BUSINESS PLAN

Indoor Vertical Farming

Regenerative Agriculture

JULY 2023

Executive summary

MT Green Technologies is a research and development (R&D) company.

MT carries out studies on climate change and its effects. MT determines the threats to the environment and living beings or how the environment and living beings are affected by the degradation process, which is defined as the climate crisis and then develops projects to reduce or eliminate these effects.

MT has the opportunity to offer flexible solutions with strong coordination and result oriented studies, such as receiving consultancy from academicians and scientists within the universities, establishing multidisciplinary project partnerships or providing technical support to the studies carried out.

CONTENTS

1-Description of Products & Services

MT has R&D studies on Indoor Vertical Farming, Soil Rehabilitation, Regenerative Agriculture, Soil Stabilization and Waste Management.

MT offers Soil Rehabilitation and Regenerative Agriculture solutions to environmental and crop yield problems case by case. MT products contain a wide range of bioactive compounds that work synergistically to cope with plant stress, regenerate soil and increase yields. Biostimulants will be presented in detail in this plan.

MT Soil Stabilization additive stabilizes and strengthens the local soil mix, reduces or eliminates the need to transport aggregate materials.

Compost machine, which is a partnership project of MT, converts waste into compost in a very short time by its special fermentation technique. This fermentation technique provides beneficial bacteria to survive at high temperatures.

MT has studies and products in an innovative agriculture approach, Indoor Vertical Farm. MT also offers consultancy during the vertical farm projects. This topic also will be presented in detail in this plan.

2-Regenerative Agriculture

Regenerative agriculture is an approach that aims to improve soil health and soil fertility as well as protecting water resources and biodiversity in farming.

According to soil scientists, at current rates of soil destruction (decarbonization, erosion, desertification, chemical pollution, etc.), within 50 years we will not only suffer from qualitatively degraded food supply characterized by diminished nutrition and loss of important trace minerals, but we will literally no longer have enough arable topsoil to feed ourselves.

Regenerative agriculture not only “does no harm” to the land but actually improves it, using technologies that regenerate and revitalize the soil and the environment. Regenerative agriculture and other farming methods that don’t harm the climate can improve farmers’ incomes, as well as cutting emissions and boosting soil health.

While chemical fertilizers cannot alleviate these negative effects, they also create pollution and health risks. As a solution, MT has 3 different products (TRL6) for 3 different problems.

For soil degradation; the product content of MT includes humic substances, organic acids, amino acids, symbiotic and non-symbiotic microorganisms, enzymes, to regenerate degraded soil and increase yields.

For climate crisis; the product content of MT includes fulvic substances, amino acids, symbiotic and non-symbiotic microorganisms, enzymes, phytohormones, natural minerals, to protect plants from extremely high and low temperatures.

For pollution; the product content of MT includes fulvic substances, non-symbiotic microorganisms, enzymes, to remove toxins and pollutants from soil.

Trial in degraded soil shows that yield of winter wheat using %100 chemical fertilizer is 5960 kg/ha. Using %50 chemical fertilizer plus MT product increases the yield by 1355 kg/ha to 7315 kg/ha. On the cost side for this increase, %100 chemical fertilizer cost is €43/ton yield, %50 chemical fertilizer plus MT product cost is €24/ton yield.

Another trial for protection against cold stress shows that yield of cherry blossom using %100 chemical fertilizer is 0 kg/ha. Using %50 chemical fertilizer plus MT product increases the yield to 18400 kg/ha. On the cost side for this increase, %100 chemical fertilizer cost is €160/ha, %50 chemical fertilizer plus MT product cost is €104/ha. Protection is up to -8ºC in single application, -14ºC in double application.

2.1-Biostimulants Market

According to the market research study by P&S Intelligence, in 2021, the biostimulants market had a total size of $3.0 billion, and it is predicted to hit $7.81 billion by 2030, progressing at a CAGR of 11.3% from 2021 to 2030. This is a result of the growing food demand, burgeoning global population, rising malnutrition and hunger, and unfavorable climate change.

Europe had a share of over 36% in biostimulant sales revenue in 2021, which is attributed to the growing agronomic product demand and shifting consumer preference toward organic and environment-friendly farming. In the coming years, the APAC region will have the highest CAGR, attributed to the expansion of sustainable farming policies in China and India.

On the other hand, there is €97 billion lost value from soil degradation in the EU, 10% of total EU GHG emissions are related to agriculture, 49% reduction in yields in major crops in EU due to climate change. Sustainability efforts and new regulations are increasing the market size of bio-based products. The EU Commission will boost the development of EU organic farming area with the aim to achieve 25% of total farmland under organic farming by 2030.

The excess of nutrients in the environment is a major source of air, soil and water pollution, negatively impacting biodiversity and climate. The Commission will act to; reduce nutrient losses by at least 50%, while ensuring no deterioration on soil fertility and to reduce fertilizer use by at least 20% by 2030

Biostimulants are organic-based (amino acids, organic acids, humic substances etc) plant promoting substances and microorganisms. Using only biostimulants is not always solving the problems as climate change and soil degradation worsen each day. More bio input is needed such as enzymes, phytohormones, microorganisms.

2.2-Marketing Strategy

MT’s strengths in the market are;

- MT’s formulations contain unique bioinputs (enzymes, phytohormones, microorganisms etc.) in addition to the common biostimulants that are already in the market.
- MT’s products include; common biostimulants (organic acids, amino acids, humic acid, fulvic acid) plus MT’s own isolated symbiotic microorganisms and enzymes, MT’s own isolated non-symbiotic microorganisms and phytohormones.
- This synergism of multiple bio-inputs with different beneficial effects results in significantly higher yields than competitive products.
- Our one other unique difference is that, MT’s technology help plants adapt to the changes in ecology due to climate crisis.

MT’s strategy includes;

- Achieving an unrivaled position in the market with the uniqueness of MT products that provide sustainability.
- Offering consultancy that aims %20-100 increase in crop yields, %50 less chemical fertilizers - %40-70 decrease in fertilization costs, increasing plant immunity system to resist disease, biotic and abiotic stress, using less pesticides, %30-40 less CO_2 emission.

