A Work Project, presented as part of the requirements for the Award of a Master Degree in Finance from the NOVA – School of Business and Economics.

A GLOBAL LEADER IN THE SOLAR ENERGY TECHNOLOGY RACE

SUSTAINABLE ENERGY: A SUBSTANTIAL GROWTH OF THE MICRO INVERTERS MARKET

SANAE CHAABI - 44485

A Project carried out on the Master in Finance Program, under the supervision of:

(Rosário André)

20th May, 2022

Abstract

This report is part of a work project that consists of valuing Enphase Energy – a listed solar technology company in NASDAQ. A thorough analysis of the company and its industry has been conducted in order to better understand the company's key value drivers. The solar inverter sector, and more specifically the micro-inverter market is growing at a rapid pace, which represents a considerable opportunity for Enphase Energy to expand and keep improving its financial performance, especially that government policies and incentives are in favor of the solar energy market growth. Nonetheless, many challenges might face the company especially at its supply chain level mainly as a consequence of the COVID-19 pandemic. Throughout the analysis of Enphase Energy, we will compare its performance to its peers in order to better understand the company's positioning in the market and therefore reach insightful outcomes from its valuation and provide a final recommendation based on our findings.

Keywords

Solar Energy, Economic Factors, ESG Trends, Valuation.

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209)

This report is part of the equity research report “A Global Leader in the Solar Technology Race” (annexed), developed by Sanae Chaabi and Aya Benlakhder and should be read as an integral part of it.

Table of Content

Introduction

For the purpose of our equity research, we have conducted our analysis in two sperate but complementary parts. Each of the two parts focuses on a different aspect with the main objective of coming up with an accurate valuation and insightful recommendations for the market regarding Enphase Energy (NASDAQ: ENPH). This part mainly contains an overview of Enphase Energy's Industry with a supply and demand outlook, the main trends in the industry as well as a valuation model of the company. The part prepared by my teammate gives an overview of the company including its business model, competition, opportunities, and challenges as well as a dynamic overview of the company's financial performance. This part also concludes the analysis by the final valuation of the company and main underlying assumptions of our final recommendation on the joint report. The two parts together take an inside out approach by starting with the company analysis followed by the industry outlook in order to achieve the final valuation and have an overall view of the company's performance.

Our main conclusions are the following:

- Based on our year end 2022 target price of $152.06, with a total return of -13.55% we issue a SELL recommendation for Enphase Energy. This recommendation is as of 5/18/2022 and due to the high volatility of our stock price in the last week, our recommendation could have changed from a day to another.
- We expected Enphase Energy to keep growing for the next five forecasted years, as it is operating in a growing market. Additionally, the trends within the renewable energy market are very popular amongst house installations' owners. We estimate Enphase Energy's revenues to grow at 53% in 2022 and continue growing by a yoy growth rate of 19% until 2026.
- Enphase Energy will undoubtedly benefit from the several government incentives in order to grow its operations. The Renewable Portfolio Standards should represent a first target and incentive to the solar technology company, as states are continuously looking for opportunities to produce electricity through renewable energies in order to meet their targets.
- The company is however faced by different challenges mainly concerning 1) the global shortage of semiconductors and the resulting supply chain complications, 2) the solar energy risks affecting the demand side as well as 3) the companies business model which relies on external contract manufacturers for handling all products manufacturing which leaves the company with much less control.

Industry Overview

Market Overview

According to a study conducted for the projected period 2022-2027, the US renewable energy industry is predicted to grow at a CAGR above 5%, mainly driven by the market expansion, as well as attempts to fulfil growing demand for renewable energy sources promoted by the government strategies[1]. Additionally, renewable technologies are continuously enhancing the cost competitiveness with fossil fuels, and further renewable energy subsidies are propelling the clean energy sector forward[1]. Conversely, the growth of the US renewable energy industry is constrained by various variables such as the developing market for natural gas rivalling the clean energy market and its restricted supply sources[1].

As Enphase Energy operations are mainly concentrated in the microinverters market, we believe that the company would undoubtedly benefit from the spread of renewable energy technologies resulting from the rising solar energy consumption and installations. The sales of microinverters and its adoption by homeowners is mainly driven by their increasing popularity amongst commercial and residential sectors along with their cost-effectiveness and high efficiency compared to the use of the electrical grid, although microinverters prices are commonly expensive due to their particularities. Additionally, the size and power level of microinverters allow them to meet not only the demand of households but also that of businesses globally.

The global solar inverter market is expected to be valued at $16.88 billions by 2030, compared to its estimated value of $8.78 billions as of end 2022, which corresponds to growing at a CAGR of 8.5% for the forecasted period[2] (Figure 1). This valuable growth is mainly linked to the increasing need for renewable and green energy in order to comply with the ESG standards set by governments and businesses. The solar technology offered by Enphase Energy revolutionized the solar energy sector whilst focusing on the key ESG factors considered by the company in order to enable the creation of a socially responsible future for microinverters owners.

On the other hand, the global PV inverter market is mainly dominated by three types of inverters used for industrial and residential purposes: central inverters, string inverters and micro inverters, with central inverters accounting for a market share of 49.5% in 2021[3] (Figure 2). The wide spread of the central inverter is particularly common amongst huge buildings in industrial areas as it allows for an efficient power supply for the entire building, whereas the string and micro inverters are typically used as part of home installations especially that households'

Figure 1: Solar (PV) Inverter Market Size, 2022 to 2030 (USD Billion) Source: Precedence Research

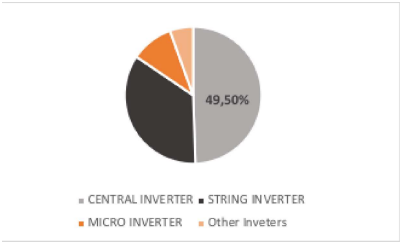


Figure 2: Global Solar Inverter Market Share in 2021, by product Source: Precedence Research

[1] https://www.mordorintelligence.com/industry-reports/united-states-renewable-energy-market

[2] https://www.precedenceresearch.com/solar-inverter-market

[3] https://www.precedenceresearch.com/solar-inverter-market

electricity needs are substantially rising due to the increasing use of gadgets and technologies on a daily basis along with the current wide spread of electric cars.

In the period between 2020 and 2030, the forecast team from S&P Global Market Intelligence estimates that about 55,000 MW and 45,000 MW of new wind and solar installations, respectively, will be deployed merely to keep up with the state Renewable Portfolio Standard concerns[1]. The RPS is a set of rules and laws set by the government in order to increase energy production through renewables. States which are concerned by this set of standards should meet, by a specific deadline, a target percentage of electricity sourced from clean energy sources.

Solar energy has yet to realize its full capability as a renewable energy source in the United States, and much effort needs to be performed to accelerate solar technology implementation. That being said, Enphase Energy will certainly have many growth opportunities to take advantage as the renewable energy sector is currently witnessing many advances especially with the keen involvement of the state to help promote energy efficiency. However, many challenges are still to be tackled like the increasing cost competitiveness as new players are entering the global solar inverter market especially in the APAC region where the technological advances are becoming a trend within house installations.

Therefore, in order to pursue its growth and maintain its increasing revenues, Enphase Energy should keep considering the Renewable Portfolio Standards in order to target the states that are mostly impacted by the RPS as the demand for solar energy technologies will definitely rise when seeking to meet the targets set by the RPS. In fact, promoting and selling its products in regions with the largest RPS requirements, like Washington DC and Oregon by 2032 and 2040[2] (Figure 3), would represent an important growth opportunity for Enphase's operations. The RPS requirements, illustrated in Figure 3, have been set since 2018 and refer to the target RPS percentage of clean electricity (coming from clean resources) that the various US states will need to meet by the mentioned year. The most crucial renewable resources that would largely contribute to satisfy the requirements are: wind and solar energies, since they are both common between all states, as each state uses its own metrics to identify which specific renewable resource it considers as "clean".

Figure 3: US State Amendments to RPS Legislation since 2018

Source: National Conference of State Legislatures

State	New RPS Target	By Year			
Washington D.C.	100%	2032	Puerto Rico	100%	2050
Oregon	100%	2040	Virginia	100%	2045-2050
California	100%	2045	New York	70%	2030
New Mexico	100%	2045	Maryland	50%	2030
Washington	100%	2045	New Jersey	50%	2030
Guam	100%	2045	Connecticut	44%	2030
Colorado	100%	2050	Delaware	40%	2035
Maine	100%	2050	Massachusetts	35%	2030
Nevada	100%	2050	Minnesota	26,5%	2025

[1] S&P Global Market Intelligence: https://www.spglobal.com/marketintelligence/en/news-insights/research/the-2020-us-renewable-energy-outlook

[2] National Conference of State Legislatures: https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx

Moreover, according to a study conducted by DOE's National Renewable Energy Laboratory, the United States needs to double its present rate of solar potential per year between 2021 and 2025 and reach 60 gigawatts solar capacity between 2025 and 2030 in order to attain 40% solar power by the end of the forecasted period[1], especially with the support of government policies, significant cost cuts and a broader electrification in order to limit the grid integration issues aforementioned.

Demand Outlook

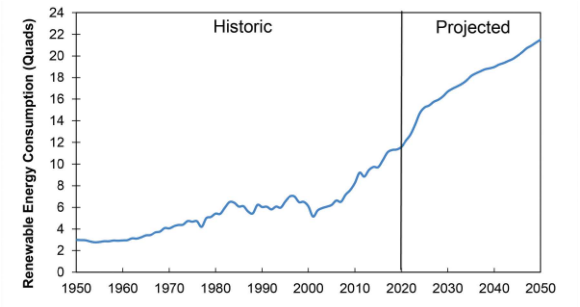
Renewable energy currently represents a significant part of the US economy, as it is not only an important player in renewable technology, but also a supporter of the country's key measures to decrease greenhouse gas emissions[2]. According to current Statista forecasts, renewable energy will account for above half of new US utility-scale capacity, with natural gas accounting for the majority of the rest[2]. In addition, renewable energies are likely to continue to supplant traditional energy sources as long as renewable energy technology costs decrease. In the coming years, microinverters and power storage are expected to witness an increased adoption driven by the products' safety, advanced remote monitoring options and enhanced energy yields. In fact, microinverters and power optimizers have been proven to be very successful in residential and commercial areas as the demand for roof-top systems is booming amidst homeowners and business owners. Besides that, Enphase Energy is increasingly investing in research and development activities, which is considered an additional reason for the growing demand in the solar inverter market, in order to meet the market's needs and potentially make use of the solar energy in the most efficient way.

