

SPRING 2017



A MULTI-FLOOR HEXAGONAL DESIGN FOR THE HYDROPONIC PRODUCTION OF LETTUCE

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challenges facing agriculture

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CONVENTIONAL
AGRICULTURE

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Leading to the end



THE DANGERS

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10 BILLION

HUMANS WILL LIVE ON EARTH BY 2050

MONOCULTURE

The practice of cultivating a single crop species possessing similar maintenance and growing requirements in the same field



CONVENTIONAL TILLAGE

The practice of plowing the soil to promote the loosening of soil structure, drainage, & aeration



INTENSIVE HILLSIDE CULTIVATION

Since arable land is finite, hillsides are being cultivated to cope with the increased demand for food



REPRECUSSIONS

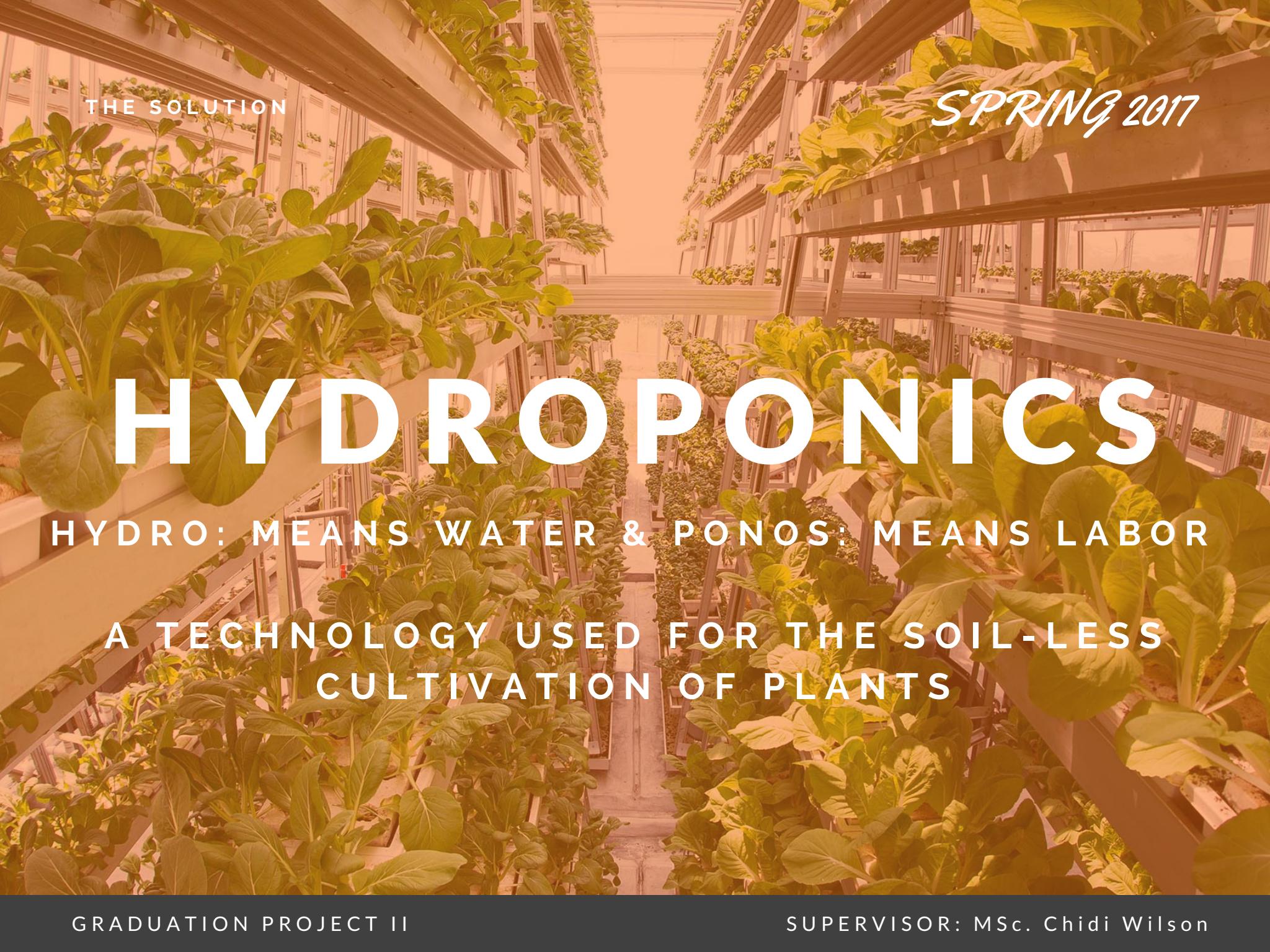
why conventional practices are harmful to the environment



DECLINE IN
SOIL FERTILITY

LOSS OF
BIODIVERSITY

DETERIORATION
OF HUMAN HEALTH

The background image shows a modern hydroponic farm with four levels of shelves. Each shelf is filled with white rectangular trays containing various leafy green vegetables, such as bok choy and basil. The farm is set against a bright, possibly glass-walled, exterior.