2.3-Financial Planning

MT plans to establish a single facility with a capacity of 15000tn/year.

MT will continue R&D studies and will provide the necessary R&D infrastructure and human resources for this purpose.

Currently, MT has finished R&D studies for several products. MT will continue to work on R&D for new products.

Investments and expenses to be covered in the following 5 years are;

INVESTMENTS	COST $
Construction works	1.450.000,00
Mechanical and electrical works	1.820.650,00
R&D infrastructure	80.000,00
TOTAL	3.350.650,00

EXPENSES	$/month
R&D, 2 personnel	16.000,00
Production, 5 personnel	25.000,00
Office, 1 personnel	7.000,00
Consumables	1.000,00
Maintenance	1.000,00
Administrative	5.000,00
Others	2.000,00
TOTAL	57.000,00

The cost may vary depending on the; general market conditions, the changing conditions of the local markets where the relevant component is supplied, market conditions of the place where the factory is established, and transportation costs to the location.

MT's Projected Cash Flow;

Year	Production Capacity ton	Month	Investment	Depreciation* (%8/year)	Production Input* 1,5$/kg	Expense*	Income* 4,5 $/kg	Profit
2024	1500	1	1.675.325,00					-1.675.325,00
		2	1.675.325,00					-3.350.650,00
		3		22.337,67	187.500,00	57.000,00		-3.617.487,67
		4		22.486,58	188.125,00	57.190,00	562.500,00	-3.322.789,25
		5		22.636,50	188.752,08	57.380,63	564.375,00	-3.027.183,46
		6		22.787,40	189.381,26	57.571,90	566.256,25	-2.730.667,78
		7		22.939,32	190.012,53	57.763,81	568.143,77	-2.433.239,66
		8		23.092,25	190.645,90	57.956,35	570.037,58	-2.134.896,59
		9		23.246,20	191.281,39	58.149,54	571.937,71	-1.835.636,01
		10		23.401,17	191.918,99	58.343,37	573.844,17	-1.535.455,38
		11		23.557,18	192.558,72	58.537,85	575.756,98	-1.234.352,16
		12		23.714,23	193.200,59	58.732,98	577.676,17	-932.323,78
2025	5000	1		23.872,32	646.148,63	58.928,75	1.932.005,86	270.732,38
		2		24.031,47	648.302,46	59.125,18	1.938.445,88	1.477.719,15
		3		24.191,68	650.463,46	59.322,27	1.944.907,37	2.688.649,10
		4		24.352,96	652.631,68	59.520,01	1.951.390,39	3.903.534,85
		5		24.515,31	654.807,11	59.718,41	1.957.895,03	5.122.389,04
		6		24.678,75	656.989,81	59.917,47	1.964.421,34	6.345.224,36
		7		24.843,27	659.179,77	60.117,20	1.970.969,42	7.572.053,54
		8		25.008,90	661.377,04	60.317,59	1.977.539,31	8.802.889,33
		9		25.175,62	663.581,63	60.518,64	1.984.131,11	10.037.744,55
		10		25.343,46	665.793,57	60.720,37	1.990.744,88	11.276.632,04
		11		25.512,41	668.012,88	60.922,77	1.997.380,70	12.519.564,67
		12		25.682,50	670.239,59	61.125,85	2.004.038,63	13.766.555,37
2026	10000	1		25.853,71	1.344.947,44	61.329,60	4.021.437,52	16.355.862,13
		2		26.026,07	1.349.430,60	61.534,04	4.034.842,32	18.953.713,75
		3		26.199,58	1.353.928,70	61.739,15	4.048.291,79	21.560.138,11
		4		26.374,24	1.358.441,79	61.944,95	4.061.786,10	24.175.163,22
		5		26.550,07	1.362.969,93	62.151,43	4.075.325,38	26.798.817,17
		6		26.727,07	1.367.513,17	62.358,60	4.088.909,80	29.431.128,13
		7		26.905,25	1.372.071,54	62.566,46	4.102.539,50	32.072.124,38
		8		27.084,62	1.376.645,12	62.775,02	4.116.214,63	34.721.834,25
		9		27.265,19	1.381.233,93	62.984,27	4.129.935,35	37.380.286,22
		10		27.446,95	1.385.838,05	63.194,21	4.143.701,80	40.047.508,80
		11		27.629,93	1.390.457,51	63.404,86	4.157.514,14	42.723.530,64
		12		27.814,13	1.395.092,36	63.616,21	4.171.372,52	45.408.380,45
2027	12500	1		27.999,56	1.749.678,34	63.828,27	5.231.596,37	48.798.470,65
		2		28.186,22	1.755.510,60	64.041,03	5.249.035,02	52.199.767,82
		3		28.374,13	1.761.362,30	64.254,50	5.266.531,81	55.612.308,69
		4		28.563,29	1.767.233,51	64.468,68	5.284.086,91	59.036.130,12
		5		28.753,71	1.773.124,29	64.683,57	5.301.700,53	62.471.269,08
		6		28.945,41	1.779.034,70	64.899,19	5.319.372,87	65.917.762,65
		7		29.138,38	1.784.964,82	65.115,52	5.337.104,11	69.375.648,05
		8		29.332,63	1.790.914,70	65.332,57	5.354.894,46	72.844.962,61
		9		29.528,18	1.796.884,42	65.550,34	5.372.744,11	76.325.743,77
		10		29.725,04	1.802.874,03	65.768,84	5.390.653,26	79.818.029,11
		11		29.923,20	1.808.883,61	65.988,07	5.408.622,10	83.321.856,32
		12		30.122,69	1.814.913,23	66.208,03	5.426.650,84	86.837.263,21
2028	15000	1		30.323,51	2.185.155,52	66.428,73	6.533.687,61	91.089.043,06
		2		30.525,67	2.192.439,37	66.650,16	6.555.466,57	95.354.894,43

