelled products always more expensive than unlabelled products?
- Are labelled products better than unlabelled products – better in the sense of more tasty, more healthy, produced in a more sustainable manner, produced in a more sustainable environment, etc.?
- What happens to the job classification if the farmers fulfil all three criteria, but the wholesale trader and olive-oil producer do not produce organically?
- What happens to the job classification if the farmers fulfil all three criteria, and the wholesale trader and olive-oil producer produces in organic manner. Are the jobs in the wholesale trader's and olive-oil producer's establishments green jobs?

In both examples, the following points are also important:

- For the farmer who produces olives, it seems to be very easy to move from "conventional" to "green" production. His product (the olives) and production process need only be labelled. In the case of olives, it is also very likely that the farming will be carried out in an organic manner, without chemical fertilizers.
- In both cases, there is a strong interdependence between the farmer who produces the olives and the owner of the olive mill. If one of the two does not produce in an organic manner, the product cannot be labelled as organic.

8.1.3 Labelling

Table 26: **Examples of organic labels – Germany**

Name of the ecological association	Year of foundation	Description
Biokreis	1979	Regional focus in the south of Germany
Bioland	1971	Verband für organisch-biologischen Anbau
Biopark	1991	Regional focus on meat production in the north-east of Germany
Demeter	1928	Only association for organic cultivation operating anywhere in the world.
Ecoland	1996	Regional focus in the south-west of Germany
Ecovin	1985	Association of ecological wine producers
Gäa	1989	Regional focus in the east of Germany
Naturland	1982	One of the world's largest certification organizations

All of these ecological associations come under the German national umbrella association known as BÖLW (Bund Ökologische Lebensmittelwirtschaft).

The international national umbrella association is IFOAM (International Federation of Organic Cultural Movements). There is also a regional body, ABM (AgriBioMediterraneo), which focuses on Mediterranean countries and has members in Tunisia.

The main label in Tunisia is "Bio Tunisia"[26] , which is used by a number of companies. There is also a special label defined in Regulation 834/2007 of the European Commission.[27] This regulation is based on the IFOAM common international principles and effectively defines the minimum rules for organic farming. However, the rules of the different national labels may be much more restrictive. This is true at least of the eight German labels referred to above.

[26] http://www.organic.com.tn/

[27] *Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91. Official Journal L 189 , 20/07/2007 P. 0001 – 0023.* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:189:0001:01:EN:HTML

8.1.4 Shares of organic farming

According to IFOAM and FIBL, the total area of organic agricultural land in 2009 was 37.2 million hectares (372,000 km^2).[28] This means that 0.9 per cent of the world's agricultural land is currently organic.

According to Kilcher and MaamerBelkhiria: "The year 2009 was a historic year for organic agriculture in Tunisia because the European Commission approved Tunisia for its 'third country' list. This means that the system adopted in Tunisia complies with rules equivalent to the EU's production and inspection provisions. 2010 was another historic year: in May, the Ministry of Agriculture launched the organic 'Bio Tunisia' label. The launch of this label is part of a strategy to develop organic agriculture in Tunisia, as decided by the government of Tunisia in 2010."[29]

In Tunisia, 1,673 km^2 is used for growing organic crops, out of a total of 3,359 km^2 of organic land. This means that 1.69 per cent of the total agricultural land in Tunisia is used for organic agriculture.[30]

- In 2009, nearly 336,000 hectares were certified organic. This is 16 times more than the 16,500 hectares certified in 2001.
- Organic vegetable production increased from 4,000 metric tonnes in 2001 to more than 240,000 metric tonnes in 2009.
- The number of actors running organic businesses increased from 294 in 2001 to 1,911 in 2009.
- Tunisia is the country with the second largest organic agricultural area in Africa.
- It has the third largest organic olive-oil area in the world.[31]
- In Tunisia, there are 1,792 organic food producers.[32]

Regarding the key institutions/organizations, Kilcher and MaamerBelkhiria indicate that government institutions are pioneering the organic sector in Tunisia. These are:

- the General Direction of Organic Agriculture, founded in 2010 as a department of the Ministry of Agriculture;
- the National Commission for Organic Agriculture;
- the APIA, the agency promoting agricultural investment.