THE SOLUTION

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HYDROPONICS

HYDRO: MEANS WATER & PONOS: MEANS LABOR

A TECHNOLOGY USED FOR THE SOIL-LESS
CULTIVATION OF PLANTS

HYDROPONICS TIMELINE

RENAISSANCE (1699)

The English Physician John Woodward grew plants in water culture taken from the Thames River

20th CENTURY (1963)

The term Hydroponics was coined by Dr. W.F. Gericke. Hydro means water and Ponos means labor

ANCIENT CIVILIZATIONS

Hydroponics is traced back to the hanging gardens of Babylon and the floating gardening rafts of the Aztecs

WW2 (1939-1945)

Lettuce was hydroponically grown by the US army for troops stationed on the infertile islands of the Pacific

ADVANTAGES

what gives hydroponics the edge over other systems

A close-up photograph of several heads of green leafy lettuce, likely romaine, growing in a hydroponic system. The plants are arranged in rows, with their roots submerged in a white nutrient solution. The background is slightly blurred.

EASY TO CUSTOMIZE

REDUCE COSTS

CONSERVE WATER

CONTROLLED
ENVIRONMENT

RECYCLE
NUTRIENTS

ALL-YEAR-AROUND
HARVESTING

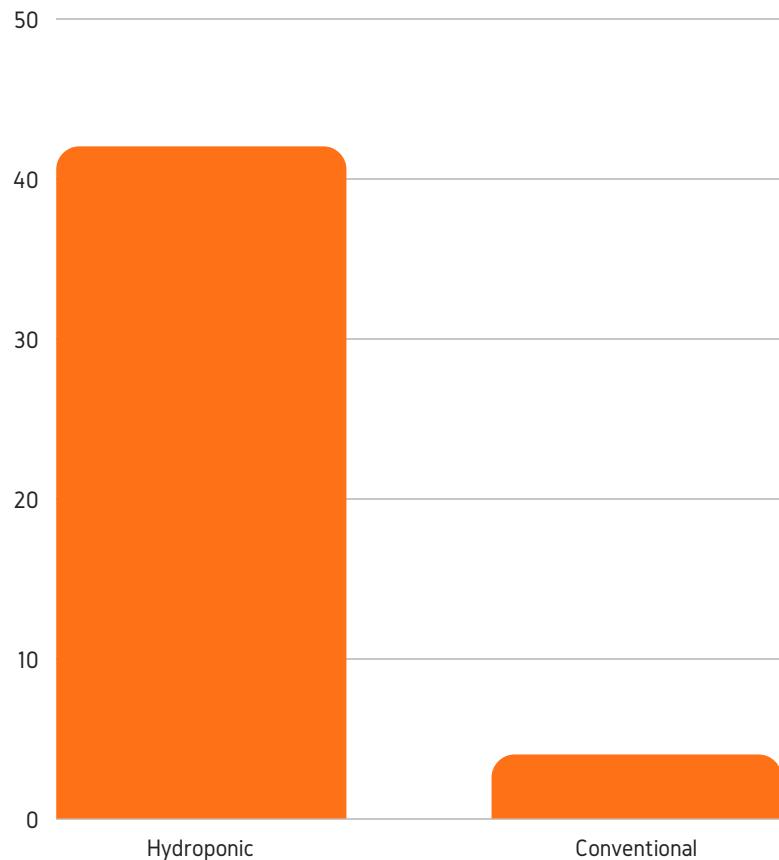
AMPLIFY YIELDS

DEVELOPMENT OF
NON-ARABLE LAND

ECO-FRIENDLY

COMPARISON BTW AVERAGE YIELDS

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HIGHER YIELDS

25%

more harvest than conventional
soil agriculture

HIGHER DENSITY PLANTING RESULT IN INCREASED HARVEST PER ACRE



LIMITATIONS

what makes hydroponics
a less favorable investment

HIGH COSTS

ENERGY INPUTS

CONVOLUTED LAWS

SKEPTICISM

LACK OF DATA

SYSTEM FAILURE

AIMS OF THE PROJECT

DESIGN AN AFFORDABLE SYSTEM
WHILE...