		3		30.729,17	2.199.747,51	66.872,32	6.577.318,12	99.634.863,56
		4		30.934,03	2.207.080,00	67.095,23	6.599.242,52	103.928.996,81
		5		31.140,26	2.214.436,93	67.318,88	6.621.239,99	108.237.340,73
		6		31.347,86	2.221.818,39	67.543,28	6.643.310,79	112.559.942,00
		7		31.556,85	2.229.224,45	67.768,42	6.665.455,16	116.896.847,44
		8		31.767,23	2.236.655,20	67.994,32	6.687.673,35	121.248.104,05
		9		31.979,01	2.244.110,71	68.220,97	6.709.965,59	125.613.758,96
		10		32.192,20	2.251.591,08	68.448,37	6.732.332,14	129.993.859,45
		11		32.406,81	2.259.096,39	68.676,53	6.754.773,25	134.388.452,96
		12		32.622,86	2.266.626,71	68.905,45	6.777.289,16	138.797.587,11
		TOTAL	3.350.650,00	1.575.401,89	74.332.835,04	3.640.541,03	221.697.015,07	

**%4 inflation is assumed.*

A profit of around $138 million is predicted at the end of 5 years for about $3,5 million investment.

3-Indoor Vertical Farming

Vertical farming refers to the process of producing crops in vertically stacked layers. It often integrates soilless agriculture techniques such as hydroponics, aquaponics, and aeroponics, as well as controlled environment farming, which seeks to optimize plant growth. The main benefit of using vertical farming technologies is higher crop yields that come with less water and unit land requirement. At the same time, the ability to grow more varieties of crops is increasing and food miles is decreasing.

In vertical farming practices, controlled environment agriculture (CEA) is used to modificate the natural environment to increase crop yield or extend the growing season. Since the crops are indoors, they are not affected by unexpected weather events and the crop loss rate is very low. Environmental factors such as air, temperature, light, water, humidity, carbon dioxide and plant nutrition can be controlled and by being in well-controlled environments, vertical farms can grow food anywhere in any climate and in any country with access to a power source and water.

With the cultivation in a sterile and controlled environment, much lower quantities of fertilizers and zero-chemical pesticides are used. Vertical farming produces pesticide-free, non-GMO and organic equivalent food with high nutritional value. There is no need for triple washing to remove pesticides before eating.

With this method, environmentally responsible production can be achieved by reducing CO_2 emissions and reducing the water needed. This type of urban farming will reduce the expense of intermediary distribution, logistic costs and product losses, from farm to sale.

Traditional agriculture is plagued with concerns over the freshness, health and nutrition of food as well as the consumer's health and ecological sustainability. Vertically-farmed food solves many of the issues related to traditional farming. By operating in a controlled environment and in an ecologically efficient manner, it opens an array of opportunities for sustainable food sourcing.

Vertical farming requires energy. The use of sustainable energy sources such as solar energy, wind turbines and other clean energy alternatives is in line with the high sustainability references of vertical farming. These sources provide an increasingly cheap source of electricity in many parts of the world, and vertical farms are using renewable energy sources for their energy needs.

MT has developed innovative flexible systems including software. MT Plant Factory increases crop production, ensure safe access to food, and include high agricultural technologies, provides the environmental conditions necessary for the cultivation of medicinal and aromatic plants as well as agricultural food products.

MT Plant Factory grow plants for 12 months using special LED grow lights, using pesticide-free, soilless growing method, with 95% water savings regardless of the climate. Plant factory may be established in an idle warehouse, a subway structure or a new building. MT Plant Factory grow plants for 12 months using

special LED grow lights, using pesticide-free, soilless growing method, with 95% water savings regardless of the climate.

Production parameters such as pH, electrical conductivity, temperature, humidity, and carbon dioxide in the plant growing environment will be controlled by the automation system and sensors, and production will be realized by providing the optimum conditions required.

Some plants that MT has studies on; lettuce, strawberry, wheat, stevia (sugar grass), mint (chocolate mint), tomatoes, basil, rocket, dill, sour grass, parsley, basil, kalanchoe flower, broccoli microgreens, sunflower, mung bean, beluga lentils, purslane, red beet, turnip, black/yellow mustard, wheatgrass, black chickpea grass, cabbage, amaranth.

Plant factory may be established in an idle warehouse, a subway structure, or a new building. MT has developed factory designs of several capacities. The number of production trays indicates the production capacity of the Plant Factory. Each production unit includes 480 trays. There are designs of new factory buildings with the capacity of 480-960-1920 trays.

The sterile plant production process begins with the planting of the seeds by Seed Sowing Machine ends in the +4°C Cold Storage for shipment. There is an optional +4°C Cold Production Unit for some valuable plantings.

Plant factories are designed with steel construction, insulated thermo panel walls and roof, epoxy coating floor, industrial doors, all necessary installations, lighting, data, camera, fire detect, transformer, generator, ups, sanitary, air-conditioning installations, HVAC and handling units, supporting the production system.

Plant Growing Rack System offers perfect solutions for vertical farming applications. It enables to reach maximum product efficiency in minimum area with vertical farming. One of the important parts of the system is the plant growing trays. The plant growing tray is presented as a set of 1 lower and 2 upper parts. There are 60 holes and 0.96 m² production area in 1 tray set.

An indispensable part of the Plant Growth System is LED Grow Lights. Plant Grow Lights, which are connected to each other in each plant production tray, are included in the system specially designed for the growth stages of the plant. 4 rows of LED grow lights are used on each plant shelf floor. LED lamps used in all units are dimmable. It is also possible to change the spectrum according to plant growth. The system operates at 3 different spectrum wavelengths.

Irrigation and fertilization system includes reverse osmosis, Nutrient Film Technique (NFT) which measures water values instantly, manages and saves %95 of water, optional drip system, water tanks with blowers.

Air conditioning system includes heating/ cooling, dehumidification, humidification with fogging, sterilization air with ozone, fresh air inlet and polluted air outlet, HEPA filters. The system software has climate control. Climate

Management allows you to manage the values of temperature, humidity, CO2, lux, PAR.