[28] *IFOAM (The International Federation of Organic Agriculture Movements) and FiBL (Research Institute of Organic Agriculture) (2011): The World of Organic Agriculture. Statistics and Emerging Trends 2011. Page 26.*

[29] Ibid. page 111

[30] Ibid. page 237

[31] Ibid. page 111

[32] Ibid. page 237

In addition, the Tunisian Union of Agriculture and Fishing (UTAP) represents the interests of organic producers.[33] According to Kilcher and MaamerBelkhiria: "A domestic market for organic products has been emerging over the last couple of years. The market started with vegetables, fruits, pasta, olives and olive products. In 2010, to improve the availability of organic products, the government of Tunisia set the goal of achieving a domestic market share of one per cent by 2014 and assuring continuous supply."[34] In the opinion of Kilcher and MaamerBelkhiria, this is an ambitious target.[35]

Based on the total production figures presented in some of the above tables, we can state that, in 2009, 5.5 per cent of the olive oil produced was organic, as were 1.9 per cent of the dates.[36]

According to Kilcher and Maamer Belkhiria, the target was to increase the export of organic products to a value of TND120 million by 2014.[37] However, due to the political changes in recent years this target has had to be amended.

Again according to Kilcher and Maamer Belkhiria, where legislation is concerned, the situation in Tunisia is as follows: "A national regulation was issued on April 5, 1999. Since then, several additional laws, decrees and orders relating to organic agriculture have appeared (web information: www.ctab.nat.tn). The complete national regulatory framework was ready by the end of 2005. In 2009, the European Commission approved Tunisia for its 'third country' list. In order to be added to this list, Tunisia had to put in place organic farming legislation and a fully implemented system of inspection and monitoring. Tunisia's organic legislation is regarded as equivalent to the EU requirements and the Codex Alimentarius. The European Commission took this decision on the basis of an assessment conducted by EU experts during the last couple of years. Organic imports from Tunisia are now subject to simpler approval procedures."[38]

"The new 'Bio Tunisia' label makes it possible for the value and benefits of all organic products from Tunisia to be communicated to consumers both nationally and abroad. The launch of this label is part of the strategy for developing organic agriculture in Tunisia, as decided by the government of Tunisia in 2010, which aims to promote organic agriculture within the agricultural system of Tunisia and give it preference due to the environmental and health benefits."[39]

According to Kilcher and Maamer Belkhiria, government support and targets for the development of the sector are as follows. "In 2010, a new governmental programme and strategy for 2010-2014 was launched with the following objectives:

- to expand the organic area to 500,000 hectares by 2014;
- to diversify organic production, based on demand and with the emphasis on products with high added value;

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33 Ibid. page 112

34 Ibid. page 112

35 Ibid. page 113

36 Olives: 8200 Mg organic production / 150000 Mg total production, making is 5.466 per cent in 2009. Dates: 3055 Mg organic production / 162000 Mg total production, making 1.886 per cent in 2009.

37 Ibid. page 113

38 Ibid. page 113

39 Ibid. page 113

- to reach an organic market share of 1 per cent of the domestic market and to ensure its continuous supply;
- to double organic exports by 2014 through better positioning of classic Tunisian products with high added value;
- ….
- to increase financial support to producers organized in cooperatives and professional groups from TND5,000 to TND10,000 per annum in the form of subsidies for quality-control and certification costs.

8.1.5 Green jobs in the agricultural sector in Tunisia

This information on organic farming and labelling gives some idea of the number of green jobs in the agricultural sector in Tunisia. It would seem that the share of green jobs is in a range of between 1 and 5 per cent of the total number of jobs in the agricultural sector. Simulation 1 illustrates the effects of an increase in the demand for organic agricultural products.