The global increasing demand for micro inverters installations in residential areas is expected to drive the market to grow at a CAGR of 20.8% for the forecasted period 2020-2025[3]. Although string and central inverters are mostly common amongst users, micro inverters are gaining more and more popularity as their continuous and stable power supply property appears appealing to home and business owners who can now stop worrying about shading issues for their panels. As Enphase Energy not only sells its goods and services in America but also in the rest of the world, we believe that this growth rate of 20.8% should be explicitly represented in the companies' forecasted revenues, therefore we estimated the revenues generated by the sales in the rest of the world to be growing at that rate. Moreover, the United States is predicted to almost double its 2020 clean energy consumption by 2050, which translates to around 21.51quadrillion British thermal units of used renewable energy[4] (Figure 4). In fact, the country had set up a large amount of procedures and incentives, which will be tackle in a detailed manner in the regulatory framework section. in order to enhance clean energy adoption and promote energy-efficiency.

[1] https://apnews.com/article/business-climate-environment-and-nature-united-states-climate-change-c5cc5de8c77a7f3d0888a6b25abf1866
[2] Statista: https://www.statista.com/statistics/1262233/countries-renewable-energy-production/
[3] https://www.globenewswire.com/news-release/2020/10/08/2105363/0/en/The-global-micro-inverter-market-size-was-valued-at-USD-2-5-billion-in-2020-and-is-projected-to-reach-USD-6-5-billion-by-2025-it-is-expected-to-grow-at-a-CAGR-of-20-8-from-2020-to-.html
[4] Center for Sustainable Systems, Michigan: https://css.umich.edu/sites/default/files/Renewable%20Energy_CSS03-12_e2021.pdf

Figure 4: U.S Renewable Energy Consumption: Historic and Projected

Source: Center for Sustainable Systems, University of Michigan



Supply Outlook

Renewable energy demonstrates a high probability of satisfying demand with a significantly lower environmental impact and by committing to an assorted and dispersed clean energy infrastructure can assist to ease miscellaneous pressing challenges like energy security[2]. The pandemic has certainly also represented a big challenge for the micro inverter and house installations sectors as the cost of raw commodities substantially rose, in addition to the closing border restrictions that heavily impacted the supply chain and transportation of goods and raw materials. Nevertheless, Enphase Energy and SolarEdge remained the most two dominant suppliers in the micro inverters and power optimizers sectors, as they both accounted for 78% and 88% of microinverters and power optimizers shipments respectively in the United States in 2020[1].

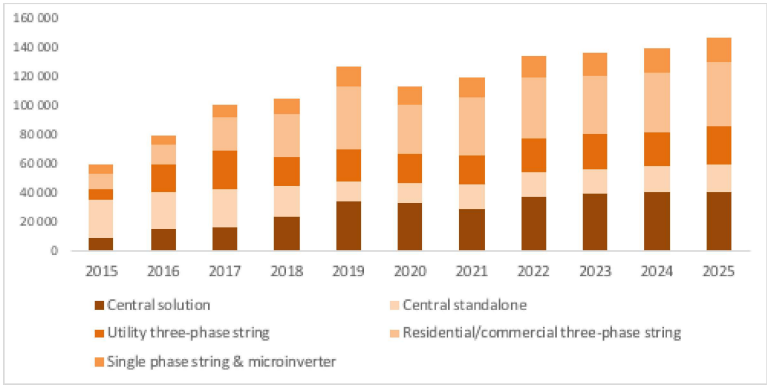
In the same year, the United States brought total installed solar capacity to account for 43% of new generating capacity, which established a new high record of 19.2 GW of solar photovoltaic capacity[2], mainly due to a major reduction in coal use for power generation purposes in the United States, as well as a steady growth in solar and wind energy usage. However, while the two leading companies mentioned above keep extending their portfolios, the competitiveness in the solar house installations sector is expanding as new entrants are entering the market since grid limitations are alleviated. In the same direction, the US Department of Energy's SunShot Initiative seeks to cut down the cost of solar energy by half, resulting in solar power meeting 33% of electricity demand by 2030 and along with an 18% reduction in electrical sector greenhouse gas emissions by 2050[2].

The shipments of central solutions and residential/commercial three-phase string inverters are expected to dominate the worldwide solar inverter market as they are expected to reach 33,000 and 34,000 MW alternating current, which means that they would represent the largest proportion of shipments by 2025[3]. Meanwhile, single phase strings and microinverter shipments are expected to reach only 34,000 MW alternating current in 2025 (Figure 5), which means that Enphase's

[1] S&P Global: https://ihsmarkit.com/research-analysis/global-market-for-microinverters-and-power-optimizers-forecast.html
[2] Center for Sustainable Systems, Michigan: https://css.umich.edu/sites/default/files/Renewable%20Energy_CSS03-12_e2021.pdf
[3] https://www.statista.com/statistics/790664/solar-pv-inverter-and-optimizer-global-shipments/

products would still be outperformed by other types of inverters for their particularity.

Figure 5: Estimated solar PV inverter and optimizer shipments worldwide from 2015 to 2025 (in megawatts, alternating current), Source: Statista



Furthermore, the renewable energy industry in the United States is now heavily reliant on international supply networks, especially Chinese subsidies, since the US imports for years now solar panels generating private and commercial energy[1]. Moreover, within 15 years, the United States' solar energy will be able to supply up to 40% of the entire country's electricity, which represents a considerable increase compared to the current 3% solar capacity, nevertheless the latter would necessitate important measures implementation along with a significant capital requirement in order to update the electric grid through federal investment[2]. As the micro inverter sector is expected to keep growing parallelly to the growing demand for solar energy, we believe that Enphase should take these target numbers into consideration in order to improve its products and make them relatively affordable for the end users to incentivize them to consider paying the "premium" for a long-term sustainable solar technology.

Regulatory Framework

The main environmental and economic advantages of adding renewable energy to a state's portfolio are mainly using fossil fuels to generate electricity that creates no greenhouse gas emissions and lowers some forms of air pollution, in addition to increasing energy diversity and lowering reliance on foreign fuels[3]. However, renewable energy installations are subject to many constraints mainly cost competitiveness, especially that barriers to increasing renewable energy are frequently regulatory, and hence within governmental control.

In the United States, electric utility wholesale sales and transmission rates in interstate commerce, natural gas transportation and sale in interstate commerce, and the licensing and inspection of private, municipal, and state hydroelectric projects are all under the jurisdiction of the Federal Energy Regulatory Commission. Additionally, the lack of common interconnection standards, as well as standardized methods and technical criteria for accessing and installing clean energy systems to

[1] https://www.americanprogress.org/article/creating-domestic-u-s-supply-chain-clean-energy-technology/
[2] https://apnews.com/article/business-climate-environment-and-nature-united-states-climate-change-c5cc5de8c77a7f3d0888a6b25abf1866
[3] U.S Environment Protection Agency: https://www.epa.gov/statelocalenergy/state-renewable-energy-resources

the electric utility's grid, can turn the connection of renewable energy systems into a hurdle.

The amount of renewable energy installations varies dramatically between states, indicating specific state or regional preferences rather than resource or technical capabilities. A variety of policies have been enacted by states to encourage increased investment in and use of renewable energy technology[1].

The U.S government has set a large number of incentives and programs for citizens and businesses in order to promote the use of renewables as their efficiency has proven to be significantly contributing to reduce greenhouse gas emissions, we have selected below the most promoted and popular incentives, among others:

- Public Benefits Funds for Renewable Energy
- Output–Based Environmental Regulations
- Interconnection Standards
- Feed–In Tariffs
- Property Assessed Clean Energy (PACE)
- Financial Incentives

Trends

- Commercial and Industrial sectors Growth:

The solar energy sector has known a major rise of its market share as different players of the renewable energy industry are starting to consider switching to sustainable sources of energy in order to meet their electricity demand, which strongly contributes to the growth of the solar inverters market. Additionally, industries are becoming more aware of the importance of ESG integration into their decision-making, which pressures them to reduce their environmental impacts and improve their social considerations towards societies[2]. Several governments have created renewable energy strategy plans, such as the Renewable Portfolio Standard, in order to enable future generations to adequately make use of energy resources, as the demand for energy is continuously rising due to globalization and technological developments that require a high amount of energy usage especially in commercial and industrial segments.

- Global Solar Inverter Market dominated by APAC region:

As currently being the largest worldwide producer of solar energy, China is expected to keep dominating the market for solar inverters with its very high demand for energy in the Asia-Pacific region for the coming years, which makes the region the leader in the solar PV inverter market[3]. The Asia-Pacific region has indeed got ahead with solar power generation due to all the technological

[1] U.S Environment Protection Agency: https://www.epa.gov/statelocalenergy/state-renewable-energy-resources
[2] https://www.researchandmarkets.com/reports/5331029/solar-pv-inverter-market-global-industry-trends
[3] https://www.marketsandmarkets.com/Market-Reports/inverter-market-263171818.html

advancements in its emerging countries such as the power plant capacities' expansion and power plant production's reduction, among others[2].

- ESG Integration:

The importance of including several ESG standards in a company's decision-making process from all point of views. It is true that Enphase Energy operates in the renewable energy sector, but it should consider those factors in its entire supply chain. The solar technology company reports yearly its ESG inclusion by quantifying it and developing its contribution to reduce greenhouse gas emissions and climate change by being socially responsible and opting for sustainable investments. Most of investors nowadays rely on ESG ratings to make an investment decision, therefore Enphase should keep disclosing their ESG culture.

Valuation

Revenue Model

In order to forecast our revenue between 2022 and 2026 we have used two different formulas. The first formula corresponds to the revenue forecast for 2022. As the Q1 results for 2022 of Enphase Energy are disclosed as well as the company's expected results for Q2 2022, we have opted for using the average growth of revenues from Q1 2021 and Q1 2022 and the growth of revenues from Q2 2021 and Q2 2022 as a proxy for the overall revenue growth of the company in 2022. The equation is:

(EQ 1) $R_{2022} = R_{t-1} * (1 + (G_{Q1} + G_{Q2})/2)$

Such as R stands for revenue, G_{Q1} is the realized growth of revenues of Q1 2022 compared to Q1 2021, and G_{Q2} is the estimated growth of revenues of Q2 2022 compared to Q2 2021 revenues based on the average of Q2 2022 revenues range estimated by Enphase Energy in its latest quarterly report.

We have used the 2021 split of revenues between the US and the rest of the world of 80% and 20% respectively in to estimate the revenue for each region in 2022 to be the base for the revenue estimation for each region in the 2023-2026 period.