Climate management is one of the most important issues in vertical farming. The management of heating, cooling, humidification, cleaning the air with ozone, dehumidification, and ventilation, from a single point and integrating it with the system ensures healthy growth of plants. It is designed for distributing air equally in plant growing environments with clean air line, evacuation of polluted air, sterilization of air with HEPA filter systems and antimicrobial air channels in air conditioning devices (HVAC).

The system software allows you to manage the PH, EC, temperature, dissolved O2 values in water and fertilization system management. All light management is done through the system software which simulates the daily light to grow the plant in the production unit.

The system software has the properties; plant growth parameter definitions, ability to manage different units, remote access and management, availability of IOT feature, reporting. The central hardware consists of an industrial process computer (IPC) and the necessary I/O modules. All I/O modules are connected to the main cabinet via a special protocol. This modern software is easy to use and offers any control you might need to control processes. The standard edition includes chart settings and data analysis tables. It also offers many possibilities to expand its features.

Personal Vertical Farm; Cabinet system not only brings Vertical Farming very close to you but delivers it directly to your home. The smart growing cabinet can be used to grow crisp Leafy Greens, Herbs and Microgreens. It provides ideal growth conditions with its automatic LED lighting, its own water circuit and climate control. This allows you to harvest healthy greens free of pesticides directly onto your plate.

Smart Control System in cabinet system can control all the parameters while growing plants until to the harvest. The system controls watering, solution dosing for Electrical conductivity (EC) and PH, air conditioning, humidity, and CO_2 system. Datalogger and internet connectivity are optional. Sensor-based climate control provides ideal conditions for faster plant growth that is up to 3 times.

The closed-loop hydroponic watering system with an integrated water tank saves up to 95% of water compared to conventional farming. LED Grow Lights provide the most important solar wavelengths for 16 hours a day.

Smart Control System can also be communicated and controlled via Internet. This allows you to record what is currently planted, the temperature, CO_2, humidity, EC and PH values of the solution, the water level.

3.1-Historical Development

It was Professor Dickson Despommier of the Public Health Sciences at Columbia University who first put forward the theory of vertical farming in 1999.

Investors and local governments in many cities have been interested in establishing vertical farming. Some of these are Incheon (South Korea), Abu Dhabi (United Arab Emirates), Dongtan (China), New York City, Portland, Los Angeles, Las Vegas, Seattle, Surrey, Toronto, Paris, Bangalore, Dubai, Shanghai and Beijing.

In 2009, the world's first pilot production system was installed in Paignton Zoo's Environmental Park in the UK. The project showcased vertical farming and provided a solid knowledge base for researching sustainable urban food production.

In 2015, the London-based Growing Underground company started producing leafy green products in underground tunnels that were abandoned after the Second World War.

In 2017, a Japanese company Mirai started marketing its multi-level vertical farming system. The company declared 10,000 pcs of lettuce production per day, 100 times the amount that can be produced using traditional farming methods, because special-purpose LED lights can reduce growth times by 2.5 times. In addition, according to the company, this method can provide 40% less energy, 80% less food wastage and 99% less water use than conventional farming methods.

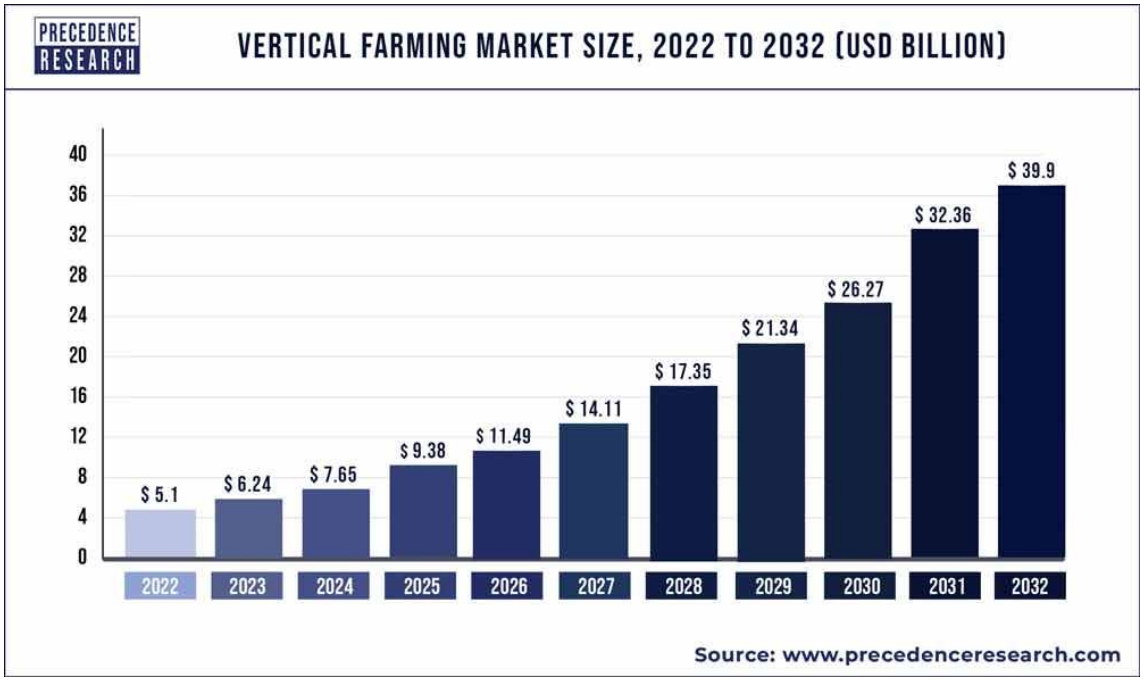
In 2019, Kroger partnered with German startup Infarm to install modular vertical farms at two grocery stores in Seattle. In 2021, the first phase of the construction of the new Nordic Harvest vertical farm was completed. Located in Copenhagen Markets in Denmark, the 7,000 square meter facility will be Europe's largest vertical farm with 14 floors.

