

# Smart EV Standalone Solar DC Fast Chargers

THE FUTURISTIC SOLUTION OF THE  
ELECTRIC MOBILITY SECTOR

Our Partners

ELSEWEDY  
ELECTRIC

T&D



SHA7EN  
EV SYSTEMS

SECTOR • B5 •





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## THE TEAM

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THE TEAM

## **Team members**

- **Mohamed Hossam Wally**
- **Mostafa Mohamed Mahmoud**
- **Mostafa Adel Awad**
- **Mohamed Zayed Sayed**



## SCOPE OF PRESENTATION

### **Content:**

1. **Literature Review**
2. **System Description**
3. **MPPT Technique**
4. **Proposed System Prototype (SOL)**
5. **Plan Timetable**
6. **References**



# What's happening to our planet Earth?

According to a report published by Facts & Factors, Earth is warming up faster than ever because of the vast amount of (GHG) greenhouse gases that humans are pumping into the atmosphere. This includes activities such as burning fossil fuels, driving cars and cutting down forests. Many of us have seen – and even experienced – the effects of climate change. But it is not just about extreme weather like floods, droughts and hurricanes. Slower and less noticeable changes in our climate have the potential to completely alter the way we live.

The consequences of global warming is severe as example (*rising sea level, warmer oceans and atmosphere, air pollution, and more*). These effects will endanger all the living organisms by disrupting their ecosystem.

Newer or developed diseases, extinction of species, lack of food and water, and death of human beings, these are just the starters of such effect. Therefore, we need to start searching for solutions to slow down our pace towards a new global extinction.

# Contributors

Determination of a problem

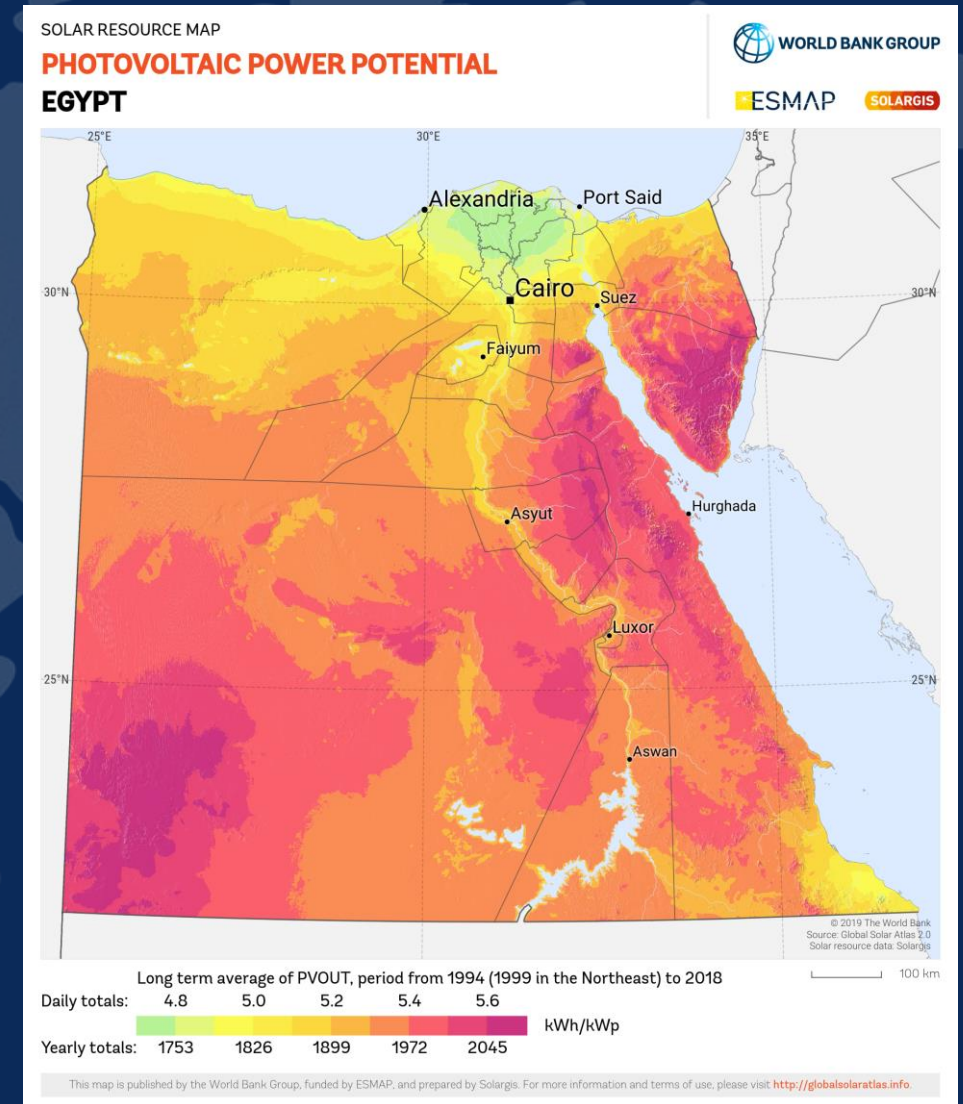
According to a report published by university of California in 2018, about 39% of Earth's GHG comes from only two contributors. Electricity and Transportation are the core of the modern human legacy, Fast Logistics, industry, technology are based on these two pillars. We can't reduce the speed of our development and industrial production instead we need to look for alternatives for our old conventional methods and techniques of going through these tracks.