8.2 Water sector

8.2.1 Typical challenges for water and sewerage operators

There are typical weaknesses and, therefore, challenges for water and sewerage operators in developing countries and emerging economies. These challenges are presented in the following section. It is expected, but not verified, that some Tunisian towns have similar problems.

- Water Supply
  - Elderly water-supply systems which lead to high water losses. In some towns, losses are higher than 80 per cent, which means that only 20 per cent of the water produced is billed to customers.
  - A lack of available water is not a typical problem, but may be the case in some towns in the dessert.
- Sewerage
  - Elderly sewerage systems. Emissions of sewage into the environment are only a minor problem: more important is the infiltration of other water into the sewerage system. Such infiltrations make the sewage too "thin" which creates problems for the WWTPs.
  - The sanitation infrastructure is heavily exposed to phenomena of subsidence and cracking, causing operational malfunctions. Such problems disturb the normal operation of the network, causing nuisance, leaks and overflows of water and wastewater.
  - A low connection rate, currently around 5.1 per cent, in rural areas.

- Treatment
  - In several towns, there is no WWTP.
  - Some WWTPs are hydraulically and biologically saturated.
  - Difficulties in the treatment of mud (elderly installations, poor drying facilities)
  - Some towns have WWTPs which are not in operation due to high operating costs – mainly the cost of electricity. These costs can often not be paid by the operator.
- Administration
  - A huge amount of unbilled consumption.
  - A low collection rate of money owed for billed water.
  - Tariffs which do not cover all operation and maintenance costs (O&M-cost covering tariffs).
  - Tariffs which do not cover operation and maintenance costs plus depreciation (full-cost covering tariffs).
  - Tariffs which do not cover operation and maintenance costs plus depreciation plus interest, taxes etc. (full-cost plus interest covering tariffs)
  - The administration is overstaffed.

The main problems can be solved only with a huge amount of investment. Some of the other problems could be solved without additional investment.

8.2.2 Future prospects

There are already plans to Improve the water system in Tunisia. GWI notes: "It is interesting to note that, although there is no compliance threshold for ONAS – which means that the existing regulation is very weak –, ONAS has been very pro-active in improving the quality of its output, an impetus mainly driven by the need to produce good quality effluents that can be sold and reused. ONAS has launched a comprehensive programme to rehabilitate and extend 19 of its WWTPs in a bid to improve its compliance with Standard NT106.02. As well as increasing the plants' capacity, the utility will retrofit them with fine-bubble aeration systems and/or biogas co-generation facilities at a total cost of TND150-200 million (US$106-141 million). All future wastewater treatment plants with capacities of more than 10,000 m3/d will also be equipped with fine-bubble aeration systems and co-generation facilities."

ONAS's medium and long-term strategy falls within the general guidelines of the national policy to improve the quality of life of citizens, protect the environment and preserve water resources. This strategy aims to achieve the following:

- Continue the national effort to generalize the benefits of urban sanitation and bring the connection rate in cities supported by ONAS to 92 per cent by 2016 and 95 per cent by 2021;

- Develop treatment capacity to treat all collected wastewater by strengthening the capacity of existing treatment facilities and installing new treatment plants;
- Produce treated water to a quality that meets the standards and requirements for its re-use;
- Increase the use of new remediation technologies, i.e. opt for treatment processes that meet the quality standards while at the same time optimizing energy and operating costs and promoting the recovery of products. This facilitates access to carbon credits;
- Continue efforts to preserve the financial stability of ONAS;
- Continue to develop and strengthen partnerships with the private sector. These forms of partnership can generate efficiencies and mobilize private financing. It may also be possible to entrust the operation of new urban sewage and sanitation stations to private firms.

To implement this strategy, the investment programme being implemented by ONAS will cost approximately TND2,000 million, representing an annual average rate of investment of between TND110 and 150 million.