In 2022 Emirates Flight Catering opened the World's Largest Vertical Farm in Dubai. Bustanica opens the doors of the world's largest hydroponic farm. The facility is the first vertical farm of Emirates Crop One, a joint venture of Emirates Flight Catering (EKFC), one of the world's largest catering operations and serving more than 100 airlines, and Crop One, which lead the industry with technology-oriented indoor vertical farming activities. Bustanica will save over 250 million liters of water annually and produce over 1 million kilograms of agricultural products free of pesticides, herbicides, and chemicals. The facility is preparing to produce over 1 million kilograms of high-quality greens per year, using 95% less water than traditional agriculture. More than 1 million cultivated plants are grown uninterruptedly at the facility, and 3,000 kilos per day of product are produced.

3.2-Vertical Agriculture Market

According to Precedence Research, The global vertical farming market size was valued at USD 5.1 billion in 2022 and it is predicted to be worth around USD 39.9 billion by 2032 and registering at a CAGR of 22.89% from 2023 to 2032. U.S. vertical farming market was valued at USD 552.7 million in 2022.

Market CAGR for vertical farming is being driven by the advantages of vertical farming over conventional farming. Global agriculture is facing a number of challenges such as lack of land to meet future demand, negative environmental consequences of global deforestation, desertification and flooding. Vertical farming is expected to play a critical role in focusing on the growing food need while decreasing environmental effect. Vertical farming is a growth system designed to withstand weather and climate change, it has the advantages of faster growth cycles, year-round crop production, consistent quality, and predictable output. Vertical farms build a farm-to-table order-based system in urban areas, decreasing packaging, waste, transport. So vertical farming is more productive and efficient than traditional farming, which is propelling market expansion.



The Asia Pacific region has the largest vertical farming market share, as key drivers for vertical farming industry growth are being created here and the public seems very interested in new product developments. Asia Pacific vertical farming market has accounted revenue share of 28.4% in 2022. Asia Pacific dominated the sector and is anticipated to continue leading in future. Rising awareness about the significance of alternative farming, due to less fertility of land its availability is the key factor expected to spur the demand. North America is probable to be the

major market. Rising urban population and commercialization of inside farming are expected to motivate the demand.

The European region is also growing steadily, with vertical farming equipment and tools widely used. Just 21% of the global vertical farming market is accounted for by Europe. In 2021, the market for vertical farming in Europe was expected to be worth USD 0.85 billion. Yet, according to a survey from Market Data Forecast, the European vertical farming industry will expand by 22% yearly and reach USD 2.31 billion by 2026. The UK is one of the leading nations in the European vertical farming sector, along with France, Germany, Spain, and Italy. The popularity of vertical farming in certain regions in Europe has been spurred by rising customer demand and technological developments in those countries and across the continent.

Vertical farming by 2050 is considered to be a new method for feeding huge global populations. Building a farm that is close to the people it serves by supplying cheaper, organic, disease-free crops and preserving limited natural resources. The more sustainable and innovative method of agriculture than conventional agriculture and greenhouse farming is known to be vertical farming. It takes very little water and saves a large amount of soil and space. The growth of the global vertical farming market is driven by rising customer health awareness, along with increasing urbanization and increasing per capita income. Indoor farming methods are also used by companies involved in the manufacture of pharmaceutical goods.

Dominant Key Players in the Vertical Farming Market are:

- Aerofarms (US)
- Crop One (U.S.)
- Urban Crop (Belgium)
- Illumitex, Inc. (US)
- Sky Greens (Singapore)
- Koninklijke Philips N.V. (Netherlands)
- Everlight Electronics Co., Ltd. (Taiwan)
- Green Sense Farms, LLC (US)
- Agrilution (Germany)
- Infarm (Germany)
- American Hydroponics (US)
- Vertical Farm Systems (Australia)

3.3-Agricultural Efficiency and Food Safety

Vertical farming in some cases allows crop yields per decare more than ten times that of traditional methods. In some instances, this efficiency goes up to 50 times. Contrary to conventional farming in non-tropical areas, indoor farming can produce crops throughout the year. All-season farming can multiply the

productivity of the cultivated surface by a factor of 4 to 50, depending on the crop. The factor is around 30 in greens product groups and in crops such as Strawberry.

According to UN reports, it is estimated that the world population will exceed 9 billion by 2050. The current world population is 8 billion. By 2050, more than 50% of the population will be living in cities. Vertical farming is a predictable response to possible food shortages as the population increases. With this method, environmentally responsible production can be achieved by reducing emissions and reducing the water needed. This type of urban farming will also reduce the expense of intermediary distribution that goes from farm to sale almost instantly. Agricultural products can be bought cheaper. The product loss rate from the farm to the table is over 35%. With production in the city and on-site, agricultural productivity can be increased by reducing logistics costs and product losses.

The food problem and nutritional insecurity is a serious problem in urban centers where the global population is projected to increase. Especially with the COVID-19 outbreak, food access has been restricted due to the increase in food insecurity in the food supply chain, the aggravation of physical and economic barriers, and the increase in food waste. Therefore, there is a need for more durable food systems and reducing food waste. Vertical farming can potentially benefit the quality and safety of food, contribute to sustainable urban agriculture, and increase food production.

In many countries, there is an increasing demand for foods rich in vitamins, proteins and minerals. In developing countries, another problem is the use of animal manure instead of manure, which should be used for cultivation. Although animal manure is an effective fertilizer, some adverse events such as parasites, infection and food poisoning may occur. The advantage of vertical farming in this regard is that it has the ability to reduce contagious or poisoning, since fecal matter is not used as fertilizer applied in traditional agriculture.

Vegetables are considered high risk crops in terms of contamination. Consumers should wash and consume after purchasing. But these procedures are ineffective, and some chemicals must be used to separate harmful pathogens from vegetables. This method can cause low quality, loss of taste and smell in vegetables. In vertical farming, nutritional supplements are applied only in the irrigation system. All products are constantly checked. As in traditional agriculture, adverse events such as seasonal changes, humidity and temperature do not occur. Crops grown in airtight environments prevent exposure to factors such as bacteria, pests, fungi.