# Facts

## Innovation

By looking for points of power in Egypt, we are located in one of the most fruitful locations in the whole world regarding the solar irradiance. The annual-average daily global irradiation values are *19.4*, *18.67*, and *21.78 MJ/m<sup>2</sup>* respectively for Cairo and Aswan. Also, Egypt has a huge road network of 65,050 km covering almost all the area of its land. With the rise and expansion of electric mobility industry Egypt faces a major problems which is the long distance between cities where average car batteries ranges can't cover this distance. In addition to the fact that not all the non rural areas has access to the electric grid and connecting these long distances needs a huge budget.





# Possibilities

## Market needs

The Egypt solar photovoltaic (PV) Market is expected to grow at a CAGR (compound annual growth rate) of around 20% by 2026. On account of growing carbon emissions, Egypt is likely to increase the share of renewable energy share to around 30% by 2050. The target is based upon Egypt's vision 2030 plan. Further, the country has an untapped solar photovoltaic generation capacity of 74,000 TWh per year. Hence, such a scenario is expected to create an opportunity for the market to grow during the upcoming years.

According to a report published by Facts & Factors, the global electric vehicle charging station market size & share income was estimated at USD 18.22 billion in 2021 and is expected to hit USD 115 billion by the end of 2028, expanding at CAGR (compound annual growth rate) by 35% between 2021 and 2028. A revolutionary solution is proposed in this project with the name of SOL. Using the most abundant energy source in our solar system, The Sun. Using the solar energy to FAST charge the EV can be a simple and creative solution for our problem, We call it SOL.



# Possibilities

## Covered topics

1. Power converters topologies and design
2. Energy harvesting
3. Integrated circuit designs of power converters
4. Renewable energy systems and control
5. Photovoltaic systems
6. Transportation electrification
7. Electric vehicles
8. High Voltage DC (HVDC) System
9. Modeling, simulation & control in power electronics
10. Industrial, commercial and residential applications
11. Energy efficiency, power quality and electromagnetic compatibility







# SOL

for electric mobility solutions





## Strengths

FAST and free source  
of energy

Suitable LCOE and  
Charging cost

Low Maintenance and  
operational cost

Zero carbon Footprint



## Weaknesses

High Initial Cost

Low market  
awareness

Limited supply during  
night from batteries



## Opportunities

Large areas and  
opportunities

Governmental  
direction towards  
green and sustainable  
solutions

A day-by-day  
development sector



## Threats

Global supply chain  
crisis may affect cost

Low number of cars  
currently in the  
Egyptian roads



# To ensure that the station maintain a long-life span and high performance

1. Accessibility: A traffic survey is made to determine the needed average energy per day and match the solar sun power irradiance availability over the daytime of operation
2. Development: Continuously monitoring the optimum running performance of EVSE and perform a feedback enhancement and smart trouble shooting if it is necessarily
3. Energy Efficiency: Continuous control over the converters according to MPPT modified technique to overcome random shading and prevent damaging of the panels to capture the highest power available
4. Energy Management: Battery management system for both the energy storage elements and the EV for safe and efficient charging and discharging

# To overcome threats and weaknesses

## 1) Reach:

- Preparing an awareness campaigns to help increasing number of electric vehicles rapidly and changing the mindset of the people around the electrification
- Providing easy payment methods to increase the targeted audience sector
- Sharing part of the cost for a portion of the income
- Having Residential/Commercial/Hybrid to cover all the EV customers