1

INCREASING
THE SYSTEM'S
PRODUCTIVITY

2

INCREASING
THE SYSTEM'S
RELIABILITY

3

REDUCING
THE RISK OF
SYSTEM FAILURE

MAINTENANCE OF ESSENTIAL PARAMETERS



WATER QUALITY

Utilization of filtered water prevents the clogging of irrigation systems

OXYGENATION

Improves physiological processes, accelerates vegetative growth, & fructification

LIGHTING

The output of irradiated light in LED lights could be adjusted

MAINTENANCE OF OPERATION

what other parameters could be controlled to optimize
hydroponic (not monitored)



COMPOSITION OF
NUTRIENT SOLUTION

EC & PH OF NUTRIENT
SOLUTION

TEMPERATURE OF
NUTRIENT SOLUTION

CO₂ ENRICHMENT

HUMIDIFICATION

DEHUMIDIFICATION

LOOSE-LEAF LETTUCE OSCARDE
(ASTERACEAE LACTUCA SATIVA L.)

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PLANT MATERIAL

The Lettuce variety that will be produced is the loose-leaf lettuce Oscarde (Asteraceae Lactuca Sativa L.). It is one of most commercially produced variety in hydroponic systems..



UTILIZED EQUIPMENT

There are several requirements for the initiation of the operations in both of the Germination and Production Chambers.

CIRCULATION
PUMP

SECONDARY
PUMP

PLEXI
GLASS

LED
LIGHTS

AIR
STONE

WHITE
FOAM

PIPES FOR
PLUMBING

PLASTIC
CONTAINERS

*MODULAR
STRUCTURE
OF THE
ASSEMBLED
PROTOTYPE*



TESTING THE LIGHTING SYSTEM OF ASSEMBLED PROTOTYPE





THE FINAL STRUCTURE OF THE ASSEMBLED PROTOTYPE



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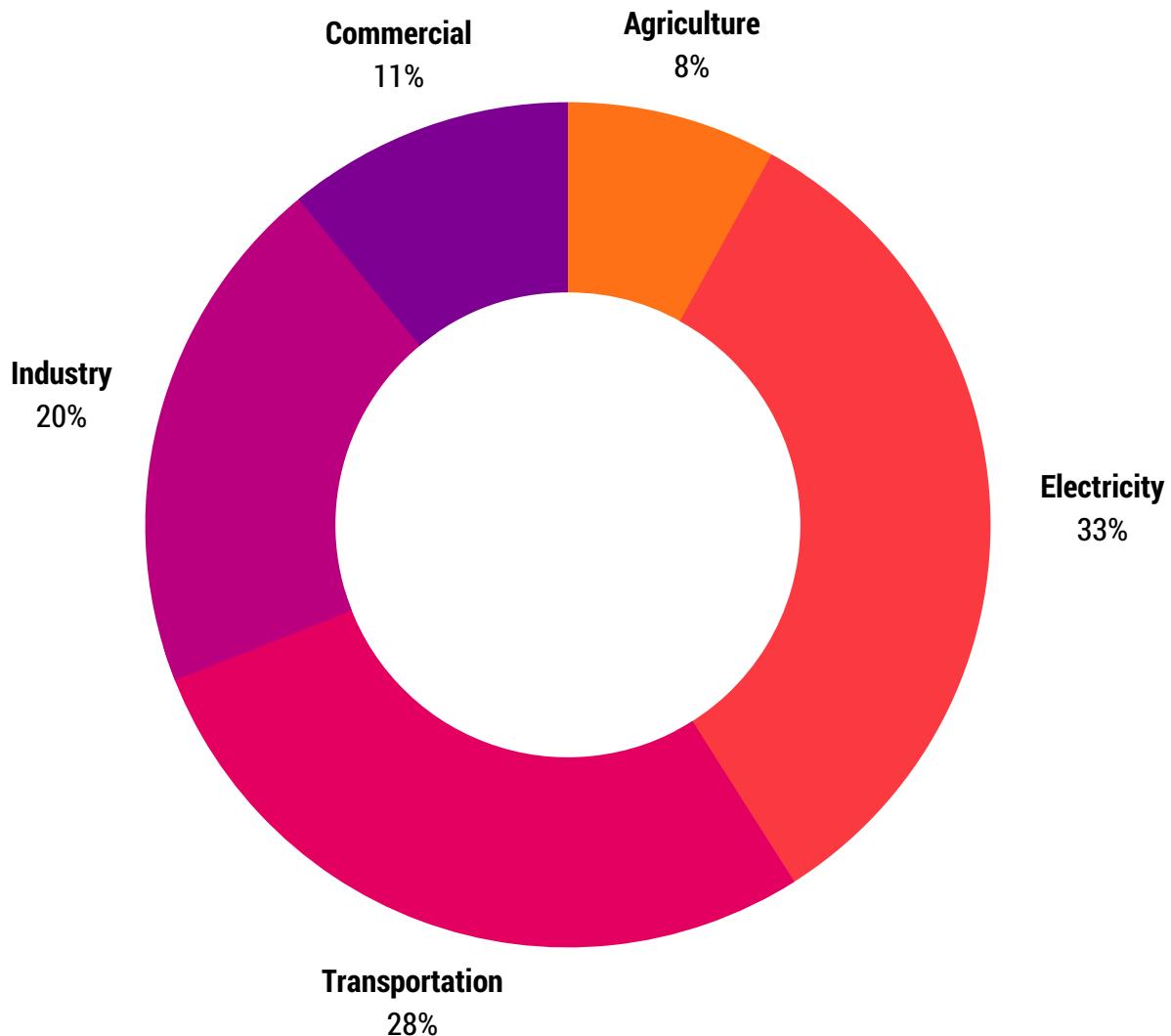
THANK YOU!