It is possible to increase agricultural production by using new technologies such as vertical farming in metropolitan cities with dense population. Municipalities should carry out leading projects for the public to access agricultural products at affordable prices.

Plants to be grown in indoor vertical farms are mainly grouped in 4 categories;

- Lettuce, parsley, dill, and similar green product groups

- Tomatoes, strawberries, and similar value-added fruits
- Basil, stevia, saffron and similar value-added medicinal aromatic plants
- Begonia, Aloe Vera and similar value-added flower product groups

3.4-Marketing Strategy

MT's strengths in the market are;

- Flexible production system, adaptability of the system for different plants, cultivating different species at the same time,
- The system and all its components are designed to eliminate the risk of disease and loss.

- MT also has consultancy capability in vertical farming and other agricultural issues.
- In addition to the fact that vertical agriculture is a sustainable practice due to the effective use of resources, MT also ensures the traceability of its products thanks to its technology.
- MT has completed its R&D studies, implemented the closed vertical farming application at -30mt carpark, and made successful trials on various species.

The problems of the market are;

- The high startup costs of vertical farming solutions and little experience in developing vertical farming technologies limit the investment propensity.
- The high energy demand of vertical farms can weaken financial planning in case of rising energy prices.
- A disadvantage of vertical farming is the lack of experienced people in the labor market.
- The lack of variety in crops cultivated and high labor costs restrict market expansion.

MT's strategy includes;

- Providing all components of indoor vertical farming; clear process management with sufficient, compatible and flexible hardware-software and consultancy including detailed information sharing.
- The right initial capacity and enlargement model; scale of the project according to the optimal ratio of price and market volume.
- Systematic approaches to marketing; optimization of distribution channels taking into account the specifics of products and volume.
- The right choice of crops with an emphasis on uniqueness; expensive crops with a short production cycle and almost complete absence of competition.
- The right choice of production location; city with a fairly high-income level and a developed public catering and tourism (HoReCa) segment.
- Systematic approaches to marketing; optimization of distribution channels taking into account the specifics of products and volume.
- Superior position in terms of carbon footprint; promoting the use of solar energy system.

3.5-Cost and ROI of MT Plant Factories

The capacities and the costs of the plant factories in an existing closed area, are in the table below;

DESCRIPTION OF WORK	COST		
	480 trays	960 trays	1920 trays

	400m2	750m2	1350m2
CONSTRUCTION WORKS	$306.720,00	$406.080,00	$594.720,00
ELECTRICAL WORKS	$309.701,00	$517.492,00	$902.287,00
MECHANICAL WORKS	$407.117,00	$680.268,00	$1.186.100,00
LIGHT, OUTOMATION AND OTHER SYSTEMS	$1.520.306,00	$3.048.410,00	$6.112.415,00
TOTAL	$2.543.844,00	$4.652.250,00	$8.795.522,00

The capacities and the costs of the plant factories as a new facility, are in the table below;

DESCRIPTION OF WORK	COST		
	480 trays 700m2	960 trays 1000m2	1920 trays 1700m2
CONSTRUCTION WORKS	$1.185.839,00	$1.646.142,00	$2.689.463,00
ELECTRICAL WORKS	$309.701,00	$517.492,00	$902.287,00
MECHANICAL WORKS	$407.117,00	$680.268,00	$1.186.100,00
LIGHT, OUTOMATION AND OTHER SYSTEMS	$1.520.306,00	$3.048.410,00	$6.112.415,00
TOTAL	$3.422.963,00	$5.892.312,00	$10.890.265,00

The cost may vary depending on the; general market conditions, the changing conditions of the local markets where the relevant component is supplied, market conditions of the place where the factory is established, and transportation costs to the location.

Features of MT's Plant Factories are in the trays below;

PLANT FACTORY	PRODUCTION UNIT NFT+ DRIP (Optional)	SEEDLING UNIT NFT	+4°C COLD PRODUCTION UNIT (Optional) NFT
480 Trays,700 m^2 h_{min}:4mt	480 Trays 225 m^2	48 Trays 2 Seed cracking cabinets	40 Trays

960 Trays, 1000 m² h_{min}:4mt	960 Trays 450 m²	96 Trays 4 Seed cracking cabinets	80 Trays
1920 Trays, 1700 m² h_{min}:4mt	1920 Trays 900 m²	192 Trays 8 Seed cracking cabinets	160 Trays

Plant Factories and capacities.

LED GROW LIGHTS	PRODUCTION UNIT			SEEDLING UNIT			+4°C COLD PRODUCTION UNIT		
PPFD (µmol/m²/s)	350			350			350		
Led fixture type	4 x T8 led			4 x T8 led			4 x T8 led		
Power	25 W			25 W			25 W		
No of Led fixtures	480 Trays	960 Trays	1920 Trays	480 Trays	960 Trays	1920 Trays	480 Trays	960 Trays	1920 Trays
	480	960	1920	48	96	192	40	80	160
Total power (kW/h)	48	96	192	4,8	9,6	19,2	4	8	16

Plant Factories and power consumptions.

SHELF FEATURES	PRODUCTION UNIT	SEEDLING UNIT	+4°C COLD PRODUCTION UNIT
Shelf depth	80cm	80cm	80cm
Shelf width	2100cm	max1050cm	max1050cm
Leg to Leg	130cm	130cm	130cm
Shelf hight	300cm, 5 shelves	300cm, 6 shelves	300cm, 5 shelves
No of rows	6	min2	min2

Plant Factory units and shelf features.