The second equation concerns the revenue forecast from 2023 to 2026, for each year of the period, the same equation is used:

(EQ 2) $R_{US} + R_{ROW} = R_{ENPH;}$ R: revenue

(EQ 3) R_{US} (t=0) = $R_{t-1} * (1 + RG_{US})$, RG: Revenue growth rate

(EQ 4) $RG_{US} = 0.8 * CAGR_{SED} + 0.2 * CAGR_{EV;}$

$CAGR_{SED}$: The compounded annual growth of the solar energy demand in the US 2022-2027.

$CAGR_{EV:}$ The compounded annual growth of the Electric Vehicles market 2022-2028.

Therefore, in EQ 3 which is part of EQ2 we estimate the US revenues for each year based on $CAGR_{SED}$ which is 17.32%[1]. Since the revenue of Enphase in the U.S is highly dependent on the demand for solar energy as well as the $CAGR_{EV}$ of 24.4%[2] as Enphase has just added EV charges to their product portfolio by the end of 2021 after acquiring ClipperCreek and is expected to start offering this product in the US first. In addition, we will assume EV revenues to make up 20% of the company's future revenues as can be shown in EQ 4.

Lastly, to estimate the R_{ROW} of the EQ 2 we set up the following equation:

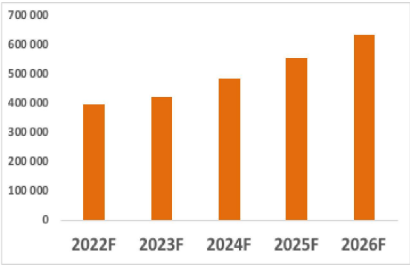
R_{ROW} (t=0) = R_{t-1} *(1+ $CAGR_{MI}$); $CAGR_{MI}$: The compounded annual growth of the microinverter global market from 2020 to 2025.

Thus, we used the global Micro-inverter market CAGR of 20.8%[3] according to business wire to grow the company's future revenues since Microinverters sales are the main value driver for Enphase Energy on a global level.

Discounted Cash Flow (DCF)

In order to determine the fair value that Enphase captures to its shareholders through its investments, we decided to use a discounted cash flow model which consists of discounting the forecasted cash flows of the company at the WACC. We believe that our thorough analysis of the solar technology company's financial statements along with our detailed assumptions regarding the different industry trends and forecasts that can potentially impact its future cash flows enabled us to reach a reasonable proxy of its future Unlevered Free Cash Flows. In fact, an important reason for choosing DCF is our assumption that Enphase would stay close to their current D/E ratio which we have kept **constant at 60% Debt-to-Enterprise Value against 40% Equity-to-Enterprise Value**.

Figure 6: Enphase Energy's Forecasted Unlevered FCF, Source: Analyst estimates



Our estimations have led us to reach increasing Unlevered Free Cash Flows for the forecasted period 2022-2025, as the FCF will gradually rise from **236.274 million dollars** in 2022 to reach **636.079 million dollars** by 2026 (Figure 6), mainly due to the increase in revenues and investments in capital expenditures as the global micro inverter sector is significantly growing. Additionally, we assumed a **perpetual growth rate of 3%** which is equal to the global GDP growth rate as we believe that Enphase Energy will perpetually grow at the same level of the global GDP, thus using this proxy along with a **WACC of 5.85%** made us reach a **terminal value of 22.966 billion dollars,** and an operating levered **enterprise value of 20.098 billion dollars.**

Therefore, we added the non-operating levered EV to the operating one and subtracted **financial debt value of 1.001 billion** dollars from the operating EV in

1 According to: https://www.mordorintelligence.com/industry-reports/united-states-solar-energy-market#:~:text=Market%20Overview,from%2096.19%20GW%20in%202020.

2 Globalnewswire article: https://www.globenewswire.com/news-release/2022/03/15/2403398/0/en/At-24-5-CAGR-Global-Electric-Vehicle-Market-Size-Share-to-Surpass-US-980-Bn-by-2028-EV-Industry-Trends-Growth-Forecast-Report-by-Facts-Factors.html#:~:text=As%20per%20the%20analysis%20shared,2028%2C%20based%20on%20primary%20research

3 We used the global Micro-inverter market CAGR according to business wire to grow the company's future revenues since Microinverters are the main value driver of Enphase Energy

order to obtain a company **equity value of 20.532 billion dollars.** Considering that Enphase Energy's number of shares outstanding will constant at 130.030 million shares, we reached a **target share price of $152.06** for the year-end 2022.

Finally, we expect Enphase energy to not pay dividends as they never did in the past, therefore we compared the target price of $152.65 to the current price of **$165.54** which yields to a total return of **-13.55%.** Consequently, our valuation model issues a **SELL** recommendation for Enphase Energy stock.

WACC Calculation

- **Cost of Debt:**

Despite being public, Enphase Energy has no attributed credit rating that would contribute to the cost of debt calculation which let us to consider determining the Z''s score in order to reach a score that we would eventually translate to an equivalent S&P credit rating. Following this first approach, the score obtained was unrealistically high (in the thousands range) due to the high market capitalization of Enphase Energy and would most probably translate to the highest S&P rating (AAA). However, the solar technology company doesn't hold any bonds in the market, only convertible notes, in order for us to determine all the necessary elements to compute the cost of debt using the following formula:

*rD = YTM – Probability of Default * Recovery Rate*

For the same reason of the unavailability of bonds in Enphase's financials, we couldn't compare its "potential" bond yield to the yield curves of the various credit ratings to have a proxy of its potential credit rating. Therefore, we assumed that it would be more accurate, given our assumptions and the reasons listed above, to estimate Enphase Energy's cost of debt through its past-year interest rate along with that of its peers. We identified the company's comparables based on their geographic positioning, market size and industry, which all had to be approximately similar to Enphase's. We then calculated the interest rates as of 2021 for each of the following identified peers, including Enphase Energy: **Generac Holdings Inc.**, **SolarEdge Holdings Inc.**, **Advanced Energy IR** and **SunPower**, and we allocated a specific weight to each one of them based on how close is their capital structure to that of Enphase. Finally, we used an average weighted approach, such that the peer with the most similar capital structure to Enphase would have the greatest weight, in order to derive the final cost of debt for Enphase which ended up equaling: **3.87%.**

- **Cost of Equity:**

In order to estimate the cost of equity, we started by computing the raw beta of Enphase energy by running a regression analysis of the company's share price against **Nasdaq Composite Index,** using the last 60 days available share prices, meaning that the oldest price used was on 31-05-2017. The output of the regression resulted in a r**aw beta of 1.87** with a confidence interval of **[0,69, 3,03].**

Since we obtained a large confidence interval for Enphase's beta, we decided to perform the same regression on Enphase's peers, the same ones used for the cost of debt estimation, but also accounting for an additional German peer "SMA Solar Technology AG" that we regressed against **SDAX.** After reaching the raw betas for each of the peers, we unlevered them in order to exclude the capital structure effect of each company and get an unlevered beta that can be used for Enphase Energy.

Additionally, we attributed different weights to the comparable companies based on how close their market capitalization is to Enphase Energy, such that **SMA Solar Technology AG** was given the lowest weight of **5%** since it operates in a different geography and has the lowest market capitalization compared to other peers and Enphase Energy was given the highest weight of **40%**, as it is clearly the most comparable company to itself. We then applied an average weighted formula using the unlevered betas of all comparables, including Enphase, which ended up resulting in an **unlevered beta of 0.66** that we relevered using Enphase Energy's 60:40 debt-to-equity ratio to obtain a **levered beta of 1.44.** Afterwards, we adjusted the raw equity beta by using the following formula:

*Adjusted Beta Equity = 2/3*Beta Equity + 1/3*1*

Lastly, in order to estimate the **cost of equity of 10.04%** for Enphase Energy we applied the CAPM formula below using the resulting **adjusted equity beta of 1.29:**

*Re = Risk-free + Adjusted Equity Beta * Market risk premium*

- **Weighted Average Cost of Capital (WACC):**

In order to be able to construct a DCF valuation model that will enable for the determination of the company's current performance and market positioning, we started by identifying the risk-free and market risk premium rates that constitute a basis to help determine the weighted average cost of capital. We used as a proxy for the risk-free rate the **10Y US Treasury Bond Yield of 2.92%,** and a market risk premium of **5.5%.**

As previously mentioned, we used the target 60:40 debt-to-equity ratio as an assumption for the WACC calculation. Therefore, we applied the formula below to obtain a **WACC value of 5.85%,** such that we considered the corporate tax rate to be equal to 21% and we inputted the previously estimated cost of equity of 10.04% and cost of debt of 3.87%:

*WACC = (E/V * Re) + [D/V * Rd * (1 – Tax Rate)]*

Multiples Analysis

Although DCF is considered the most accurate and insightful valuation approach, we decided to additionally conduct a multiples analysis for the purpose of summarizing and testing our valuation. In order to measure how Enphase Energy

is valued relative to its peers, we selected the same peers as the ones used in our cost of debt estimation based on their capital structure, industry and size, then carefully analyzed their EV/EBITDA and P/E multiples that we retrieved from Bloomberg. Although it is widely used as part of multiples analysis, the P/E multiple is commonly known to be distorted by the non-operating gains and losses and the capital structure of the company since for instance a company with high level of debt in comparison to its comparables would have a lower P/E, we decided to conduct our valuation based on the EV/EBITDA multiple.

After a thorough analysis, we decided to exclude **SunPower Corp** from our analysis as the company has negative EBIT and EBITDA, which would disturb our calculations, and we retained: **Generac Holdings Inc.**, **SolarEdge Holdings Inc.** and **Advanced Energy IR,** including **Enphase Energy**.