GRADUATION PROJECT II

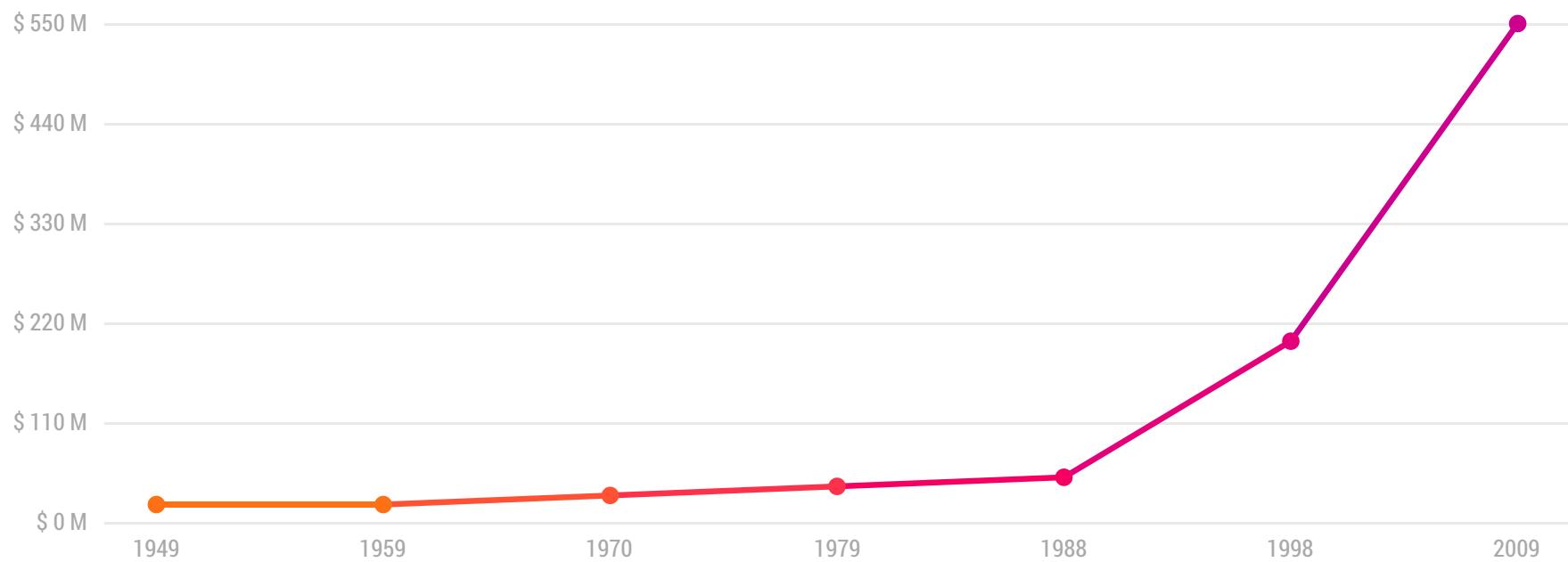
GREENHOUSE GASES EMISSIONS

Conventional agricultural practices are responsible for 8% of the overall global greenhouse gases emissions.

Many industrial crops processing technologies require the intensive use of fossil-fuel dependent machinery.



SALES OF FOOD CROPS GROWN UNDER PROTECTION IN THE US



Source: United States Department of Agriculture (USDA), 2011