Below is the ROI (month) calculated for some plants based on the above costs;

960 production trays as a new facility (1000 m2)	Parsley (100gr)	Med. Green (150gr)	İtalian Basil (25gr)
No of trays	960		
No of holes or pcs in a trays	120	50	100
Monthly harvest (pcs)	115200	48000	96000

Monthly harvest (kg)	17280	7200	2400

Trays growing leds (kW/day)	1152
HVAC and others (kW/day)	2073,6
TOTAL (kW/day)	3225,6
kW price ($/kW)*	0,13
Monthly electricity cost ($)	12.579,84

Monthly workers cost 4000$/worker ($)	16000		
Monthly technician cost 5500$/technician ($)	11000		
Monthly maintenance and office exp. ($)	6000		
Fertilizers, consumables etc. ($)	1.382,40	576,00	1.152,00
Seed ($)	2.304,00	960,00	1.920,00
Rockwool ($)	345,60	144,00	288,00
Packaging ($)	40.320,00	2.400,00	4.800,00
Water ($)	57,60	57,60	57,60
Other monthly cost SUM ($)	77.409,60	37.137,60	41.217,60

TOTAL monthly cost ($)	89.989,44	49.717,44	53.797,44

Unit cost ($)	0,78	1,04	0,56

Unit price ($)	5,00	3,18	3,35
Monthly sales ($)	576.000,00	152.640,00	321.600,00
Unit profit ($)	4,22	2,14	2,79
Monthly profit ($)	486.010,56	102.922,56	267.802,56

The operation cost may vary depending on the local market. This table has been prepared according to market data.

Projected Cash Flow of a Plant Factory;

Year	Month	Investment	Depreciation* (%8/year)	Expense* (average)	Income* (average)	Profit
2024	7	2.946.156,00				-2.946.156,00
	8	420.879,43				-3.367.035,43
	9	420.879,43				-3.787.914,86

	10	420.879,43				-4.208.794,29
	11	420.879,43				-4.629.673,71
	12	420.879,43				-5.050.553,14
2025	1	420.879,43				-5.471.432,57
	2	420.879,43				-5.892.312,00
	3					-5.892.312,00
	4					-5.892.312,00
	5		49.102,60	64.501,44		-6.005.916,04
	6		49.429,95	64.716,44	350.080,00	-5.769.982,44
	7		49.759,48	64.932,17	351.246,93	-5.533.427,15
	8		50.091,21	65.148,61	352.417,76	-5.296.249,22
	9		50.425,15	65.365,77	353.592,48	-5.058.447,66
	10		50.761,32	65.583,65	354.771,12	-4.820.021,51
	11		51.099,73	65.802,27	355.953,69	-4.580.969,82
	12		51.440,40	66.021,61	357.140,21	-4.341.291,61
2026	1		51.783,33	66.241,68	358.330,67	-4.100.985,95
	2		52.128,55	66.462,49	359.525,11	-3.860.051,88
	3		52.476,08	66.684,03	360.723,53	-3.618.488,46
	4		52.825,92	66.906,31	361.925,94	-3.376.294,75
	5		53.178,09	67.129,33	363.132,36	-3.133.469,81
	6		53.532,61	67.353,09	364.342,80	-2.890.012,71
	7		53.889,50	67.577,60	365.557,28	-2.645.922,54
	8		54.248,76	67.802,86	366.775,80	-2.401.198,36
	9		54.610,42	68.028,87	367.998,39	-2.155.839,26
	10		54.974,49	68.255,63	369.225,05	-1.909.844,34
	11		55.340,98	68.483,15	370.455,80	-1.663.212,68
	12		55.709,92	68.711,43	371.690,65	-1.415.943,38
2027	1		56.081,32	68.940,47	372.929,62	-1.168.035,56
	2		56.455,20	69.170,27	374.172,72	-919.488,31
	3		56.831,57	69.400,84	375.419,96	-670.300,75
	4		57.210,44	69.632,17	376.671,36	-420.472,01
	5		57.591,85	69.864,28	377.926,93	-170.001,21
	6		57.975,79	70.097,16	379.186,69	81.112,53
	7		58.362,30	70.330,82	380.450,64	332.870,05
	8		58.751,38	70.565,25	381.718,81	585.272,23
	9		59.143,06	70.800,47	382.991,21	838.319,91
	10		59.537,34	71.036,47	384.267,84	1.092.013,94
	11		59.934,26	71.273,26	385.548,74	1.346.355,16
	12		60.333,82	71.510,84	386.833,90	1.601.344,40
2028	1		60.736,05	71.749,21	388.123,35	1.856.982,49
	2		61.140,95	71.988,37	389.417,09	2.113.270,25
	3		61.548,56	72.228,33	390.715,15	2.370.208,51
	4		61.958,88	72.469,10	392.017,53	2.627.798,06
	5		62.371,94	72.710,66	393.324,26	2.886.039,72
	6		62.787,75	72.953,03	394.635,34	3.144.934,27

	7		63.206,34	73.196,20	395.950,79	3.404.482,52
	8		63.627,72	73.440,19	397.270,62	3.664.685,23
	9		64.051,90	73.684,99	398.594,86	3.925.543,20
	10		64.478,91	73.930,61	399.923,51	4.187.057,19
	11		64.908,77	74.177,04	401.256,59	4.449.227,96
	12		65.341,50	74.424,30	402.594,11	4.712.056,27
2029	1		65.777,11	74.672,38	403.936,09	4.975.542,87
	2		66.215,62	74.921,29	405.282,54	5.239.688,50
	3		66.657,06	75.171,03	406.633,49	5.504.493,90
	4		67.101,44	75.421,60	407.988,93	5.769.959,80
	5		67.548,78	75.673,00	409.348,89	6.036.086,90
	6		67.999,11	75.925,25	410.713,39	6.302.875,94
	TOTAL	5.892.312,00	2.902.475,23	3.503.067,34	18.600.730,51	

**%4 inflation is assumed.*

A profit of around $6 million is predicted at the end of 5 years for about $6 million investment. If solar energy is used, the electricity cost is negligible after 5 years.

After the location and species research are completed, MT has planned to operate the plant factory on a turnkey basis in 8 months, and to start production in the 11th month, in accordance with the work schedule, except in case of force majeure.

3.6-Financial Planning

MT plans to establish 2 facilities with 960 trays in Switzerland within 2 years and facilities with a total of 5x960 trays in the European region within 5 years.

