

bioltec
GREENmyGENERATION.com



Hybrid Center

for Demonstration, Training and Application of
Renewable Energy, Energy Efficiency and Sustainable Mobility

bioltec GREENmyGENERATION
SUNfarming Food & Energy



Special Thanks to:

Eberhard Oettel, Senior Head of Technology Transfer and International Cooperation of FEE e.V.,
Mastermind of the Hybrid Center Concept

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1. Introduction

SUNfarming GmbH and bioltec systems GmbH are two German companies specialized in the field of renewable energies combining their technologies for the initiative of the Hybrid Center Project.

As a solar photovoltaic project development company in Germany, SUNfarming GmbH has, to date, realized over 500 MWp solar systems both free field and rooftop of which the company group owns 95 MWp. With our photovoltaic (PV) plants we have achieved more than 9.7% output than forecasted. An independent auditor who performs account controls determines these results every year.

SUNfarming's core business is national and international project development of high-quality PV free field plants or large roof plants financed, constructed and operated by ourselves. Our shareholders obtain substantial decade-long experience in biomass production and project development of PV plants.

bioltec systems GmbH is a Germany based engineering company founded in 2004. With bioltec "GREENmyGENERATION" we offer innovative overall solutions in renewable energies: Holding several international patents our experts develop and applicate the unique bioltec product lines and provide consulting services and training programs - from customer-specific special applications to international field tests and OEM projects.

bioltec „Fuel Efficiency Management“ is known as the award-winning retrofit conversion technology for heavy duty standard diesel engines for the use of renewable fuels, successfully proven in more than 4000 vehicles and gen sets in a dozen of countries.

Figure 1: For our SUNfarming Food & Energy Greenhouse solution, we designed substructures with transparent SUNfarming PV modules in order to meet greenhouse criteria and provide protection to crops against wind, rain, hail and sun, combined with customized drip irrigation.



In the Low Carbon Truck Trial (United Kingdom, Department of Transport) and a field test in Germany realized with 200 trucks (including the European emission standard Euro VI), both launched in 2012, an average of 95% reduction in CO2 emissions and almost 50% reduction in soot particle emissions was achieved. bioltec operates internationally in Austria, Switzerland, Ireland, Spain, France, the Netherlands, Denmark, the Czech Republic, Italy, Great Britain, Brazil, Colombia and The Bahamas.

2. SUNfarming Food and Energy – bioltec GREENmyGENERATION

2.1. SUNfarming Food and Energy

Throughout our 12 years' experience carrying out solar PV projects, not only in Europe but also in Africa and the Middle East, SUNfarming has realized that education, sustainable job creation and food security are essential factors that should be included in our solutions. That is how SUNfarming Food & Energy was born. This initiative consists of the combination of high quality PV systems and food production through modified newly developed solar greenhouse constructions and free-field PV systems, which can be used to grow vegetables, fruit and flowers.

Figure 2: In 2 hectares SUNfarming Food & Energy Free Field open areas, photovoltaic plants of 1MWp can be installed along with crops that are able to grow in land with poor soil and moisture.



2.1.1. SUNfarming Solar Training Centers

SUNfarming Solar Training Centers are the result of our company's effort to offer, not only German technology and expertise, but also education and jobs through cooperation with educational institutions.

In 2008, we established the Syrian Solar Training Center in Aleppo in cooperation with the DEG/BMZ (DEG is the German investment and development corporation and BMZ is the German Federal Ministry for Economic Cooperation and Development) and the University of Aleppo. For over two years, before the civil war in Syria began, we developed solar modules applicable in high-temperature regions, abrasion by sand and extreme irradiation. In 2013, SUNfarming starts with DEG and the North West University in Potchefstroom (Republic of South Africa) the next Solar Training Center where more than 600 people have been trained. Some years later, in 2015, a Public-Private Partnership between SUNfarming, GIZ / BMZ was carried out, this time, to open a new center in the SENATI Institute in Peru. As an outcome of this initiative, over 80 instructors have been trained to keep on transferring the PV technologies all around Peru.