Prospects for the development of co-generation40 :

Five WWTPs featuring anaerobic digestion and exploitation of recovered biogas are currently planned for the water-treatment plants at Mahdia, Sousse Hamdoun, Nabeul SE4, Gafsa and Mokenine. These WWTPs are expected to come into operation in 2017.

Prospect for equipping with fine bubble aeration systems:

ONAS has opt for fine-bubble systems for large sewage, rather than surface-aerator stations. The agency has seized the opportunity of rehabilitation to make changes to the old sewage treatment plants. The gain between the surface-aeration and fine-bubble systems is estimated at 30 per cent. However, these changes are only possible if the depth of the basins is sufficient (>4.5 m).

In this context, ONAS is running an energy efficiency programme that is subject to a feasibility study. It covers treatment plants with a capacity of more than 50,000 population equivalent. The feasibility study was launched in May 2013 and was due to continue for nine months. The expectations are that, in addition to energy recovery from sludge, the energy efficiency programme will lead to the introduction of an efficient ventilation energy-saving programme.

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[40] *Source: Study "Définition et développement de possible NAMA's dans le secteur de l'assainissement en Tunisie" - Groupement Perspective-Alcor-IDEA-STE ; December 2013*

■ Table 27: **Investment plans for selected sites**

Name	Asenovgrad	Gotse Delchev	Bansko	Ulcinj
Location	Central Bulgaria	South West Bulgaria	South West Bulgaria at a ski ressort	At the coast in the south of Montenegro
Population				
Considered year	2008	2008	2008	2011
Total				20 000
Urban area	52 000	20 000	7 000	
Rural area				
Tourists	--	--	26 000	90 000
System is created for (inhabitants)	52 000	20 000	33 000	110 000
System is created for (area)	Urban area	Urban area	Urban area	Urban and rural area
Comment	rural areas are not connected and cosidered	rural areas are not connected and cosidered	rural areas are not connected and cosidered	
Current situation				
Water supply system	overage with leakages	overage with leakages	overage with leakages	overage with leakages, some rural population is not connected
Sewerage system	overage with leakages	overage with leakages	overage with leakages	overage, some rural population is not connected
WWTP	not existing	not existing	not existing	not existing
Proposed investments				
Planing horizon	2010 to 2034	2010 to 2034	2010 to 2034	2014 to 2027
Amounts in million Euros (including contigencies and design, excluding VAT)				
Water supply system	16	26	16	39
Sewerage system	57	35	35	86
WWTP	12	5	6	14
Total	**85**	**66**	**57**	**139**

Given these plans, it pays to learn from other countries' experiences. Three examples of water projects undertaken over the last five years in transition economies are therefore outlined below.

The first cases concern the improvement of an underdeveloped system to "ideal" status and the large investment necessary to do so. The following table shows examples of investments plans for various towns in Bulgaria and one municipality in Montenegro. Only the early stages of these investment plans have so far been realized. Whether or not the future stages will be implemented depends on the availability of funding and on affordability.

In the following paragraphs, investment proposals for some of the towns are presented:[41]

In the case of Ulcinj, more detailed information on the allocation of investment to asset types (in per cent) is available:

Table 28: Allocation of investment in Ulcinj (in percent of total cost objective investment)

	Water supply system	Sewerage system	WWTP
Civil works (%)	23	9	67
Pipe works (%)	66	88	
Electrical and mechanical equipment (%)	11	3	33
Total (%)	100	100	100

It is currently expected that €20 million will be invested in Ulcinj up to 2017, mainly in the water supply sector. Whether or not the remaining amount of €119 million will be invested by 2027 is currently unknown. It may be that the period over which the investment is made will be extended.

The number of construction jobs created in this sector can be estimated only very roughly at this stage of the project. Assuming that:

- there is total investment to a value of €50 million,
- the construction work takes place over a period of four years,
- the work per capita, including the related machinery and material inputs, costs €12,000 per month.