Figure 7: Peers Forward-Looking EV/EBITDA, Source: Bloomberg

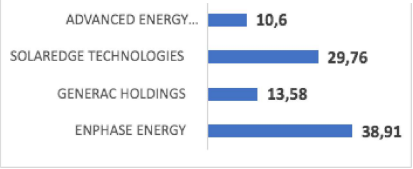
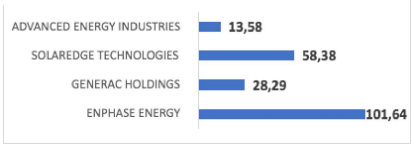


Figure 8: Peers Trailing Twelve Months EV/EBITDA, Source: Bloomberg



We figured that it would be practical to consider both the Trailing Twelve Months and Forward-Looking EV/EBITDA multiples in order to derive Enphase's Enterprise Value and reach valuable conclusions. We first computed the average of the **EV/EBITDA FY1 (23.21x),** using the multiple for each peer as shown in Figure 7, in order to multiply it by the YE2022 EBITDA for Enphase resulting in an Enterprise Value of **11.952 billion dollars,** which ended up being almost twice lower than our DCF estimation of **21.533 billion dollars.** The share price resulting from using the forward-looking EV/EBITDA is **$81.11**, which is much lower than our **DCF target price of $152.06,** therefore we believe that the market has lower expectations or the company's future performance when using the EV/EBITDA FY1, using the multiple for each peer as shown in Figure 8. On the other hand, when we followed the same approach using the peer's average **Trailing Twelve Months EV/EBITDA (50.47x)** to obtain Enphase's Enterprise Value, we ended up with an **Enterprise value of 21.831 billion dollars**, which is close enough to our estimated Enterprise Value through the DCF valuation. Therefore, the resulting **share price is $154.26** which is not much different from our DCF target price: **$152.06.**

Finally, we believe that it is more appropriate to consider the TTM EV/EBITDA as it gives a better estimation and valuation for Enphase Energy, especially that it is in line with our DCF estimation. However, although the two approaches resulted in different share prices, we believe that they are both consistent with our final **SELL** recommendation as in both cases the share price is lower than the current share price of **$165.54,** which will result in a negative total return.

ENPHASE ENERGY

COMPANY REPORT

RENEWABLE ENERGY

20 MAY 2022

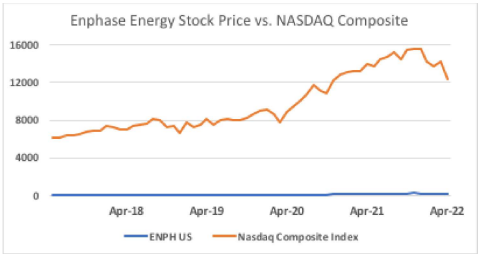
AYA BENLAKHDER, SANAE CHAABI

Recommendation:	**SELL**
Price Target FY22:	**152.06 $**
Price (as of 20-May-22)	**165.54 $**

Yahoo Finance: ENPH

52-week range ($)	113.4-282.46
Market Cap ($B)	22.353
Outstanding Shares (m)	135.03

Source: Yahoo Finance



Source: Bloomberg

(Values in $ million)	2020	2021	2022F
Revenues	774,4	1,382	2,114
EBIT	186.4	215.8	379.9
Gross Margin	44.7%	40.1%	40.1%
Net Profit	134	145.5	276.3
Operating margin	24.1%	15.6%	18%
P/E	21.24	211.9	134.32
EPS ($)	0.95	1.02	1.17

Source: Nasdaq.com, Bloomberg, Analyst Estimates

A Global Leader in the Solar Energy Technology Race

A constantly growing market with major future aspirations

- Based on our year end 2022 target price of $152.06, with a total return of -13.55% we issue a SELL recommendation for Enphase Energy. This recommendation is as of 5/18/2022 and due to the high volatility of our stock price in the last week, our recommendation could have changed from a day to another.
- Enphase energy has been showing consistent growth of both its top and bottom-line results as revenues have been growing at 48% CAGR for the past 5 years. We expect the company to keep growing in the next years due to its strong fundamentals' performance which mostly overperforms the peers as well as the favorable industry environment. We estimate Enphase Energy's revenues to grow at 53% in 2022 ad continue growing by a yoy growth rate of 19% until 2026.
- We believe that Enphase Energy has promising opportunities to grow further in the future mainly through: 1) The expanding EV market which Enphase Energy is about to enter after its acquisition of ClipperCreek as a provider of EV chargers which the company is adding to its products portfolio. 2) The growing renewable energies market in Europe as household owners are driven by the need for energy independence as well as the political and economic environment that highly encourages the transition into cleaner energies.
- The company is however faced by different challenges mainly concerning 1) the global shortage of semiconductors and the resulting supply chain complications, 2) the solar energy risks affecting the demand side as well as 3) the company's business model which relies on external contract manufacturers for handling all products manufacturing which leaves the company with much less control.

Table of Contents

Company Overview

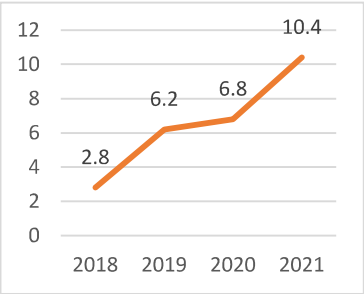
Company Description

2,260 employees
Founded in 2006
NASDAQ: ENPH
Headquarters: California, U.S.

Founded in 2006 and headquartered in Fremont, California, Enphase Energy Inc. is an American NASDAQ listed manufacturer of solar power products and a provider of solutions for energy management globally. The Company is a leading supplier of solar and battery systems that are microinverter-based on a worldwide level with over 2,260 employees globally as of end of year 2021.[1]

Furthermore, Enphase Energy offers networking and software technologies in order to allow energy monitoring and control of services. These products and services are available for different types of clients, mainly solar distributors, that resell Enphase Energy's microinverter technology to installers. Those installers integrate the microinverters into the final solar Photovoltaic systems to be delivered to both the commercial and residential markets worldwide. Other clients of Enphase Energy include OEMs and strategic partners such as suppliers of industrial equipment as well as homeowners.[1]

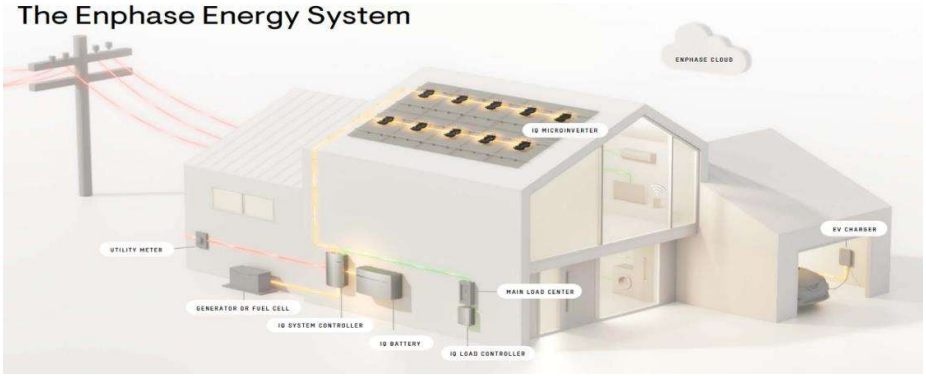
Figure 1: Enphase Energy's Microinverter global shipments (in millions); Source: Enphase CEO letters to shareholders for the past 3yrs



Currently, Enphase energy has installed around 1.5 million energy systems in more than 130 countries, and has shipped over 10 million microinverters compared to 6.8 million in 2020 (*Figure 1*), providing millions of individuals with access to clean and affordable energy and helping to reduce carbon emissions.[1] The company generates most of its revenues in the U.S. with a percentage of 80% and is expected to maintain this level for the few upcoming years.

Regarding its product line, Enphase energy offers an all-in-one energy management, storage and solar solution named "The Enphase Home Energy Solution with IQ™" (*Figure 2*) which brings together high technology components for a better maximization of energy potential as well as advanced remote maintenance and control. Enphase energy provides the system components separately, such as IQ Microinverters, Enphase IQ ™ Combiner, Enlighten ™

Figure 2: The energy Home solution with IQ™ ; Source: Enphase Energy letter to shareholder's



[1] According to the company's CEO letter to shareholders 2021

mobile app, batteries, EV chargers as well as other IQ Microinverter and IQ Envoy accessories.

Figure 3: Top institutional holders of Enphase Energy; Source: Yahoo Finance

Top Institutional Holders

Holder	Shares	Date Reported	% Out	Value
Blackrock Inc.	15,018,530	Mar 30, 2022	11.12%	3,030,438,983
Vanguard Group, Inc. (The)	13,920,337	Dec 30, 2021	10.31%	2,546,586,450
State Street Corporation	5,222,264	Dec 30, 2021	3.87%	955,349,989
Invesco Ltd.	3,350,517	Dec 30, 2021	2.48%	612,913,579
Geode Capital Management, LLC	2,518,259	Dec 30, 2021	1.86%	460,630,301
FMR, LLC	2,329,495	Dec 30, 2021	1.73%	426,157,815
JP Morgan Chase & Company	1,933,279	Mar 30, 2022	1.43%	390,097,036
Brown Advisory Inc	1,503,239	Mar 30, 2022	1.11%	303,323,565
Allianz Asset Management GmbH	1,464,107	Dec 30, 2021	1.08%	267,813,734
Northern Trust Corporation	1,385,919	Dec 30, 2021	1.03%	253,540,021

Enphase Energy has been showing a consistent growth of both its top line and bottom line over the past years with a 48% CAGR of revenues between 2017 and 2021 as well as a historical EPS growth of 137%[1]. The company has a baseline financial model consisting of attaining 35% gross margin 20% operating income, and operating expenses of 15%, based on revenues which the firm has been beating since 2019 when the model was introduced. The investor base of Enphase energy is composed of 73.18% shares held by institutions with Blackrock Inc. and Vanguard Group representing the highest ownership percentage with 11.12% and 10.31% respectively.[2](Figure 3)

Figure 4:Enphase Energy's recent acquisitions; Source: Crunchbase

Acquisition	Date
SolarLeadFactory	15-Mar-22
365 Pronto	21-Dec-21
ClipperCreek	16-Nov-21
Sofdesk	26-Jan-21

The solar technology company seeks for more growth in the future both organically and inorganically mainly through expanding its operations into new markets namely the European one as well as growing inorganically by actively engaging in acquisitions to help accelerate its digital strategy and expand its products offering (Figure:4). As per its recent acquisitions the company has recently (March 2022) acquired SolarLeadFactory which is a solar leads distributor in the U.S. through this acquisition, Enphase Energy is expected to decrease its customer acquisition costs by leveraging SolarLeadFactory's lead generating capabilities and integrating it into Enphase's digital platform which allows installers to have control over their solar and battery systems.[3]

Business Model

Enphase Energy describes its business model as CAPEX lite (or Asset light) and OPEX efficient.