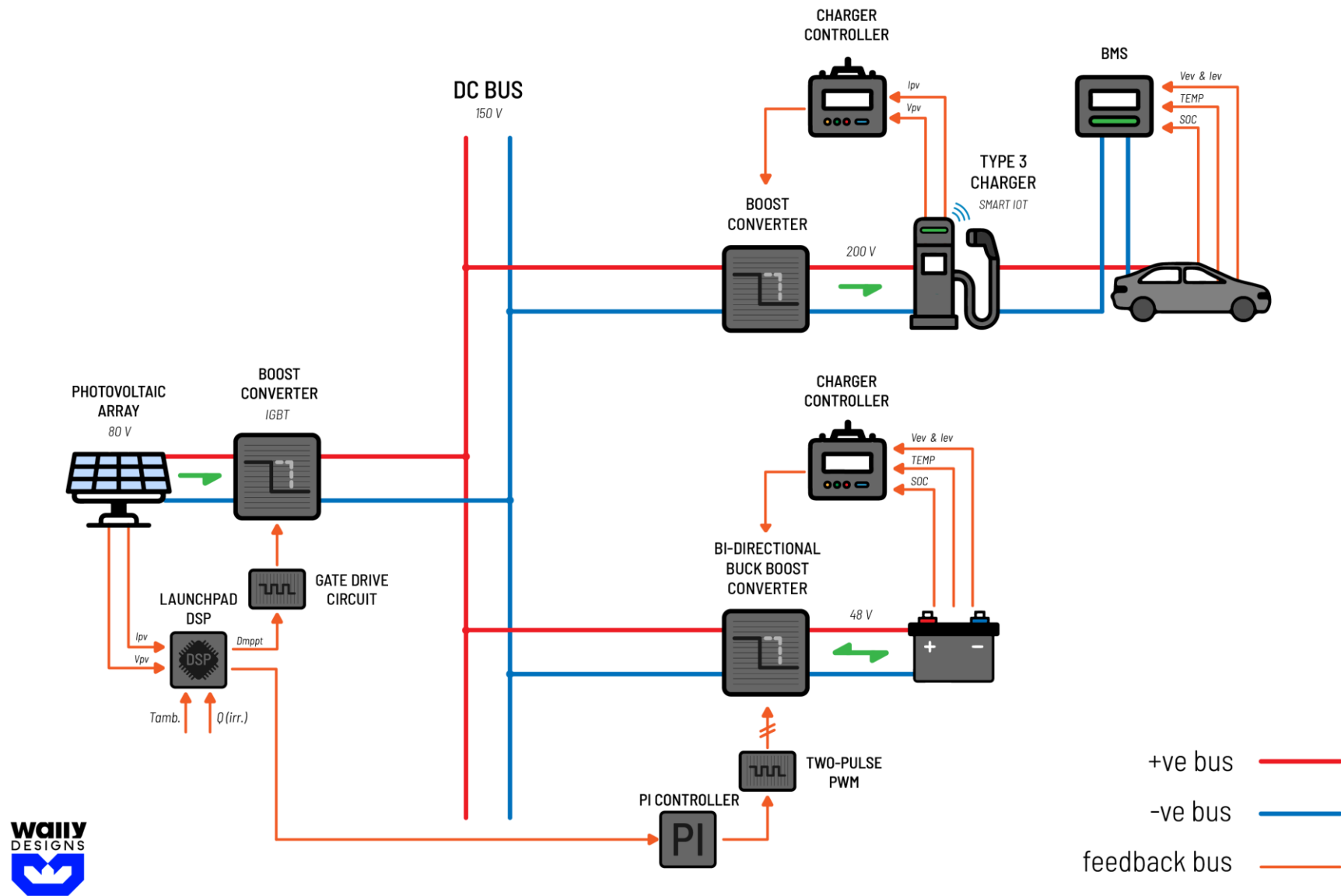
## 2) Sustainability:

- Depending on Egyptian materials and factories to overcome logistics headache
- Partnership with investors may help increasing the number of charging stations therefore increasing the possibility of rapid increase in the electric mobility sector
- Global expansion and exploring new markets may have easier paths to go through