Then 87 jobs will be created in the construction sector over a period of four years.[42] It is reasonable to assume that all the electrical and mechanical equipment will be imported (thus creating jobs in other countries), while the civil engineering and pipe-related works will be carried out by domestic employees.

If these water-supply investments are carried out, the companies which produce the equipment will not be creating green jobs, because water is not allocated to the environmental sector (see criterion 7a). If the investment is made in the sewerage sector or for the construction of WWTP, green jobs will be created in the waste sector.

[41] *JV Dahlem - Kocks - Pecher (2010): Master Plans for Asenovgrad, GotseDelchev and Bansko. Prepared in the Europeaid funded project: Technical Assistance for Project Preparation in the Water Sector Asenovgrad, Bansko and GotseDelchevEuropeaid/124486/D/SV/BG.* Dahlem and Dahlem Montenegro (2013): Montenegro – Water Supply and Sanitation Adriatic Coast V. Feasibility Study Water Supply and Sewerage Disposal in Ulcinj. Final Conceptual Engineering Report. Prepared for KfW, Frankfurt (Germany) and Vodacom, Tivat (Montenegro).

[42] 50 million Euro / 12,000 Euro per worker per month = 4,167 per month.
4,167 per month / 48 months = 86.8 jobs.

8.3 Waste

According to data from ANGeD,[43] the following results have been achieved during the last decade:

Table 29: Results achieved in the waste sector

Programme for the management of household and similar waste:
Projects during the 9th Plan (Pilot programme, 1997-2001):
• Five controlled waste sites in Greater Tunis and the cities of the Medjerda valley (Beja, Jendouba, Gauteng and Medjez El Bab), for a total cost of about TND15 million • Entry into operation: 1999 • Quantities of waste shipped to landfills: about 750,000 tonnes per annum • Percentage of waste sent to landfill: 40 per cent of the total amount
Projects during the 10th Plan (2002-2006):
• Nine landfills and 45 transfer centres in the governorates of Bizerte , Nabeul , Sousse , Monastir, Kairouan, Sfax, Gabes , Médenine and the island of Djerba, for a total cost of approximately TND70 million • Effective exploitation: 2007-2009 • Quantities of waste shipped to landfills: about 800,000 tonnes per annum • Percentage of waste sent to landfill: 85 per cent of the total amount
Projects during the 11th Plan (2007-2011):
• Ten landfills and transfer stations in Greater Tunis and the governorates of Zaghouan, Mahdia, Tozeur, Sidi Bouzid, Gafsa, Kasserine, Beja, Jendouba, Le Kef, Siliana and the islands of Kerkennah, for a total cost of approximately TND 72 million • Quantities of waste shipped to landfills: about 500,000 tonnes per annum • Percentage of waste sent to landfill at the end of Plan: 93 per cent of the total amount
Programme for the closure and rehabilitation of unauthorized/uncontrolled landfills
• The closure and rehabilitation of nine large uncontrolled waste sites: „The Cement" in Bizerte, „El- Kantara" in Djerba, „GharEttfal" in Nabeul , „BeniWael" in Hammamet, „Ezzouhour" in Sousse, „Rmila" in Hammam Sousse, „Gazzeh" in Monastir, „Dissa" in Gabes and „Thyna" in Sfax • The closure and rehabilitation of small and medium-sized uncontrolled landfills (approximately 140) , improving the current state of municipal landfills and participating in the elimination of black spots in cities • For this purpose, a sum of TND18 million was included in the 11th Development Plan, with TND10 million provided by the World Bank.
Programme for the management of industrial and hazardous waste:
• Realization of the special industrial waste processing centre at Jradou (Zaghouan) at a cost of approximately TND 32 million. The Jradou treatment centre for industrial and special waste was inaugurated on 5 June 2009 • Planning for three reception, storage and transfer (IRST) facilities in the North (Bizerte), Centre (Sfax) and South (Gabes),for a total cost of approximately TND 22 million • The facility will treat about 60 per cent of industrial and special wastes by 2011.