Figure 3: The Solar Training Center in Lima (Peru)



Figure 4: Opening of the Solar Training Center in Aleppo (Syria)



Figure 5: The 3 greenhouses of the Food & Energy Training Center at North West University (Rep. of South Africa)

The Food & Energy solution is part of SUNfarming in partnership with Alensys' Training Center initiative. In 2015, a demonstration plant was established also at the North West University (NWU). Currently, it consists of 3 unique SUNfarming greenhouses where not only vegetables (green lettuce, red lettuce, broccoli, spinach, pepper, tomato and cabbage) are grown but also sustainable energy is generated by means of photovoltaic panels integrated into the roofs. A team of experts is responsible for the operation and training of agro-solar technologies. The facilities are also used for research purposes to identify what kind of crops can be grown under the structure. Jobs for maintenance and bookkeeping are also guaranteed within this demonstration plant. Besides master training (train the trainer), workers from local communities are taught to bring the Food and Energy technology to rural areas.



In brief, the Food & Energy Training Center at North West University focuses on redoubling our company's efforts to ensure sustainable energy security as well as to provide sustainable food supply through agro-solar technologies. We strive to fight against unemployment through education and jobs in resource-poor areas.

Figure 6: Growing vegetables in one of the greenhouses of the Food & Energy Training Center at NWU.



Figure 7: Our team of the Food & Energy Training Center at NWU.



2.1.2. SUNfarming “5 in 1” Integrated Sustainable Model

Energy, food, job creation, education and water management are integrated into the unique Food & Energy solution. Our model is applied especially in resource-poor or refugee areas in order to actively contribute to the sustainable improvement of the living conditions of people.

1. Energy Production

The sustainable energy produced by photovoltaic generators can be used for powering the components of the Food & Energy systems as well as for the consumption in local communities.

2. Food Production

Vegetables, fruits and flowers can be produced in environments where crops are protected from extreme conditions like wind, rain, hail and sun.

3. Job Creation

Jobs can be created among the local communities for shift work, cultivation, maintenance, harvesting, marketing and bookkeeping.

4. Education

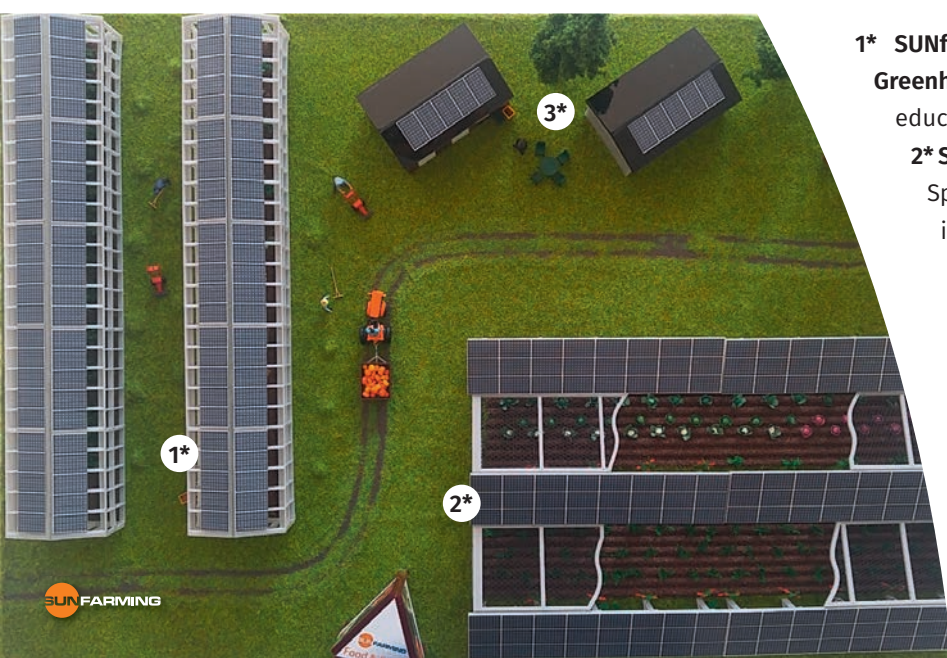
Trainings are essential among SUNfarming’s goals. Through our Solar Training Centers, we aim to transfer technology and encourage research based on specific local conditions and needs.