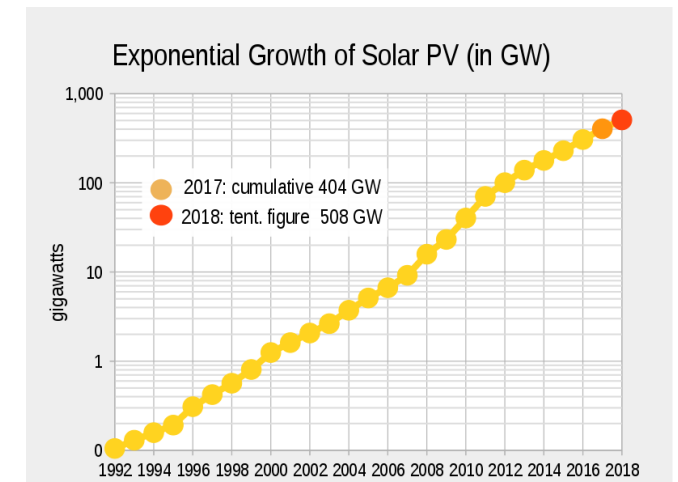
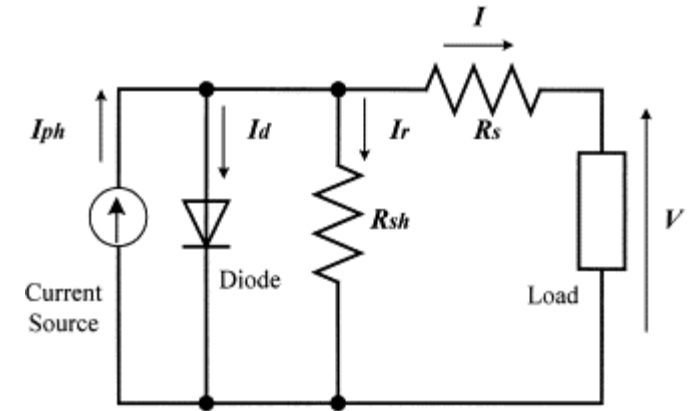
Egypt covers an area of 1 million km<sup>2</sup> there are many roads at where there is no grid accessibility , EV solar stations are very important for EV owners. So that they can travel from one city to another safely. The main roads we see a good opportunity at:

1. Ain El-Sokhna and Zaafarana
2. Cairo – Sharm El-Sheikh
3. Hurghada
4. Sinai roads
5. Luxor Road



# 1) Solar Panels

Solar power is the cleanest and the cheapest form of renewable energy available, and it can be used in several forms to help power your home or farm. Solar powered photovoltaic (PV) panels convert the sun rays into electricity as given in figure. As the statistics shows, the growth of solar PV production of energy is increasing exponentially that means that there's a huge R&D Investment. This R&D will increase the efficiency of the system and opens the road towards a fully electric civilization.