[43] *ANGed, the National Agency for Waste Management, is a public non-administrative agency created by Decree n° 2005-2317 of 22 August 2005.* (www.anged.nat.tn),

Programme for the management of recyclable and recoverable waste
Management of plastic waste, „ECOLEF"
• Total number of points established: 310 • Number of businesses created in the framework of Mechanism 41: 30 companies in all governorates • Number of units having recycling agreements with ANGeD: 109
• Total number of small businesses (for the collection, transport and recycling of plastic wastes) created by graduates of higher education: 23 • Amounts collected since the start of the industry in 2001: 85,000 tonnes • Creation of between 15,000 and 18,000 thousand jobs
Collection of accumulators and batteries:
• The application of the system for the compulsory depositing of accumulators used in transport and for various industrial purposes began on 1 August 2009 • In the case of used batteries, collection operations continue in schools and public places in accordance with the signed agreements in place
Collection and recycling of waste cooking oil
• 35 small businesses have received specifications for the collection of these wastes, and four companies have been approved to establish primary units for processing them by filtration
Management of waste electrical and electronic equipment:
• Plans for the management of waste electrical and electronic equipment are going ahead

From experience with waste management over the last decade, it is possible to identify future challenges and areas for improvement. The scenario for the development of the waste sector (see below) is based on these future requirements.

8.3.1 Possible investments in the solid waste sector

Table 30: Two examples of investment in a solid waste system

Name	Govenorate of Ramallah / Al Bireh	Mangaung Municipality (Bloemfontein)
Location	Occupied Palestine Territories	Republic South Africa
Population and general information		
Considered year	2008	2010
Total	290 000	730 000
Urban area	134 000	
Rural area	156 000	
Tourists	--	--
System is created for (inhabitants)	The total population which is expected to increase to more than 550 000 inhabitants in 2030.	The total population areas which is expected to increase to more than 860 000 inhabitants in 2032.
System is created for (area)	Urban and rural area	Urban and rural area
Current situation		
Area	The twin towns Ramallah and Al Bireh have their own solid waste system and there are several independent systems in the villages around.	The area is Mangaung Municipality with the former town Bloemfontein, Botshabelo and Thaba Nchu. Two separate systems exist before the investments.
Collection system	Differs between the towns (good) and the villages (poor).	Aceptable
Sorting	Maybe by some private waste pickers.	By about 60 to 100 private waste pickers. No children.
Landfill	One landfill in Ramallah and several small landfills in other villages.	Two landfills, at least one has strong negative impacts to the groundwater.
Proposed investments Amounts in million Euros (including contigencies and design, excluding VAT)		
Planing horizon	2012 to 2031	2013 to 2032
Proposed initial investments		
Collection system	No planned investments	3.7
Transfer stations	3.1	--
Long distance transport	1.2	--
Transfer stations and transport	--	2.3
Sorting system	Not planned	9.0
Sanitary landfill	16.1	14.0
Subtotal (initial investments)	**20.4**	**28.9**
Necessary future replacements		
Collection system	--	5.5
Transfer stations	1.4	--
Long distance transport	1.5	--
Transfer stations and transport	--	1.9
Sorting system	--	5.5
Sanitary landfill	1.0	1.3
Subtotal (replacements)	**4.0**	**14.2**
Total	**24.3**	**43.1**
Not constructed:		
Initial investments		
Material recovery facility		4.4
MBT		24.7
Replacements		
Material recovery facility		4.6
MBT		12.6

When a medium-level system is improved to high-level status, huge investment is necessary. The following table provides two examples: one in Ramallah/Al-Bireh in the

Occupied Palestine Territories,[44] the other in Mangaung Municipality (Bloemfontein), South Africa[45].