5. Water Management

Our special drip irrigation is 20 to 30% more efficient compared to regular irrigation systems. Crops can be grown with minimum water consumption in areas where agriculture would be barely possible.

SUNFarming Food & Energy systems can be installed together with special modular rooms known as SUNhome. These can be used as classrooms for training, housing, packing rooms, storage rooms, etc.

Local communities can also take advantage of becoming our partners. Food and Energy can be produced efficiently on their land, obtaining best results. Taking into account the social approach of the „5 in 1“ model, the role of public entities is essential. SUNfarming considers energy purchase contracts with the government to guarantee long-term cooperation.



1* SUNfarming Food & Energy Greenhouse: Greenhouses for educational purposes.

2* SUNfarming Food & Energy: Special construction, drip irrigation and netting for crop protection (for different seasons).

3* SUNfarming SUNhome: Special Rooms for teaching and technical purposes (cooling, packaging rooms and more).



Figure 8: SUNfarming Food & Energy "5 in 1" model with SUNhomes

Figure 9: SUNfarming Food & Energy "5 in 1" model with SUNhomes

2.2. bioltec GREENmyGENERATION

bioltec offers solutions for the use of biogenic fuels in Diesel engines. bioltec's Fuel Efficiency Management can be combined in multiple ways, in heavy duty vehicles (bioltec vario), as well as for use in cogeneration plants (bioltec genny) with or without electricity grid integration. Motors modified with bioltec technology can be monitored and managed remotely with the telemetric system (bioltec tele) which has been especially developed for this purpose.

2.2.1. bioltec Flagship Projects

Additionally, to technological development and transfer, bioltec GREENmyGENERATION focuses on providing and maintaining the know-how of users with different skills for all procedures and adapting them to the corresponding local needs. This philosophy is the key to the success of many projects carried out nationally and internationally.

Within the framework of bioltec's GREENmyGENERATION concept, the technical content is put into a wider context through comprehensive awareness raising on the environment and sustainable development based on the logic of material flow.

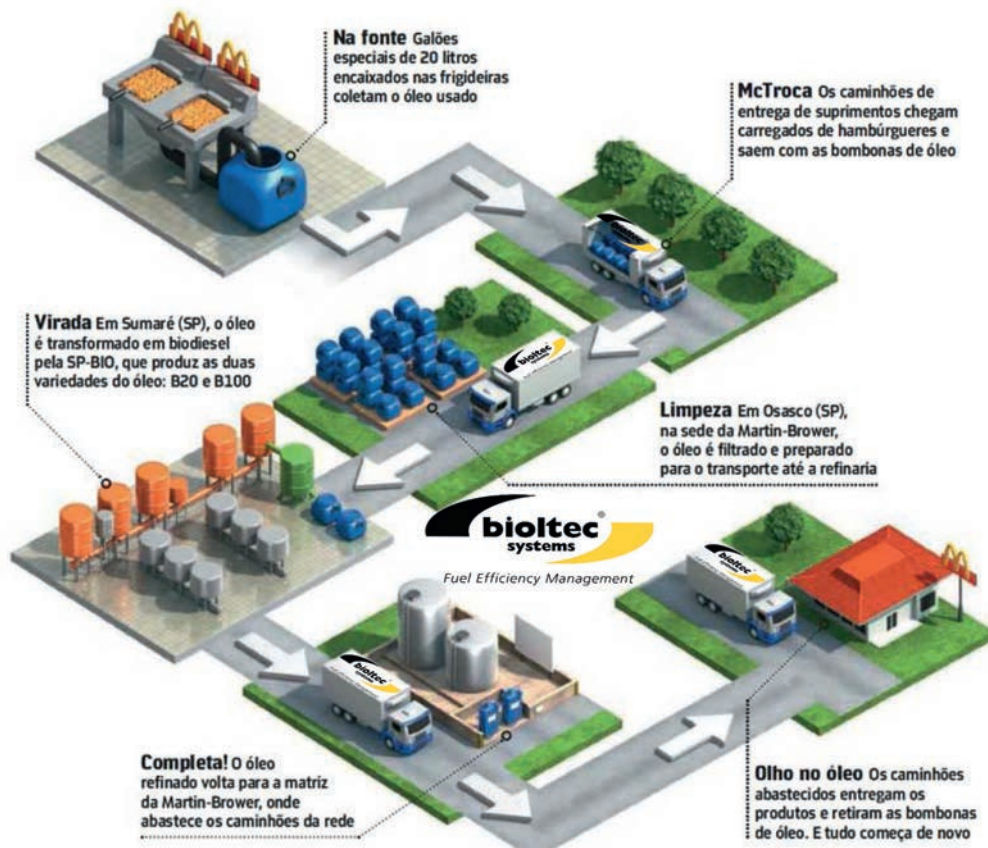
In 2007, bioltec converted a John Deere tractor to be operated with rapeseed oil on the island of Samsö, Denmark. Samsö received global accreditation as an Energy Island: it is self-sufficient and carbon neutral. The TV show „ZDF heute journal“ was widely reported in 2009, as part of the World Climate Conference in Copenhagen.