MT will continue hardware and software development activities at the Marly Innovation Center and will provide the necessary R&D infrastructure and human resources for this purpose.

Currently, MT has optimized the environment simulations for the species mentioned above. MT will continue to work on R&D for new species as well.

Although the supply of vertical agricultural components is dominated by some production regions, MT will produce some critical elements on its own, create its own critical import stocks, and encourage alternative production regions.

Investments and expenses to be covered in the following 5 years are;

INVESTMENTS	COST $
R&D investment (vertical farm with 100 tray capacity, RD infrastructure)	850.000,00
Production infrastructure investment	150.000,00
Stocks for 2 facilities (2x960 trays)	7.800.000,00
TOTAL	8.800.000,00

EXPENSES	$/month
R&D, 2 personnel	16.000,00
Production, 3 personnel	21.000,00
Office, 1 personnel	7.000,00
Consumables	1.000,00
Maintenance	2.000,00
Administrative	5.000,00
Others	2.000,00
TOTAL	54.000,00

MT's Projected Cash Flow;

Year	Month	Investment	Depreciation* (%8/year)	Production Input*	Expense*	Income*	Profit
2024	1	500.000,00		1.560.000,00			-2.060.000,00
	2	500.000,00		1.560.000,00			-4.120.000,00
	3		10.416,67	1.560.000,00	54.000,00		-5.744.416,67
	4		10.486,11	1.560.000,00	54.180,00		-7.369.082,78

	5		10.556,02	1.560.000,00	54.360,60		-8.993.999,40
	6		10.626,39		54.541,80		-9.059.167,59
	7		10.697,23	200.000,00	54.723,61	2.946.156,00	-6.378.432,43
	8		10.768,55		54.906,02	420.879,43	-6.023.227,57
	9		10.840,34		55.089,04	420.879,43	-5.668.277,53
	10		10.912,61		55.272,67	420.879,43	-5.313.583,38
	11		10.985,36		55.456,91	420.879,43	-4.959.146,22
	12		11.058,60		55.641,77	420.879,43	-4.604.967,15
2025	1		11.132,32		55.827,24	420.879,43	-4.251.047,29
	2		11.206,53		56.013,33	420.879,43	-3.897.387,72
	3		11.281,24		56.200,04		-3.964.869,01
	4		11.356,45		56.387,38		-4.032.612,84
	5		11.432,16		56.575,33		-4.100.620,34
	6		11.508,38	207.333,33	56.763,92	3.054.181,72	-1.322.044,25
	7		11.585,10		56.953,13	436.311,67	-954.270,81
	8		11.662,33		57.142,98	436.311,67	-586.764,44
	9		11.740,08		57.333,45	436.311,67	-219.526,30
	10		11.818,35		57.524,56	436.311,67	147.442,46
	11		11.897,14		57.716,31	436.311,67	514.140,68
	12		11.976,45		57.908,70	436.311,67	880.567,20
2026	1		12.056,30		58.101,73	436.311,67	1.246.720,85
	2		12.136,67		58.295,40		1.176.288,77
	3		12.217,58	900.000,00	58.489,72		205.581,47
	4		12.299,03		58.684,69		134.597,75
	5		12.381,03	1.000.000,00	58.880,30	3.166.168,38	2.229.504,81
	6		12.463,57	2.528.000,00	59.076,57	452.309,77	82.274,44
	7		12.546,66		59.273,49	452.309,77	462.764,06
	8		12.630,30		59.471,07	452.309,77	842.972,46
	9		12.714,50		59.669,31	452.309,77	1.222.898,42
	10		12.799,27		59.868,20	452.309,77	1.602.540,72
	11		12.884,60		60.067,76	452.309,77	1.981.898,13
	12		12.970,49		60.267,99	452.309,77	2.360.969,41
2027	1		13.056,96		60.468,88		2.287.443,57
	2		13.144,01	936.000,00	60.670,45		1.277.629,11
	3		13.231,64		60.872,68		1.203.524,80
	4		13.319,85	1.040.000,00	61.075,59	3.282.261,22	3.371.390,58
	5		13.408,65	2.629.120,00	61.279,18	468.894,46	1.136.477,22
	6		13.498,04		61.483,44	468.894,46	1.530.390,21
	7		13.588,02		61.688,38	468.894,46	1.924.008,26
	8		13.678,61		61.894,01	468.894,46	2.317.330,10
	9		13.769,80		62.100,33	468.894,46	2.710.354,43
	10		13.861,60		62.307,33	468.894,46	3.103.079,96
	11		13.954,01		62.515,02	468.894,46	3.495.505,40
	12		14.047,04		62.723,40		3.418.734,96
2028	1		14.140,68	973.440,00	62.932,48		2.368.221,79

	2		14.234,96		63.142,25		2.290.844,58
	3		14.329,86	1.081.600,00	63.352,73	3.402.610,80	4.534.172,80
	4		14.425,39	2.734.284,80	63.563,90	486.087,26	2.207.985,97
	5		14.521,56		63.775,78	486.087,26	2.615.775,89
	6		14.618,37		63.988,37	486.087,26	3.023.256,41
	7		14.715,82		64.201,66	486.087,26	3.430.426,18
	8		14.813,93		64.415,67	486.087,26	3.837.283,84
	9		14.912,69		64.630,39	486.087,26	4.243.828,02
	10		15.012,11		64.845,82	486.087,26	4.650.057,35
	11		15.112,19		65.061,98		4.569.883,18
	12		15.212,93		65.278,85		4.489.391,40
	TOTAL	1.000.000,00	734.653,12	22.029.778,13	3.448.933,61	31.702.756,26	

**%4 inflation is assumed.*

A profit of around $4,5 million is predicted at the end of 5 years for about $1 million investment and $8 million stock investment.

Appendix

Presentation: Indoor Vertical Farming Plant Factory

Presentation: Soil Stabilization Additive

Presentation: Regenerative Agriculture

Presentation: Soil Rehabilitation

Presentation: Waste Management – Composting