8.3.2 Hazardous waste

As mentioned above, hazardous waste is waste containing substances dangerous to human health and the environment, i.e. substances that are explosive, oxidizing, flammable, toxic, irritant, harmful, carcinogenic, corrosive, infectious and so on. Examples are:

- Used oil from ships or vehicles
- Biohazardous waste from animals, e.g. cadavers or slaughterhouse waste that cannot be used elsewhere
- Biohazardous human waste (in Tunisia, probably mainly from hospitals)
- Nuclear waste (in Tunisia, probably mainly from hospitals and related research centres)
- Used batteries, etc.

These items may be considered as cost objectives. The related cost centres are as many as the different kinds of waste.

Used oil from garages, machines, hydraulic systems, transformers and so on is collected in special tanks on the premises of the companies concerned. The different categories of oil should not be mixed. A special vehicle then collects the different types of oil, most of which are then used for heating purposes.

Biohazardous wastes from animals, e.g. cadavers or slaughterhouse waste which cannot be used elsewhere, are disposed at an animal cadaver disposal plant. This kind of waste is normally incinerated.

Biohazard human waste, originating mainly from hospitals, is collected as part of a centralized system, then incinerated.

Medical nuclear waste, originating mainly from hospitals, should be centrally collected and stored. It disposal must be documented in a very detailed manner.

Used batteries (not including car batteries) are recycled for their lead, cadmium and zinc content. They are collected at specified collections points, sometimes at the larger supermarkets. There are special plants for this type of recycling in several EU countries.

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[44] *Joint Venture of ERM GmbH, Gopa, IngenieurbüroSehlhoff, EcoConServ, Birzeit University (2009): Feasibility Study Report. Elaboration of a Feasibility Study for a Regional Solid Waste Management System for the Ramallah / Al Bireh District. Carried out for: Ramallah / Al Bireh Governorate and KfWEntwicklungsbank.*

[45] *Joint Venture of ERM GmbH, Infrastruktur & Umwelt and PD Naidoo Associates (2010): Feasibility Study Report. Elaboration of a Feasibility Study for an Advanced Integrated Solid Waste Management System for Mangaung Local Municipality. Carried out for Mangaung Local Municipality and KfW Development Bank.*

The return rate for these batteries was 44 per cent in Germany in 2012. In other countries, such as Switzerland, Sweden and Belgium, the return rate is even higher.

The collection and the treatment of all these categories of waste fulfils Criterion 7a; the collection and treatment of used oil and used batteries also fulfils Criterion 7b. Criteria 8 and 9 are also fulfilled by the treatment of all these kinds of waste. People employed by the companies concerned (or units thereof) therefore fulfil Criterion 12, because they are producing environmental services.

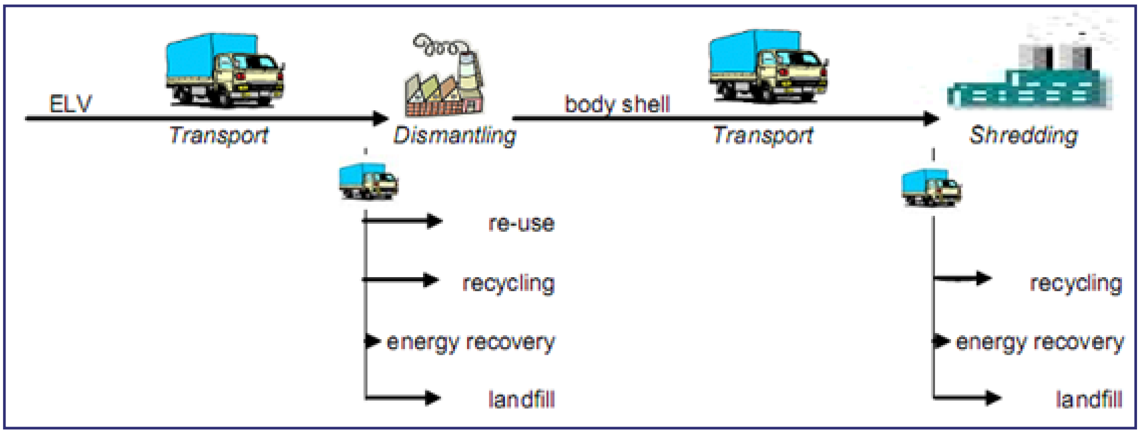
Details of the number of employees working in this sector cannot be provided here.