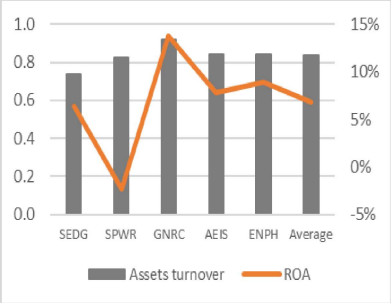
Figure 5: Enphase Energy's global supply chain; source: Enphase Investor day presentation 2021

CAPEX Lite:

The capex lite model tends to be more flexible and allows some new entrant companies to compete or outperform incumbents since the model doesn't require heavy investment in capex. In Enphase Energy's case, the company doesn't have any big factories, but it outsources the manufacturing of its products to its contract manufactures, namely Flex and Salcomp which are located in India, China, and Mexico with a new agreement to start manufacturing its products in Romania which will start in Q1 2023 as the company seeks to better serve its European market. (Figure: 5) By outsourcing its manufacturing including testing and assembling, the company focuses on product innovation, development and design as well as sales of its products. This aligns with the company's supply chain strategy that aims to

1 According to Yahoo Finance: https://finance.yahoo.com/news/enphase-energy-enph-incredible-growth-164504055.html#:~:text=While%20the%20historical%20EPS%20growth,for%20EPS%20growth%20of%2071.5%25.
2 According to Yahoo finance holders' page.
3 According to Globalnewswire: https://www.globenewswire.com/news-release/2022/03/15/2403376/20176/en/Enphase-Energy-Acquires-SolarLeadFactory.html

Figure 6: Enphase Energy's Asset turnover and ROA vs. peers for 2021; Source: Analyst calculations



diversify production in locations providing cost competitive and tariff free advantages. However, this gives the company less control over its production and makes the management more challenging as well as the risk of intellectual property leak. All in all, this gives the company better cost reduction capabilities as well as better return on assets but makes it dependent on external manufacturing players. Based on our analysis the company's return on assets of 9% is above its industry average based on selected peers[1] which stands at 6.9%. The asset turnover of Enphase is however similar to the industry average standing at 8% as of 2021 numbers.(Figure: 6)Thus, the company's ability to generate revenues using its assets is similar to its industry average but returns generated based on its net income using assets are higher than the industry average meaning a better profitability based on assets.

OPEX Efficient:

In terms of OPEX efficiency, Enphase Energy is open to the global market with serval partnerships around the world. The headcount of Enphase Energy shows that the majority of the company's employees are located in India by 65% followed by North America representing 26%[2]. (Figure:7) Enphase intends to continue expanding their market share in the regions of Europe, Asia Pacific and Latin America, by capitalizing on their market leadership in terms of microinverters as well as expanding into new markets such as the emerging ones by offering both new and existing products.

Figure 7: Enphase energy's global headcount distribution; Source: Enphase Investor day presentation 2021

In addition, the solar energy company adopts a high growth strategy as it continues expanding its product offerings by investing in research and development and constantly upgrading its solar energy management solutions through different partnerships and acquisitions.

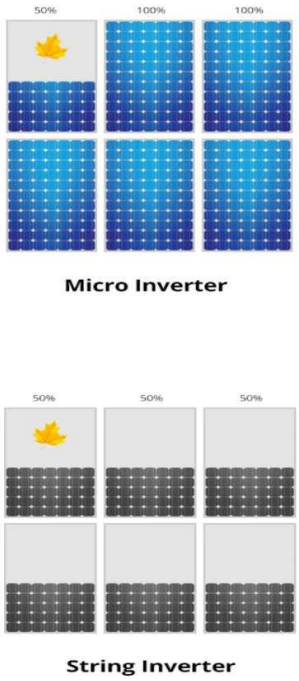
Competition

Nature of competition:

Enphase Energy's main product is microinverters. In fact, Enphase energy was the first company to manufacture microinverters worldwide in 2008.[3] There are 3 main solar inverter types, microinverters, power optimizers coupled with a string inverter, and string inverters. The string inverters are the oldest and most popular type of inverters, whereas microinverters are the most recent technology in the inverters sector and have been gaining more popularity during the past decade especially. Inverters play a major role in a solar system since they are the ones in charge of converting the power generated by the solar panels called direct current (DC) into

1 Solaredge technologies (SEDG), Sunpower (SPWR), Generac holdings (GNRC), Advanced Energy Industries (AEIS): Peers selected are all based in the US where 80% of the company's revenues are generated and have a similar core business to Enphase Energy operating in the inverter and energy storage market as well as providing energy technology solutions.
2 as of 30-Sep-2021
3 According to Solarchoice: https://www.solarchoice.net.au/products/inverters/Enphase-review/

Figure 8: Microinverter vs String inverter energy generation based on panels performance in case of shading issue. Source: Gosolarquotes



alternating current (AC) electricity which is grid compatible. However, the variant types of solar inverters come with major differences in terms of performance, safety and cost.

String inverters are the most common type of inverters in the market due to their long existence in the market which increased their reliability as well as their easier monitoring and maintenance since they are not placed on the roof such as the other inverter types. In addition, string inverters are the least expensive option between the three solar inverters. However, these conventional inverters have many performance and efficiency issues that make them less attractive compared to both microinverters and power optimizers.[1]

Therefore, Enphase Energy competes with all types of inverter producers, storage system manufacturing firms as well as other new technologies that rival Enphase Energies core products and alternative options by utility companies.

The main aspects of competition include products' features and performance level, distribution and sales capabilities, brand recognition, as well as products' warranty reliability and compliance with some industry standards. Many of Enphase Energy's global competitors are larger companies with greater brand recognition and more resources and experience regarding distribution, sales, and marketing activities such as the two leading Chinese inverter players Huawei Technologies and Sungrow power as well as the leading German company SMA.

The main competitive advantage of microinverters is that these inverters have a higher energy production rate since the power generation of each solar panel is not affected by the performance of other solar panels contrary to string inverters which produce power according to the solar panel with the lowest performance level in the string.(Figure: 8) Moreover, the fact that the electricity conversion into alternating current happens on the individual solar panel level for microinverters results in a low voltage current in the roof but for string inverters there is a high voltage current coming from all the panels and combining on the roof level which causes a higher safety risk such as electrical fires. Another important advantage of microinverters is the easiness of expanding the solar system compared to central inverters since using microinverters the system can be upgraded by adding individual panels one by one but a system with central inverters requires larger expansions and can therefore be more costly and complicated.

Although microinverters seem to outperform string inverters mainly regarding their energy production efficiency and safety characteristics, central inverters can still be more attractive for larger solar installations that have little exposure to shading since these inverters can be less costly while microinverters are gaining more

1 https://greenridgesolar.com/2020/11/types-of-solar-inverters/

popularity especially in the residential market where roofs can be smaller and more exposed to shading.

SolarEdge Technologies:

The U.S. market represented 80% of Enphase Energy's total annual revenue by the end of 2021 which makes it the most important market for the company in terms of revenue and one of the main companies that competes Enphase Energy in this market is SolarEdge Technologies. SolarEdge competes fiercely with Enphase Energy as they are the considered the invertor titans and they make together 90% of the U.S. inverter market share as of the latest available data in December 2020. In the U.S. market and as for the end of 2020, Enphase Energy dominated with a 48% market share compared to 40% for SolarEdge[1].This market share increase occurred simultaneously with the Encharge battery launch by Enphase in North America in July of the same year. This shows that the U.S. inverter market is an oligopoly dominated by two large companies which results in a limited competition as the strong brands are already established by since this industry is based on technology development, we believe that the competition is still elevated since a company coming up with a disruptive innovation that reduces costs or increases efficiency can overtake market share of established brands especially if they have a business model not requiring heavy investment in capex.

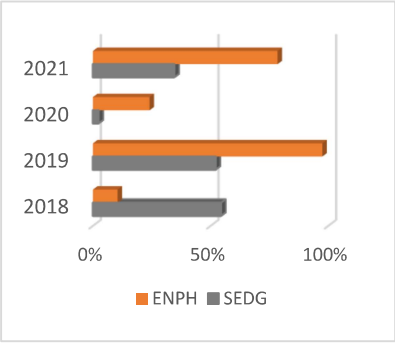
In terms of product offering, Enphase Energy provides microinverters while SolarEdge is a producer of power optimizers that are couples with a string inverter. The overall performance of the products offered by the two companies depends on different factors but the main elements are that Enphase offers a more expensive solution than Solaredge. Solaredge's optimizer+inverter solution shows an efficiency of 99% compared to 97%[2] for Enphase energy but these two could not be directly compared since although Solaredge optimizers show better performance in partial shade but the microinverters technology by Enphase has superior performance concerning the management of shade as well as complex rooftop layouts.[3] (Figure: 9)

Figure 9: Overall Performance of Enphase Energy vs. SolarEdge; Source: Nrg clean power and Helius Energy

	ENPH	SEDG
Scalability	Easy	Limited
Battery	lower storage Capabilities	Better storage Capabilities
Efficiency	97%	99%
Warranty	25y	25y optimizers 12y central inverters
Replacement process	Fast	Complex
Cost	Expensive	Cheaper
Customer Service	Short waiting time	Long waiting time

Over the past 5 years Enphase Energy displayed a higher revenue CAGR of 48% compared to 34% for SolarEdge Technologies. (Figure 10) Both companies' revenues have been growing constantly with a lower yoy growth in 2020 especially for Solaredged which grew its revenues by 2% while Enphase showed a growth of 24% in the same year. In 2021, Enphase had a strong recovery of revenues by a yoy growth of 79% more than double the yoy revenue growth of SolarEdge of 35% in the same year. (Figure 10)

Figure 10: Yoy revenue growth of Enphase Energy vs. Solaredge; Source: Analyst Calculations



1 According to pv magazine: https://www.pv-magazine.com/2021/02/09/enphase-set-to-challenge-solaredge-in-us-inverter-market/
2 An efficiency of 99% indicates that 1% of electricity entering the system is lost during power conversion, for 97% it would be 3%.
3 According to Nrg clean power: https://nrgcleanpower.com/learning-center/solaredge-vs-enphase/#:~:text=SolarEdge%20vs%20Enphase%3A%20Scalability&text=SolarEdge%20systems%20are%20limited%20to,solar%20panels%20with%20compatible%20microinverters.

Figure 11: Enphase Energy vs SolarEdge's historical gross margin; Source: Analyst Calculations

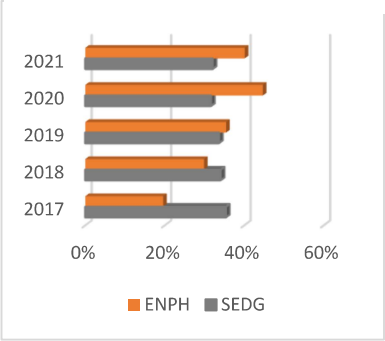
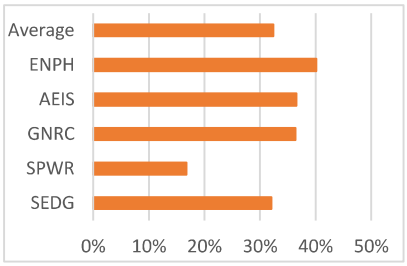


Figure 12: Enphase energy's gross margin vs. peers and industry average 2021;Source: Analyst calculations



Regarding the gross margin evolution, Enphase energy's gross margin has been growing constantly in the last 5 years with a slight drop in 2021 from 45% to 40% which is still above the company's previously mentioned baseline financial model of 35-15-20, mainly due to some supply chain issues that resulted in an increase in the cost of some product components as well as the higher freight cost by 8x which the management faced by reducing costs and modestly increasing their price which helped maintain a high gross margin for the year 2021.