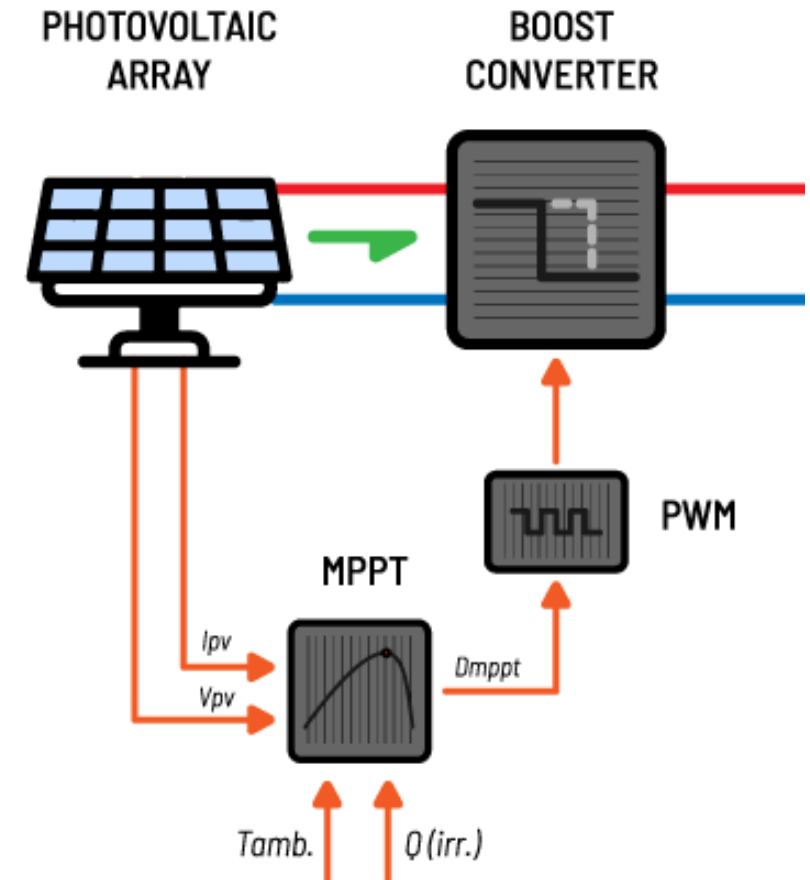




## 2) DC-DC Boost Converters

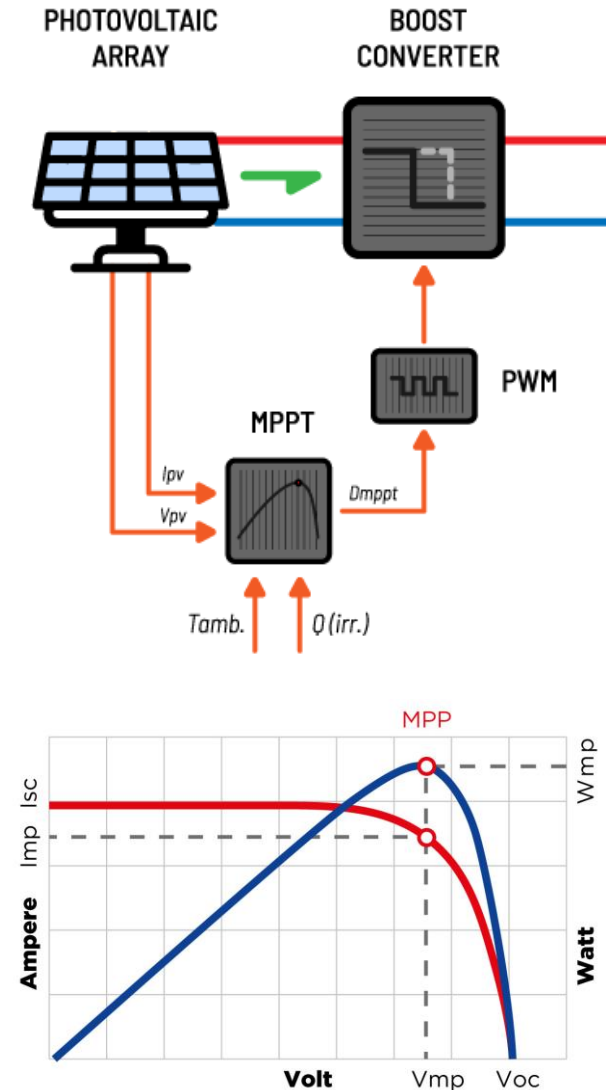
Boost converter, a DC-to-DC converter with the greater output voltage than the input voltage. The aim of this converter is to attain the maximum output as much as we can do from the DC.

The “maximum power point” voltage is maintained by installed DC-DC converter, by changing the duty cycle by DC-DC converters. Normally, boost, buck and buck-boost configuration is connected between the load and solar panel.