Figure 10: bioltec tractor in Samsö, Denmark, 2009

Caso Prático em Frotista

Ex: Mc Donald's (Martin Brower)



Fonte: <http://planetasustentavel.abril.com.br/noticia/energia/oleo-fritura-combustivel-mcdonalds-quatorrodas-574247.shtml>

MAN Latin America	Biodiesel Congress 2010	Gian G. Marques	23.09.2010
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modificada: bioltec system GmbH Wolfram Kangler 2011

Figure 11: Material flow management of UCO (Used Cooking Oil) of Mc Donald's, 2011

In 2009, know-how in research and development was transferred by bioltec to the academics at the Institute of Technology of Paraná in Curitiba, Brazil (TECPAR). For this purpose, stationary application engines equipped with bioltec technology were used for studies on domestic vegetable oils, which were subject to very detailed performance tests.



Figure 12: To the right: Professor Dr. José Carlos Laurindo TECPAR - Paraná Institute of Technology, Curitiba, Brazil, 2009



■ Vencedor Categoria Veículos com PBT > 15t

■ Vencedor Categoria Tecnologia Diesel



Gian Gomes Marques, M.Sc.
MAN Latin America
Alternative Powertrain Systems &
Alternative Fuels



Figure 13: Challenge Bibendum Award 2010 and AEA Environment Award 2010, Brazil



bioltec was an exclusive collaborator in 2009 and 2011 in a fleet test of VW do Brazil/MAN Latin America (Resende, Sao Paulo, Rio de Janeiro, Brazil) for the adaptation of engines for fuel based on UCO (used cooking oil). Multinational companies such as Coca-Cola and McDonald's provided test vehicles. This project received the AEA Environment Award 2010, promoted by the Brazilian Association of Automotive Engineering. The same year, a VW Constellation 17.250 truck with bioltec system, supplied with the B100, obtained the best classification in the Michelin Challenge Bibendum 2010 „Rallye for sustainable traffic” in Rio de Janeiro, in the categories energy efficiency (fuel consumption), lower level of carbon dioxide emissions (CO₂), and driving ease and acceleration.



Figure 14: Training of engineers

Figure 15: Training of mechanics on the emissions test



Figure 16: Truck with low carbon emissions, Low Carbon Truck Trail, 2012

In the Low Carbon Truck Trail (United Kingdom, 2012) bioltec technology as well as bioltec know-how was applied. bioltec was decisively involved in the knowledge transfer to the University of Leeds as well as to stakeholders in the fuel use process (quality of the fuel of the producers and fuel management by the drivers).

Since October 2015, bioltec has been working on optimizing fuel use in fleet vehicles in Colombia. bioltec and Ecodrive S.A.S., based in Bogotá, have worked as a team on the development and implementation of a telemetric systems for vehicle fleets, resulting in considerable savings in a fleet of 50 vehicles (Ciudad Limpia Bogotá).