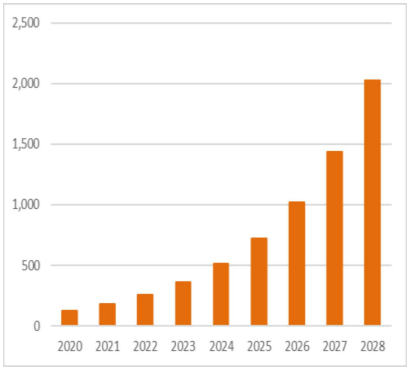
We also expect the company to improve its gross margin in 2022 as it has increased capacity by adding a second fully automated line at both its Mexico and India contract manufacturers as well as its engagement in more cost reducing M&As (eg. SolarLeadFactory). SolarEdge on the other hand has been experiencing a declining gross margin over the last years with a few percentages. (Figure 11) On an industry levels based on the previously mentioned peers set, Enphase Energy's 40% gross margin seems to be the highest among its peers and the peers average for the year 2021 which stands at 32% implying better profitability.

Another big rival for both Enphase Energy and SolarEdge is one of the world's leading inverter makers Huawei. However, the Chinese company is not competing with Enphase and SolarEdge on the U.S. market as it had exited the U.S. market in 2019 after the arrest of its CFO, the US government ban of importing main Huawei inverter components as well as tariff restrictions on Chinese inverters leaving more market share room for the two rivals. [1]

Opportunities:

Electric Vehicles Market:

Figure 13: Projected size of the global market for electric commercial vehicles for the period 2020-2028 (in thousand units); Source: Statista



The increasing trend of clean energy and the several government incentives as well as global agreements[2] create more opportunities for Enphase Energy to expand its operations and grow further in the future. One of the main opportunities for Enphase lays in the EV charging market.

The demand for electric vehicles is in an upward trend. (Figure: 13) According to Globalnewswire, the global electric vehicles market is expected to grow between 2022 and 2028 at a 24.5% CAGR[3]. This growth in the EV market will be certainly accompanied by a high increase in the demand for electricity. Batteries make up one third of the cost of EVs, these batteries have known a steady decrease in costs

1 According to PV magazine: https://www.pv-magazine.com/2019/06/26/reports-huawei-has-exited-us-solar-inverter-market/#:~:text=Roth%20Capital%20Partners%20has%20reported,the%20Trump%20administration%20and%20China.&text=Huawei's%20rivals%20can%20be%20expected%20to%20react%20quickly%20in%20the%20U.S.%20market.
2 See more details in the regulatory framework section.
3 Globalnewswire article: https://www.globenewswire.com/news-release/2022/03/15/2403398/0/en/At-24-5-CAGR-Global-Electric-Vehicle-Market-Size-Share-to-Surpass-US-980-Bn-by-2028-EV-Industry-Trends-Growth-Forecast-Report-by-Facts-Factors.html#:~:text=As%20per%20the%20analysis%20shared,2028%2C%20based%20on%20primary%20research.

for the past years which represented a great boost to EV economics leading to a 60% increase in EV sales globally only between 2014 and 2015.[1]

Forecasts expect that EVs will overtake the sales of traditional vehicles by 2038. This growth in EVs will entail an increase in the demand for electricity amounting to around 2 to 3.5% with at least half of it covered by solar energy according to Deutsche Bank[2]. Moreover, the several restrictions imposed by governments and global institutions to reduce greenhouse gas emissions and achieve global standards as well as decreasing the dependence on fossil fuel resources also contributes to more powering using renewable energies including solar.

According to the U.S. Department of Energy, 80% of the charging of electric vehicles is performed at home as residential charging is characterized by its convenience as well as lower cost.[3] As a leader in home energy management solutions, Enphase Energy will certainly benefit from the growth of the EV market especially as it has acquired ClipperCreek by the end of 2021 as a step forward to enter the EV market through the companies' brand of EV chargers. Enphase Energy is also expected to grow its EV chargers manufacturing through transferring their production to the factory in Mexico. The company is expected to create smart EV chargers which would be Wi-Fi connected and can be integrated into the home energy system as well as partnering with EV makers to optimize the use of their chargers.

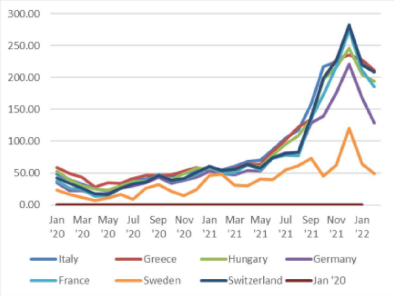
European Renewable Energy Market:

Another growth opportunity for Enphase energy is the European market. As of 2021, the company's revenue from Europe more than doubled on a yoy basis. The company has already entered different European countries with the latest being Italy, where it introduced its IQ™ Microinverters and batteries. The European market has a strong urge to accelerate its transition to renewable energies as the most sustainable long-term solution to surpass the current crisis with regard to energy security as well as the climate emergency.

Due to the Russian invasion of Ukraine resulting in highly increasing natural gas and power prices in Europe, the region is expected to spend 1 Trillion dollars on Energy in 2022 which represents double the budget spent in 2019[4]. This implies a big increase in energy bills for the average European household as average

1 New Energy Solar: https://www.newenergysolar.com.au/renewable-insights/renewable-energy/electric-vehicles-will-drive-demand-for-solar-energy
2 Reneweconomy: https://reneweconomy.com.au/solars-trillion-dollar-market-driven-evs-microgrids-cost-parity-storage-13315/
3 According to NREL: https://www.nrel.gov/docs/fy21osti/78540.pdf
4 According to RMI organization: https://rmi.org/europe-must-go-renewable-to-escape-energy-and-climate-crisis/

Figure 14: Average monthly electricity wholesale prices in selected countries in EU in euros/megawatt; Srouce: Statista



	Jan '20	Jan '21	Feb '22	2Yrs % Change
Italy	48.17	59.64	210.54	337%
Greece	58.39	52.51	211.73	263%
Hungary	52.96	56.39	194.29	267%
Germany	34.98	52.79	128.78	268%
France	37.97	59.47	185.63	389%
Sweden	23.48	46.65	48.89	108%
Switzerland	42.56	60.48	208.71	390%

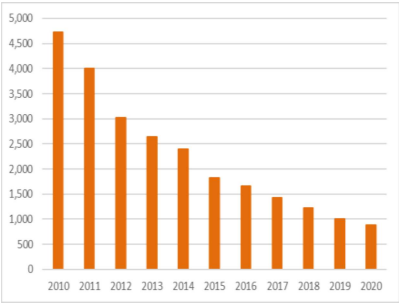
monthly electricity wholesale prices have increase on average by 290% in Jan 22 compared to Jan 2020 based on statistics from a selected number of EU countries. (Figure 14) These mounting prices coupled with the increasing urge of governments to adopt clean energies and reduce greenhouse gas emissions makes renewable energy solutions, namely solar technologies, the best way for the European market to overcome its crisis and achieve global agreements regarding emissions reduction. Solar energy installation cost has also been steadily decreasing on a global level as the production materials availability is increasing resulting in cheaper production costs, in the past 10 years the average installation cost for solar photovoltaics has declines by over 80% which will increase the demand for more solar energy adoption. (Figure 15)

European households are also looking for more energy independence which could be achieved by adopting full range home solar energy systems in which Enphase Energy is a market leader. The microinverter market specifically is also growing at a CAGR of more than 20% until 2025 meaning if Enphase grows with the market it will be more than doubling by then which seems realistic given the company's 48% CAGR of revenues for the past 5 years.

Challenges

Global Chip Shortage:

Figure 15: Average installation cost for solar PVs between 2010-2020 in U.S. $ per kilowatt;Source: Statista



Semiconductor components are a main part of Enphase Energy's products as a solar technology player. However, the world has been facing a semiconductors crisis represented by the global chips shortage. This was aggravated by the supply chain issues arising with the pandemic. The demand for semiconductors has been also increasing as the world is heading towards more digitalization but the supply for these important components is not keeping up with the demand.

The median demand for semiconductors has increased by 17% for buyers in 2021 compared to 2019 while most of the semiconductor manufacturers are operating at a utilization rate of 90% or more implying a limited increase of capacity to expect in the next few years.[1] According to Deloitte, the shortage of one crucial chip which usually costs less than a dollar could hinder the sale of an end device with a value reaching tens of thousand dollars, this illustrates the gravity of the ship shortage which for the last two years has caused missing out on $500 billion of revenues on a global level between the semiconductor manufacturers and their customer sectors based on Deloitte analysis.[2]

Deloitte expects the semiconductor sector to grow by 10% in 2022 on a global level as a first time in its history as semiconductor components are increasingly

1 According to abc news: https://abcnews.go.com/Technology/global-chip-shortage-threatens-economy-national-security-americans/story?id=82399618
2 According to Deloitte: https://www2.deloitte.com/us/en/pages/technology-media-and-telecommunications/articles/semiconductor-industry-outlook.html

becoming a major part of different products. On the other hand, the economic world forum expects that the shortage of these chips is expected to remain an issue in the near future partially due to the complexities entailed in the production process of these semiconductors which is related to the long lead time the limitations regarding capacity increase as well as the long time required for design alternations when it comes to switching manufacturers.[1]

This problem will definitely cause a challenge to Enphase Energy as well as its industry peers in terms of increasing costs as well as constraints in meeting their demand as the company has already faced problems with semiconductor components availability in 2021 which played a major role in the decrease of their gross margin by 4.6%

Solar Energy Risks:

Renewable energies namely the solar energy has different risk that could impact the demand side. One of the main challenges in a solar energy system is the battery component which allows the storage of power to be used in low sunlight hours, system irruptions or emergency blackouts. Having an efficient battery is critical for a robust solar system, however these batteries contain different element from manganese, lithium and zinc which are extracted through mining. This would imply a negative impact of solar energy systems on the environment which can weigh down the benefits of a solar energy transition to combat climate change and become more environment friendly. Another environmental concern in solar energy production is the use on several toxic chemicals in the manufacturing of solar cells such as Hydrochloric acid, Acetone and Nitric acid posing both health and safety issues. This could affect the demand side by making it more relucent to the energy transition meaning less demand for solar energy than anticipated.