### 3) Intelligent MPPT Controller

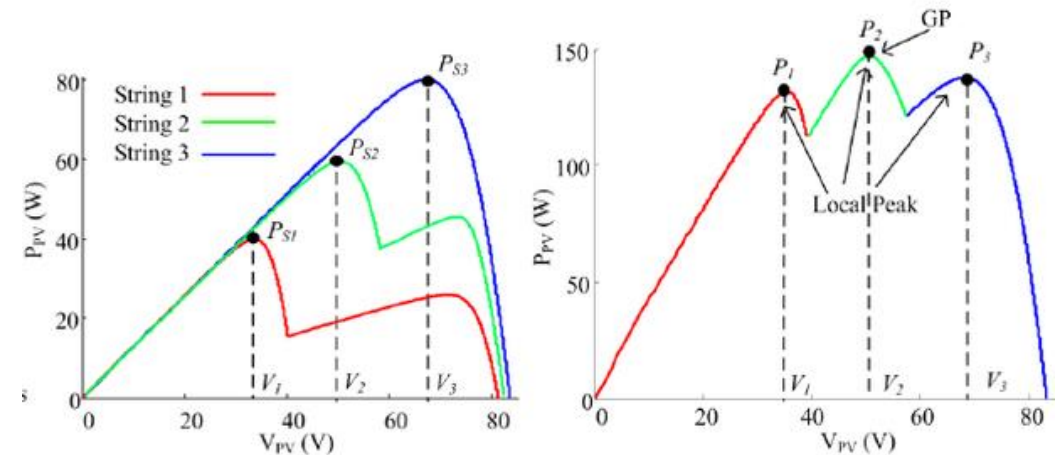
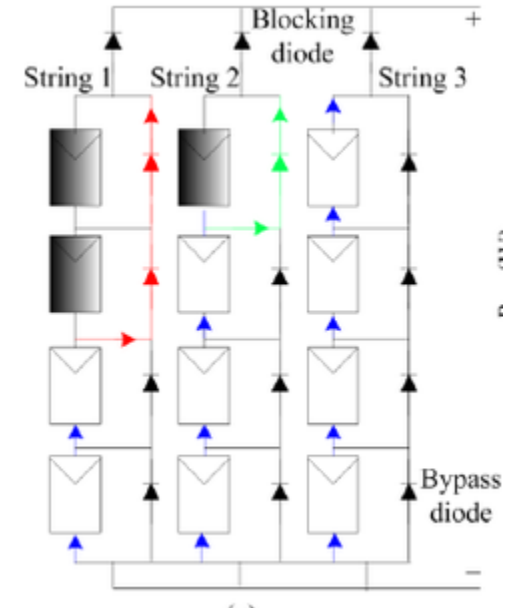
The irradiation and the temperature affect the PV output power. These atmospheric conditions are not constant during a single day. This causes the MPP to move depending on the temperature and irradiation conditions. Great power losses occur when the operating point is not close to the MPP. Hence, it is essential to track the MPP in any conditions to ensure that the maximum available power is obtained from the PV panel.



### 3) Intelligent MPPT Controller Challenges

#### A) Partial Shading

- The P-V curves are characterized by multiple peaks.
- The number of peaks is equal to the number of different insolation levels irradiated on the PV array, and any peak point may be the GMPP
- Considerable power loss can be incurred if a local maximum is tracked instead of the real MPP.
- The voltages of PV modules that receive different solar radiations are different





# The Main Goal of SOL

Develop and build up the first “Smart EV Standalone Solar DC Fast Charger” that is Made in Egypt to serve the electric mobility sectors of highways and long-distant areas.

## Objectives

- Easy, Fast, Cheap EV Chargers
- Improving the planet ecosystem ( ZERO CARBON EMISSION )
- Efficient and Enhanced Battery Chargers

# Our Approach

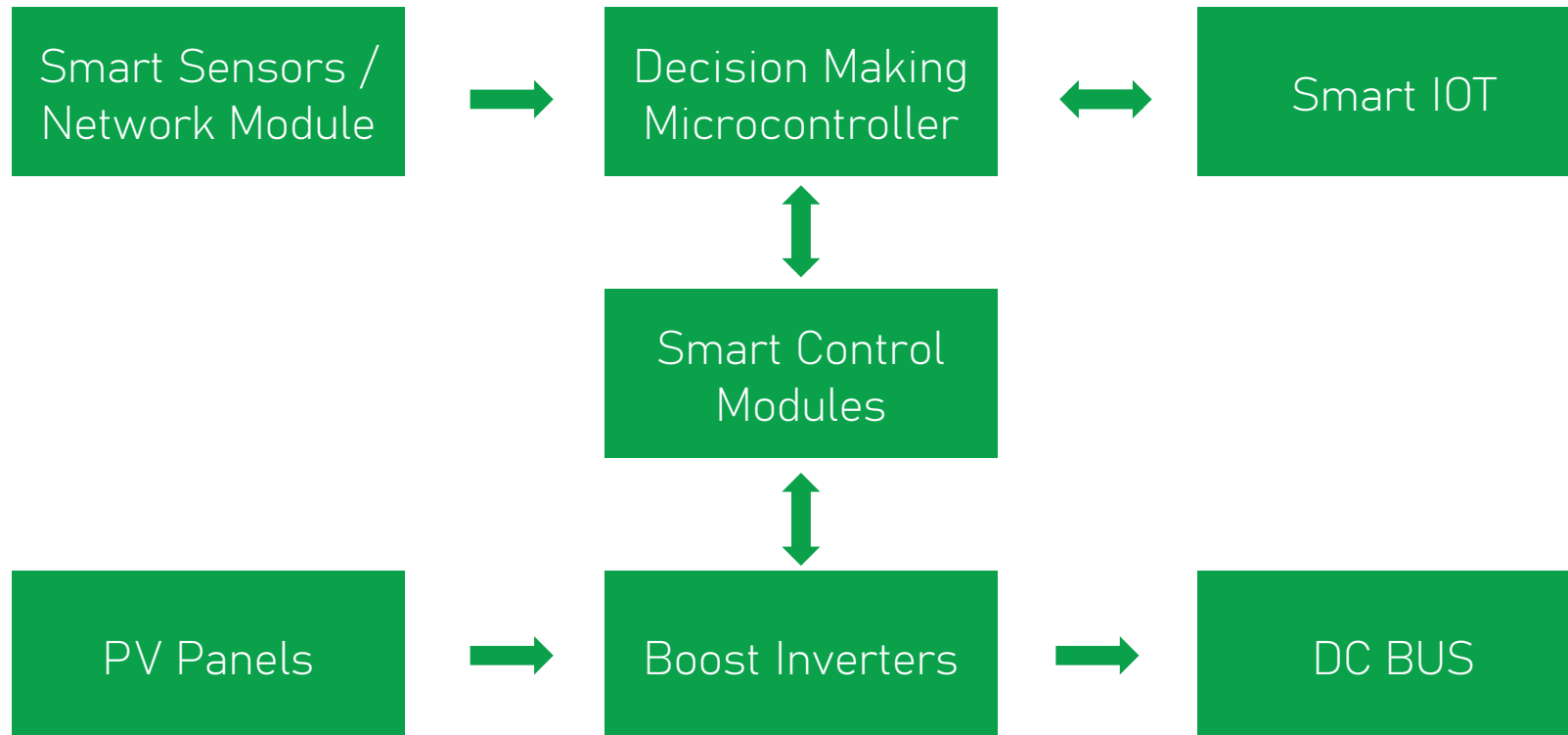
- An Integrated Standalone DC Fast Chargers 100% Made in Egypt including all Components (electronics, power modules of boost converters, smart sensors for measurement, monitoring, and feedback)
- All Components are PCBs industrial-based format designed (Altium Design) and locally manufactures in this research at capacity of about 5KW
- The techniques and the algorithms used for all main modules (PV panels, boost converter, filtering blocks, management, interrupts, processes, protection, etc) will be designed in our study including the power and smart control drive circuits that are interfaced to the main micro-controller of the system.