With „bioltec tele“, the driving behaviour and the workload of the drivers are monitored and evaluated together with fuel consumption and the technical condition of the vehicles. In this way, the optimal training potential for drivers and managers is achieved.



Figure 17: Training of drivers, Ciudad Limpia Project, Bogota, 2016

2.2.2. bioltec Product Lines

bioltec's GREENmyGENERATION equally embraces technique, resource management and the people who work with both, in accordance with the three dimensions of sustainability: ecology, economics and social aspects. By defining the corresponding quality parameters, e.g. only high-quality fuels are used that guarantee efficient technical useability and sustainability goals. bioltec links the existing potential of biogenic fuels with demand, both in the transport sector and in the energy sector. For this purpose, fuels from vegetable oils, animal fats and „FAME Biodiesel“ are used, as well as fuels based on used cooking oil. The wide range of biofuels used as an alternative to diesel of fossil origin allows for the use of renewable raw materials and waste and residues that meet the three dimensions of sustainability at the same time.

1. bioltec vario

bioltec's dual-fuel technology automatically supplies the engine with diesel and alternative fuel in a variable mixture from two separate tanks in an electronically controlled operation. The bioltec tank heater and the coaxial tube system (fuel heating lines) guarantee the optimal use of fuels, including alternative fuel with high viscosity (CFPP).



Figure 18: Diagram of the bioltec vario 3.0 with details of the bioltec tele electronic equipment

Componentes do Sistema:



1. Módulo eletrônico
2. Tanque de óleo diesel – 80 ou 150l (depende da aplicação)
3. Tanque de biodiesel – 480 l
4. Sistema de aquecimento
5. Conjunto de filtros de combustível específicos para B100
6. Unidade dosadora de combustível
7. Display digital



Nota: Mangueiras e tubulações compatíveis com B100

Fonte: <http://planetasustentavel.abril.com.br/noticia/energia/oleo-fritura-combustivel-mcdonalds-quatorrodas-574247.shtml>

MAN Latin America	Biodiesel Congress 2010	Gian G. Marques	23.09.2010
modificada: bioltec system GmbH Wolfram Kangler 2011			



Figure 19: bioltec vario 3.0 installed in a Scania G450, Germany, 2015



The technology of the two stage filters and the diagnostic capability of bioltec Fuel Efficiency Management ensures highest operational performance. You can individually choose the ideal fuel for each application - FAME biodiesel (B100), for example, from recycled materials, or refined products from animal fats and vegetable oils. For a 350 kW engine of a heavy duty truck (driven 150,000 km per year), the reduction of CO2 emissions can be as much as 100 metric tons per year.

2. bioltec tele

bioltec tele is a telemetry system for the transmission of vehicle data and remote control in real time. bioltec has its own transmission system (via a GPRS mobile network) which is a sophisticated analysis and maintenance tool. The data is available online and serves i.a. as a basis for visualization and future training content.