Another problem facing solar energy systems is the weather constraints since solar systems will produce much lower energy during periods of rain and cloudy days. High temperatures can also make solar systems produce less energy due to the drop in voltage.[2]Unless solar technology players including Enphase Energy develop better solutions to increase the efficiency of their solar systems in the different weather conditions, this could affect the demand for their products especially in regions with more unfavorable weather conditions.

Company specific challenges:

The company relies on different external factors that could slow down its expected growth. For the fiscal year ended December 31, 2021, 34% of the total net revenues of the company are represented by one large customer which they do

1 According to World Economic Forum : https://www.weforum.org/agenda/2022/02/semiconductor-chip-shortage-supply-chain/#:~:text=A%20confluence%20of%20problems%20led%20to%20the%20semiconductor%20shortage.,2020%20as%20vehicle%20sales%20plummeted.
2 According to genusinnovation: https://www.genusinnovation.com/blogs/weather-effect-on-solar-panels

not disclose. Therefore, the company's revenue is highly dependent on the financial performance of its large customer which could create more uncertainty about Enphase Energy's future performance.

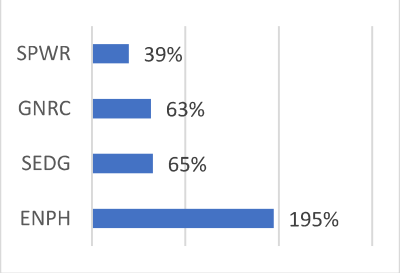
Another challenge facing Enphase Energy is its complete dependence on external contract manufacturers regarding the production of its products which gives the company less control over the management of its manufacturing in terms of the availability of components, delivery schedules as well as costs. In addition, the agreements Enphase has with these contract manufacturers do not include long-term supply commitments. This poses high risks in terms of meeting customers demand in case of any operational deficiency in the contract manufacturer production site.

Financial Performance

Total Shareholder return (TSR):

As a measure of financial performance, the total shareholder return would give us an overall idea of the total amount an investor would reap from investing in Enphase Energy's stock for the past 5 years as well as the annual growth rate of these total shareholder returns based on capital gains from the change in share price and the dividends yield, this later will not apply for Enphase since they have never distributed any dividends and are not planning to in the foreseeable future. This measure also reflects the changes in market expectations for the future performance of the company. We have computed the cumulative shareholder return of Enphase Energy's stock as well as its set of selected peers. We have used the monthly adjusted[1] stock prices for each company from 29-Dec-2017 to 31-Dec-2021 to find the cumulative TSR for that period for each company with TRS for t=0 as 100. (Figure: 17) We have then computed the TSR CAGR based on the cumulative numbers for each company for the same period. Our results show that Enphase Energy is extremely outperforming its peers in terms of historical TSR growth with a 195% TSR CAGR from 29-Dec-2017 to 31-Dec-2021. (Figure 16) Although this measure gives a concrete idea about the returns of investors in a certain company but it cannot be an indicator of superior operating performance as the growth in the share price can be affected by different factors unrelated to the operational performance of the company such as the market expectations and the growth coming from inorganic activities.

Figure 16: TSR CAGR from 29-Dec-2017 to 31-Dec-2021 for Enphase Energy vs. Peer; Source: Analyst Calculations



1 To account for dividends

Figure 17: Historical cumulative TSR for Enphase Energy vs. Peers from 29-Dec-2017 to 31-Dec-2021; Source: Analyst Calculations

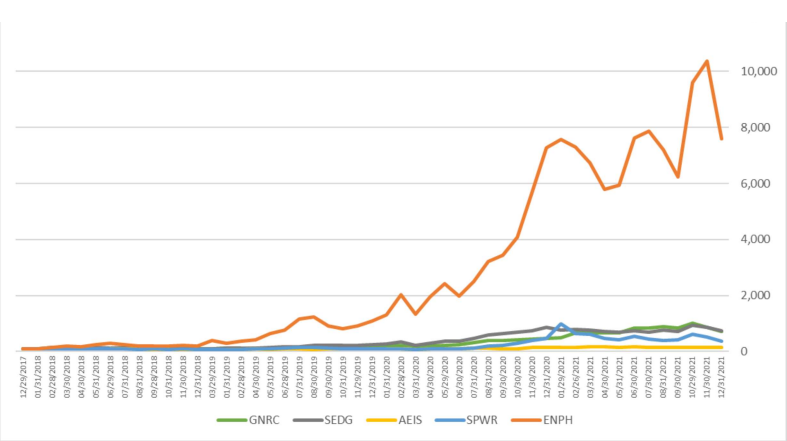
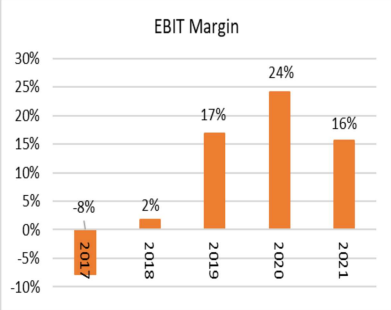


Figure 18: Historical Adjsuted EBIT Margin for Enphase Energy; Source: Analyst Calculations



Operating margin breakdown:

In order to measure the performance of the company in terms of operating margin we have broken down the EBIT Margin of Enphase Energy into its operating costs, COSG, R&D, SG&A and D&A as a percentage of revenue. The Adjusted EBIT[1] margin of Enphase Energy has increased between 2017-2020 but it has materially decreased in 2021 from 24% to 16%. (Figure: 18) Since the company's revenues have grown from 2020 to 2021 by 79%, this decrease in EBIT margin seems to be mainly due to a 5% increase in COGS which represent the highest cost for the company as well as a 3% increase in SG&A which are the second highest costs for Enphase Energy. (Figure: 19)

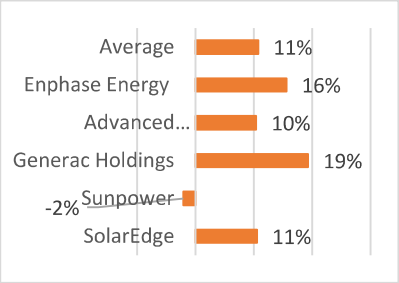
The cost of goods sold of Enphase Energy is mainly composed of product costs, freight costs, logistics and warranty costs. As mentioned before in the challenges part of the Equity research, Enphase has faced shortage of product components as well as an increase of freight costs during the year 2021 which explains the increase in COGS. SG&A costs are primarily composed of personnel related expenses which the company intends to keep a high level of investment in, in order to achieve their market penetration goals and expand into more geographies.

Figure 19: Operating costs as a percentage of revenues; Source: Analyst Calculations

	2017	2018	2019	2020	2021
COGS/Revenues	80%	70%	65%	55%	60%
R&D/Revenues	8%	7%	4%	5%	5%
SG&A/Revenues	16%	18%	12%	13%	17%
D&A/Revenues	3%	3%	2%	2%	2%

1 Adjusted for operating items only

Figure 20: Adjusted EBIT Margin of Enphase Energy vs. Peers for 2021; Source: Analyst Calculations

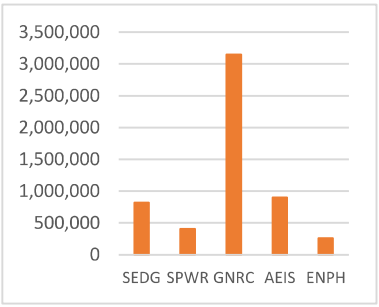


We have also performed the same analysis for the year 2021 to compare Enphase Energy's cost structure with its peers. In order to compute the EBIT margin and break down the operating costs of Enphase Energy's Peers, we have only taken into account operating items (eg. Excluding, non-recurring restructuring costs, loss or gain on sale of assets or business divestures…). For 2021 Enphase Energy had a superior Adjusted EBIT margin of 16% compared to its peers average of 11%. (Figure: 20) In terms of cost of goods sold, Enphase Energy has a lower percentage based on revenues of 60% in 2021 compared to its peers average of 66%. However, the second largest costs as a percentage of revenues for Enphase which are SG&A are larger than its peers average by 3%. (Figure: 21) The high percentages of COGS and SG&A for Enphase Energy seem to be aligned with its industry peers and the company appears to be well positioned in terms of costs management with both the highest gross margin and highest Adjusted EBIT between its peers.

Figure 21:Operating cost structure of Enphase Energy vs. Peers for 2021; Source: Analyst calculations.

	SolarEdge	Sunpower	Generac Holdings	Advanced Energy Industries	Enphase Energy	Average
COGS/Revenues	68%	83%	61%	60%	60%	66%
R&D/Revenues	9%	0%	3%	11%	5%	6%
SG&A/Revenues	10%	18%	12%	13%	17%	14%
D&A/Revenues	2%	1%	2%	4%	2%	2%
Other operating expenses/Rev	0.1%	0.0%	1.9%	1.8%	0.0%	0.8%
Adjusted EBIT	11%	-2%	19%	10%	16%	11%

Figure 22: Enphase Energy's Invested Capital incl. GW & intangibles for the year 2021. Source: Analyst Calculations



Invested Capital:

In order to analyze Enphase Energy's capital invested to perform its operations, we have calculated the Invested capital for Enphase Energy and its peers including Goodwill and intangibles by only accounting for operating assets and liabilities and disregarding non-operating items for both Enphase Energy and its peers in order to get an accurate view of the company's operating performance and have a more meaningful comparison with peers. The calculated invested capital for 2021 shows that Enphase energy invests the lowest capital among its peers with an amount of $260 million. (Figure: 22) In order to compare how efficiently Enphase Energy is using its invested capital, we have calculated the company's capital turnover vs peers, by dividing the company's total revenues by the invested capital. We have also computed the percentage of each component of the invested capital from each company's revenues in order to observe how heavily each company is invested in each item. (Figure: 23)

Figure 23: Enphase Energy's Capital Turnover (Incl. GW & Intangibles) for 2021 and invested capital components as a percentage of revenues for the same year; Source: Analyst Calculations.