8.3.3 Recycling: End-of-life vehicle dismantling as an example

A large number of employees are probably engaged in the recycling of wastes in every sector. Let us examine the **end-of-life vehicles (ELVs)** sector as an example. In European Union countries, the ELV Directive 2000/53/EC sets strict targets: since the beginning of 2006, at least 80 per cent of the weight of a car has to be reused and recycled, and at least 85 per cent has to be reused and recovered. This means only 15 per cent of the weight of a car can be consigned to landfill. At the beginning of 2015, the first of these requirements was increased to 85 per cent and the second to 95 per cent. The procedure for dismantling ELVs is also described in detail in the Directive.

The following diagram shows the typical procedure.

■ Figure 26: **Diagram: Overview of the ELV treatment process**[46]



This gives rise to the following cost and revenue centres:

- Transportation from the final user of the ELV to the depollution and dismantling station
- At the depollution and dismantling station, the typical cost centres are:
  - Re-use of spare parts (revenues and costs)

[46] *Source of the diagram: GHK (in association with Bio Intelligence Service) (May 2006): A study to examine the benefits of the End of Life Vehicles Directive and the costs and benefits of a revision of the 2015 targets for recycling, re-use and recovery under the ELV Directive. Final Report to DG Environment. Birmingham. Page 2.*

- Recycling of materials such as batteries, wheel rims, fuels (costs and revenues)
- Energy recovery from materials such as oils and plastics (costs and revenues)
- Some dismantled materials, e.g. plastics and glass, are transported directly to the landfill at this stage (costs)

> Transport from the depollution and dismantling station to the shredder station

> Shredder station:

- Recycling of materials such as scrap iron (cost and revenues)
- Energy recovery (cost and revenues)
- Landfill (costs)

The typical composition of ELVs in different years is presented in the following table.[47] Most of these items generate revenues; very few of them incur only landfill disposal costs.

Table 31: ELV composition

	kg per Mg of ELV		
Material / Fraction	**2002**	**2006**	**2015**
Ferrous Metal	680	680	650
Non Ferrous Metal	80	80	90
Plastics and Process Polymers	100	100	120
Tyres	30	30	30
Glass	30	30	30
Batteries	13	13	13
Fluids	17	17	17
Textiles	10	10	10
Rubber	20	20	20
Other	20	20	20
Total	1 000	1 000	1 000

Mg = Megagramme

In the case of Romania, the working time required for dismantling one average ELV was estimated for small and large-sized companies which dismantle respectively around 1,000 and 5,000 ELVs per annum. The results are presented in the following table:[48] the dismantling of an average ELV takes about 2.6 hours or 2.4, depending on the size of the company. The table also presents the various steps in the process[49].

47 *GHK in association with Bio Intelligence Service (2006): A study to examine the benefits of the End of Life Vehicles Directive and the costs and benefits of a revision of the 2015 targets for recycling, re-use and recovery under the ELV Directive* ec.europa.eu/environment/waste/pdf/study/final_report.pdf

48 *Enviroplan (2008): Assistance in Promoting Solutions Regarding Recycling and Use of Recycled Materials from End-Of-Life Vehicles. Costs And Revenue Analysis.*

49 *LPG Tanks – Liquefied Petroleum Gas Tanks. It is assumed that the crushing of oil filters and treatment of catalysts will be carried out only by larger companies, because special equipment is needed. At small companies, oil filters and catalysts are collected but not processed.*

Design by the International Training Centre of the ILO – Turin, Italy