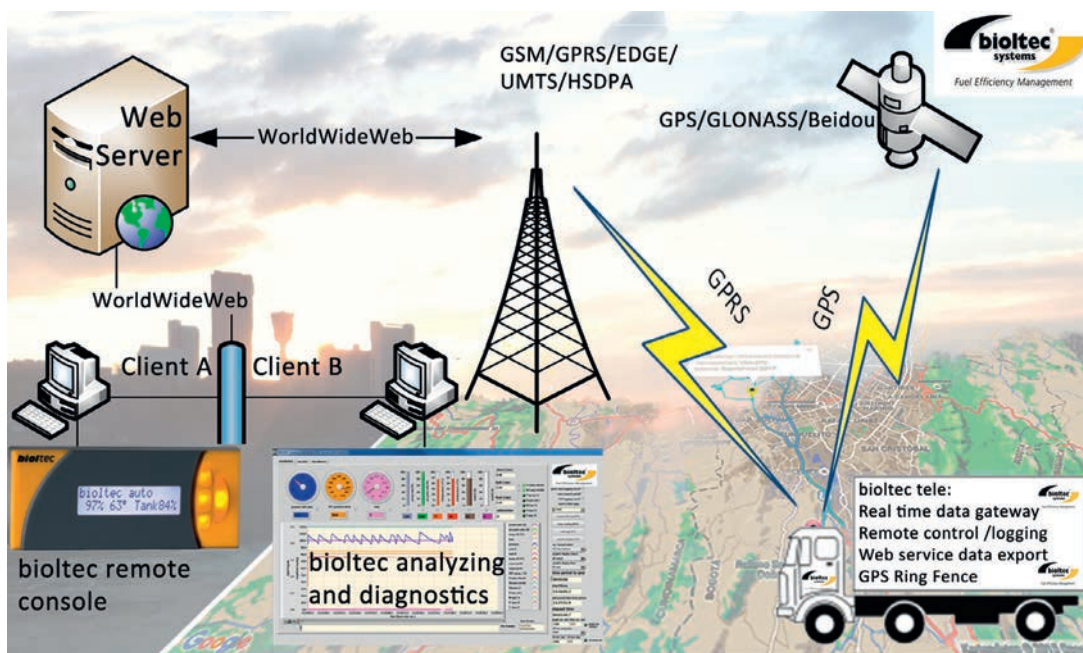


Figure 20: Diagram of the bioltec tele system



Figure 21: bioltec genny, 5.5 kWel cogeneration demonstration plant (fuel: chicken fat) and a 30 kWp photovoltaic plant with a 10 kWh battery storage system

3. bioltec genny

bioltec genny allows for the cogeneration of electricity and heat/cold with renewable fuels like refined vegetable oils or UCO and animal fat. With renewable electric power produced with the bioltec genny, the battery storage system is powered first. Its use can be applied to the demand for charging electric vehicles, local electricity use, or powering the electricity grid.

Please note: in order to keep operating costs low for the application of the Hybrid Centre for demonstration, training and implementation, an engine class with a low and reproducible power rating is chosen. Together with SUNfarming, a charging station for electric vehicles (renewable mobility) is installed.

bioltec's target market is that of engines of 50 kW to 500 kW of mechanical/electrical power providing an option for use of the heat to generate cold (tri-generation mode). With a 350 kW cogeneration engine (operated 8,000 hours per year) the reduction of CO₂ emissions can be as much as 1,000 metric tons per year.



bioltec genny, demonstration plant: several electric vehicles during recharging, bioltec headquarters Germany, 2016

Figure 22: Tesla Model S



Figure 23: Forklift truck, Specialized Levo E-Bike

4. bioltec battery

In order to ensure 24/7 operation - even without connection to the public electricity grid - a battery storage system is implemented. For best performance and durability bioltec uses lithium-ion battery technology.

5. bioltec smart conductor

The Hybrid Centre system is adapted to respective requirements through an efficient intelligent monitoring system in real time.

The bioltec smart conductor was developed by bioltec and intelligently controls the PV system, CHP and battery bank within the electric power system (injection onto the grid vs. internal consumption), depending on the local demand for energy (electricity and heat).

The smart grid management provides the option of injecting electricity into an existing grid („on-grid“), as well as the option of a 24/7 isolated operation in remote areas („off-grid“). The battery storage system also optimizes the generation and use of electricity and vice versa. bioltec techniques allow for the integration of SUN-farming technology for a joint generation of electricity, thus supporting PV systems and employing renewable electric mobility for this Hybrid Center project.