# Vision

Apart from the configuration of the advanced technology illustrated in the proposed system, the key successful of the EVSE system is the smart sophisticated development and implementation to the integrated components of the system to:

1. Ensure the reliability of the smart sensors network in measuring, and monitoring the status of the target power and energy stored or consumed including relevant variables of temperature, soil humidity, rain, light,...etc.
2. Activate successfully and reliably all the smart actuators in the smart controller system to full fill the best performance in all modes of operation including the trajectory tracking of the solar irradiance.





## Research Group 1: Committed to develop all the power spectrum modules (2Kw Capacity) including:-

1. Hardware Development: PV operation, MPPT, Boost Converters, Sensors and transducers, Filters, Isolation, and Protection
2. PCBs Production: Layout, Design, and Fabrication
3. Commission and Testing: Integration of all electronics and communication protocols
4. Batteries

## Research Group 2: Committed to design and develop the knowhow and algorithms of embedded systems:-

1. Microcontroller the Main brain of the system
2. Smart Control Drivers for MPPT and Boost Converter
3. Sensors & Feedback
4. IOT
5. BMS

# An Integrated Smart EV Standalone Solar DC Fast Chargers completely made in Egypt for industrial use (A 2Kw Prototype)

1. Boost Converters
2. Smart Sensors Network
3. Batteries
4. Interfacing
5. Communication Modules
6. Digital Display
7. IOT Modules
8. PCBs
9. Embedded system of microcontroller (algorithms, decisions, interrupts, process)
10. Protection
11. BMS



Wally (who has a full coexistence with El Sewedy) is responsible for the design side and working with Awwad (trainee at the Korimat power plant) on the integrated circuits.

while Mustafa (an active member of the Jawad organization) is responsible for the programming side. Marketing plan and time with Zayed (obtaining training in cooperation with the Ministry of Communications in Creativity and Entrepreneurship).

A diverse workforce allows for creativity and innovation to be fostered. We have different backgrounds and skills that work together as a team to achieve our goals. These help us discover creative solutions and innovative approaches to improve processes and reach operational goals.

Our project includes concern for the environment, profitability and goodwill for the common good at the forefront of its priorities. This requires asking the question, "How can you, like, use your influence to help society be more sustainable?"

The whole concept revolves around "doing more with less." Suffice it to say, if you want to create a sustainable business, there are people who will listen to you.

However, it is up to you to develop a unique idea that allows the community to come together and be part of the solution. It sounds scary, but there are companies that have done just that. The common theme is a genuine desire to help.

Renewable energy is an important topic during sustainability discussions. The renewable energy market is worth more than \$880 billion and is expected to grow at a compound rate of 8.4% year-on-year. It can undoubtedly be one of the best sustainable business ideas, if done right. There is a huge market for electric cars. But you don't need to be a manufacturer to get into the electric vehicle industry.

It could be very profitable to make charging electric vehicles as affordable as possible. This makes owning an EV "easier" compared to fossil fuel cars!



More automotive companies that previously produced only gasoline-powered vehicles have shifted focus to manufacturing EVs for your daily use, with Tesla leading the way. If you already own or look forward to purchasing an EV, then having an efficient and effective solution to charge the car battery in your city is beneficial and fulfilling. Among other home solar system benefits, the government stands to benefit monetarily from installing Solar EV Charging stations. Electric vehicles are growing in popularity as a credible alternative to gas-powered vehicles. These vehicles require their batteries to be “fueled up” for operation.



While EV charging has traditionally been grid-based, the use of solar-powered chargers has emerged as an interesting opportunity. These chargers provide clean electricity to electric-powered cars that are themselves pollution free resulting in positive environmental effects. In this project, we design a solar-powered EV charging station. Although electric vehicles are considered an eco-friendly option, global warming due to greenhouse gas emissions will remain an issue if conventional sources of energy are used to generate electricity to power EVs. Generating power from renewable energy sources like solar addresses this concern, maximizing the green impact of EVs.

It is true that the production of solar panels results in carbon emissions, but they become carbon-neutral in a few years and last for 15 to 20 years, on average. The environmental benefits of charging stations that run on solar power are many. Besides better air quality and reduced dependence on fossil fuels, everyday running costs are lower. The load on conventional grids also gets reduced. Apart from this, large-scale implementation will increase employment opportunities owing to the need for trained people for the installation, maintenance, and operation of these stations.

Imagine being paid to help the environment. That sounds like a great deal, right? If you install solar-powered EV chargers in your organization, your fleet will be able to do both as well. Electric vehicles are gradually becoming mandatory across the globe due to their positive environmental impacts. A typical charging station is still an option for EVs, but it utilizes 40%–60% of national grid power to charge a vehicle, which is manufactured from non-renewable energy. Solar-powered EV charging stations are the solution to bring that percentage down to zero. Not only is it beneficial for the environment, but it is also a major benefit for fleets.

## 1. Save on Energy Costs

The average cost in the United States to use grid power to charge a vehicle is \$13.31 kilowatts per hour. That cost is predicted to continue increasing over the coming years. Installing a solar system will help cut your monthly power bill by more than half. The initial cost to install solar systems into your facility may seem intimidating, but the long-term savings make up for the upfront costs.

## 2. Government Incentives and Tax Credit

The government offers a federal investment tax credit for the installation of commercial solar panels. A 26% tax credit will be provided for solar panel systems whose construction commenced before December 31, 2022. After 2022, a 22% credit will be provided and 10% for those commencing in 2023. You can learn about your fleet's eligibility by visiting the US Department of Energy's website.



### 3. Convenience

There are many conveniences when it comes to a solar charging system:

The installation requires no permitting, no construction, no electrical work, and no utility bill.

One solar panel can charge up to multiple vehicles at once

EVs can be charged during power outages.

EVs can park underneath the unit, so there is no loss of parking spaces.



## 4. Zero Carbon Footprint

A solar EV charging station guarantees a 100% carbon-neutral footprint. Governments are asking for drivers to use EVs since they have a lesser environmental impact than internal combustion engines. Despite EVs being more environmentally friendly, they still use fossil fuels and other non-renewable energy to use the grid for charging electricity. EVs still reduce environmental impacts but using an EV charging station reduces them to zero.

## 5. Net Metering

Net metering is what makes a solar power system so appealing in the first place. Most of your fleet vehicles will be used during the day, so that means vehicles will be unable to utilize the daylight for charging. Thankfully, solar panels offer net metering to store the energy produced during the day into the grid. This energy can be used as a credit, so vehicles can draw back the electricity from the grid in the evening or night. If your fleet does not use all the energy produced and has excess, it can be sold to electric companies for extra profit. The amount utility companies can pay for net metering varies by state, so be sure to check the regulations for your state.

Thanks