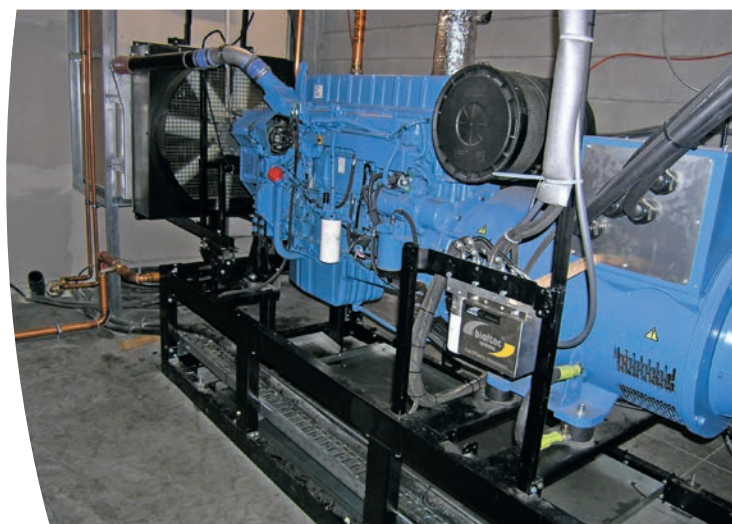


Figure 24: bioltec genny 100 kWel commercial plant

Figure 25: bioltec genny 250 kWel commercial plant



Figure 26: Palm oil extraction plant: Bioplanta Palmera para el Desarrollo S.A., Carepa, Colombia, 2014

6. bioltec matflow

In the concept of material flow, technology, management and financing are the three dimensions that make up the target for the national potential to meet local demands. Vegetable oils can be grown nationally and processed in local extraction plants. Crude oil can then be refined to obtain a high-quality raw material for subsequent use such as in food products as well as detergents or cleaning agents.

In bioltec's matflow concept (bioltec's material flow management), for example, the need for a Hybrid Center and/or a fleet of vehicles is assessed. To avoid transportation costs and consequently also CO₂ emissions, the required quantities of the corresponding fuel must be obtained locally primarily from renewable sources. Both the trucks involved in the production and distribution of palm oil and the facilities of the Hybrid Centre can be supplied with this renewable fuel. The trucks that deliver the products grown in the greenhouses of SUN-farming Food & Energy as well as the public transportation buses around the training center are more examples for substituting diesel with renewable fuel. In this way, the material and energy flow is managed in closed cycles and added value is created for the region.

bioltec's GREENmyGENERATION concept featuring environmentally friendly technology for sustainable vegetable oil as a fuel decreases a country's dependence on imports and allows for the protection of its own national resources. The benefits are: lower expenditure on financial resources, a lower environmental impact as well as increased employment and prosperity in the region.

3. SUNfarming – bioltec: Your partners

The goal of the Hybrid Center Project is to instruct and demonstrate on the topics of SUNfarming Food & Energy and bioltec GREENmyGENERATION in an alliance with local entities to create the conditions for the development of an economic model. Based on this, an expansion of the system and its commercial use can be achieved through know-how and technology transfer aligned with the economic and political frameworks of the country.

Technology transfers combined with the local prerequisites such as the richness of biodiversity create the possibility of building a national bioeconomy with the core of food production and bioenergy (PV and fuel based on vegetable oils) to give solutions to local issues in food, energy and water saving. This synergy of the components like PV electricity, agricultural production (SUNfarming Food & Energy) and biofuel are the drivers for the creation of permanent jobs and food security, as well as for the production of safe and sustainable energy. The long-term goal is the installation of these renewable technologies on a large scale with local alliances. Cooperation with local partners and universities in your country, in terms of construction and operation of the Hybrid Center SUNfarming Food & Energy and bioltec GREENmyGENERATION, will generate the following benefits:

- Long-term establishment of partnerships between local educational institutions, communities and SUNfarming (with the focus on SUNfarming Food & Energy providing applications of agricultural technologies) and bioltec GREENmyGENERATION (with the focus on Fuel Efficiency Management)
- Alliances that will provide training to local inhabitants in the area of agriculture and the Hybrid Systems (solar PV, renewable mobility as well as cogeneration) using high quality German material and standards.
- Contribution to the development of the agriculture and renewable energy sectors, with a focus on job creation especially in developing countries.
- Create a safe investment environment with the purpose of accessing international financing.

The Hybrid Center trainings offer the opportunity to:

- Collect information on specific production conditions in the local market.
- Plan projects for investment in Hybrid Systems for larger commercial use.
- Provide German technology and know-how in energy and agricultural technologies as well as know-how in material flow management.
- Involve local communities and municipalities in the investment.
- Become a partner of SUNfarming and bioltec.

This is how we seek to lay the groundwork for future investments and joint ventures between our companies and local communities in your country.

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