	SEDG	SPWR	GNRC	AEIS	ENPH
Capital Turnover (Incl. GW& Int)	**2.4**	**3.3**	**1.2**	**1.6**	**5.3**
WC & Other operting assets	9%	12%	4%	21%	-8%
PP&E + Operating lease right-of-use assets	23%	7%	15%	15%	7%
Goodwill	7%	10%	44%	15%	13%
Intangibles	3%	2%	21%	11%	7%

We can observe that Enphase Energy has the highest capital turnover meaning it generates more revenues based on its invested capital compared to peers. We can also observe that Enphase energy has one of the lowest investments in PP&E and operating lease assets vs. peers as a percentage of revenues as well as a negative WC+other operating assets for Enphase Energy which comes from its higher operating liabilities compared to assets resulting in negative net operating assets and the main account concerned is the non-current deferred revenues account which has a high value. We believe that having high non-current deferred revenues for the company is not alarming as long as Enphase Energy is able to deliver its products to the customers as it can be a better financing option that getting bank loans.

Lastly, we have computed the NOPLAT for Enphase Energy and peer companies using operating items from the income statement in order to compute the ROIC incl. GW & intangibles for our analyzed company vs peers. We have excluded SunPower in this analysis as it showcases a negative NOPLAT which will lead to distorting results. Enphase energy shows a very high ROIC which is greater than 50%. This ROIC number is largely higher than peers which is a good indicator of Enphase Energy's superior performance in terms of return on invested capital. (Figure: 24)

Figure 24: ROIC calculation for Enphase Energy vs. Peers for 2021; Source: Analyst calculations

	SEDG	SPWR	GNRC	AEIS	ENPH
NOPLAT	163,640	-27,716	569,697	119,828	220,423
Invested Capital (Inc G&Int)	820,873	406,203	3,145,732	899,698	259,737
ROIC (inc G&Int)	**20%**	**-7%**	**18%**	**13%**	**85%**

This high ROIC indicated a high value creation for Enphase Energy's Investors as we compare it to our 5.85% WACC.

Industry Overview

Market Overview

According to a study conducted for the projected period 2022-2027, the US renewable energy industry is predicted to grow at a CAGR above 5%, mainly driven by the market expansion, as well as attempts to fulfil growing demand for renewable energy sources promoted by the government strategies[1]. Additionally, renewable technologies are continuously enhancing the cost competitiveness with fossil fuels, and further renewable energy subsidies are propelling the clean energy sector forward[1]. Conversely, the growth of the US renewable energy industry is constrained by various variables such as the developing market for natural gas rivalling the clean energy market and its restricted supply sources[1].

As Enphase Energy operations are mainly concentrated in the microinverters market, we believe that the company would undoubtedly benefit from the spread of renewable energy technologies resulting from the rising solar energy consumption and installations. The sales of microinverters and its adoption by homeowners is mainly driven by their increasing popularity amongst commercial and residential sectors along with their cost-effectiveness and high efficiency compared to the use of the electrical grid, although microinverters prices are commonly expensive due to their particularities. Additionally, the size and power level of microinverters allow them to meet not only the demand of households but also that of businesses globally.

The global solar inverter market is expected to be valued at $16.88 billions by 2030, compared to its estimated value of $8.78 billions as of end 2022, which corresponds to growing at a CAGR of 8.5% for the forecasted period[2] (Figure 25). This valuable growth is mainly linked to the increasing need for renewable and green energy in order to comply with the ESG standards set by governments and businesses. The solar technology offered by Enphase Energy revolutionized the solar energy sector whilst focusing on the key ESG factors considered by the company in order to enable the creation of a socially responsible future for microinverters owners.

Figure 25: Solar (PV) Inverter Market Size, 2022 to 2030 (USD Billion)
Source: Precedence Research

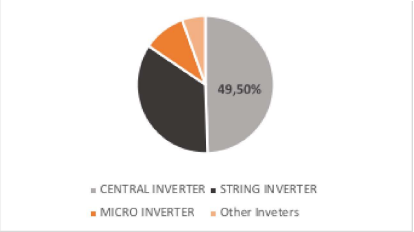
On the other hand, the global PV inverter market is mainly dominated by three types of inverters used for industrial and residential purposes: central inverters, string inverters and micro inverters, with central inverters accounting for a market share of 49.5% in 2021[3] (Figure 26). The wide spread of the central inverter is

[1] https://www.mordorintelligence.com/industry-reports/united-states-renewable-energy-market

[2] https://www.precedenceresearch.com/solar-inverter-market

[3] https://www.precedenceresearch.com/solar-inverter-market

Figure 26: Global Solar Inverter Market Share in 2021, by product
Source: Precedence Research



particularly common amongst huge buildings in industrial areas as it allows for an efficient power supply for the entire building, whereas the string and micro inverters are typically used as part of home installations especially that households' electricity needs are substantially rising due to the increasing use of gadgets and technologies on a daily basis along with the current wide spread of electric cars.

In the period between 2020 and 2030, the forecast team from S&P Global Market Intelligence estimates that about 55,000 MW and 45,000 MW of new wind and solar installations, respectively, will be deployed merely to keep up with the state Renewable Portfolio Standard concerns[1]. The RPS is a set of rules and laws set by the government in order to increase energy production through renewables. States which are concerned by this set of standards should meet, by a specific deadline, a target percentage of electricity sourced from clean energy sources.

Solar energy has yet to realize its full capability as a renewable energy source in the United States, and much effort needs to be performed to accelerate solar technology implementation. That being said, Enphase Energy will certainly have many growth opportunities to take advantage as the renewable energy sector is currently witnessing many advances especially with the keen involvement of the state to help promote energy efficiency. However, many challenges are still to be tackled like the increasing cost competitiveness as new players are entering the global solar inverter market especially in the APAC region where the technological advances are becoming a trend within house installations.

Therefore, in order to pursue its growth and maintain its increasing revenues, Enphase Energy should keep considering the Renewable Portfolio Standards in order to target the states that are mostly impacted by the RPS as the demand for solar energy technologies will definitely rise when seeking to meet the targets set by the RPS. In fact, promoting and selling its products in regions with the largest RPS requirements, like Washington DC and Oregon by 2032 and 2040[2] (Figure 3), would represent an important growth opportunity for Enphase's operations. The RPS requirements, illustrated in Figure 27, have been set since 2018 and refer to the target RPS percentage of clean electricity (coming from clean resources) that the various US states will need to meet by the mentioned year. The most crucial renewable resources that would largely contribute to satisfy the requirements are: wind and solar energies, since they are both common between all states, as each state uses its own metrics to identify which specific renewable resource it considers as "clean".

[1] S&P Global Market Intelligence: https://www.spglobal.com/marketintelligence/en/news-insights/research/the-2020-us-renewable-energy-outlook
[2] National Conference of State Legislatures: https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx

Figure 27: US State Amendments to RPS Legislation since 2018

Source: National Conference of State Legislatures

State	New RPS Target	By Year			
Washington D.C.	100%	2032	Puerto Rico	100%	2050
Oregon	100%	2040	Virginia	100%	2045-2050
California	100%	2045	New York	70%	2030
New Mexico	100%	2045	Maryland	50%	2030
Washington	100%	2045	New Jersey	50%	2030
Guam	100%	2045	Connecticut	44%	2030
Colorado	100%	2050	Delaware	40%	2035
Maine	100%	2050	Massachusetts	35%	2030
Nevada	100%	2050	Minnesota	26,5%	2025

Moreover, according to a study conducted by DOE's National Renewable Energy Laboratory, the United States needs to double its present rate of solar potential per year between 2021 and 2025 and reach 60 gigawatts solar capacity between 2025 and 2030 in order to attain 40% solar power by the end of the forecasted period[1], especially with the support of government policies, significant cost cuts and a broader electrification in order to limit the grid integration issues aforementioned.

Demand Outlook

Renewable energy currently represents a significant part of the US economy, as it is not only an important player in renewable technology, but also a supporter of the country's key measures to decrease greenhouse gas emissions[2]. According to current Statista forecasts, renewable energy will account for above half of new US utility-scale capacity, with natural gas accounting for the majority of the rest[2]. In addition, renewable energies are likely to continue to supplant traditional energy sources as long as renewable energy technology costs decrease. In the coming years, microinverters and power storage are expected to witness an increased adoption driven by the products' safety, advanced remote monitoring options and enhanced energy yields. In fact, microinverters and power optimizers have been proven to be very successful in residential and commercial areas as the demand for roof-top systems is booming amidst homeowners and business owners. Besides that, Enphase Energy is increasingly investing in research and development activities, which is considered an additional reason for the growing demand in the solar inverter market, in order to meet the market's needs and potentially make use of the solar energy in the most efficient way.

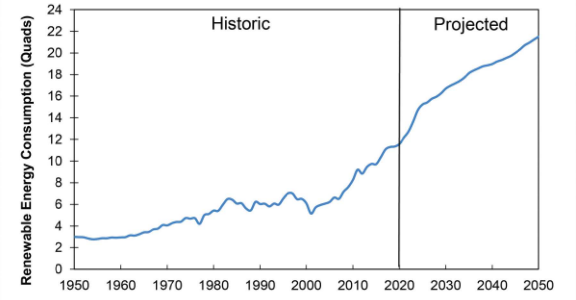
The global increasing demand for micro inverters installations in residential areas is expected to drive the market to grow at a CAGR of 20.8% for the forecasted period 2020-2025[3]. Although string and central inverters are mostly common amongst users, micro inverters are gaining more and more popularity as their continuous and stable power supply property appears appealing to home and business owners who can now stop worrying about shading issues for their panels.

[1] https://apnews.com/article/business-climate-environment-and-nature-united-states-climate-change-c5cc5de8c77a7f3d0888a6b25abf1866
[2] Statista: https://www.statista.com/statistics/1262233/countries-renewable-energy-production/
[3] https://www.globenewswire.com/news-release/2020/10/08/2105363/0/en/The-global-micro-inverter-market-size-was-valued-at-USD-2-5-billion-in-2020-and-is-projected-to-reach-USD-6-5-billion-by-2025-it-is-expected-to-grow-at-a-CAGR-of-20-8-from-2020-to-.html

As Enphase Energy not only sells its goods and services in America but also in the rest of the world, we believe that this growth rate of 20.8% should be explicitly represented in the companies' forecasted revenues, therefore we estimated the revenues generated by the sales in the rest of the world to be growing at that rate. Moreover, the United States is predicted to almost double its 2020 clean energy consumption by 2050, which translates to around 21.51quadrillion British thermal units of used renewable energy[1] (Figure 28). In fact, the country had set up a large amount of procedures and incentives, which will be tackle in a detailed manner in the regulatory framework section. in order to enhance clean energy adoption and promote energy-efficiency.

Figure 28: U.S Renewable Energy Consumption: Historic and Projected

Source: Center for Sustainable Systems, University of Michigan



Supply Outlook

Renewable energy demonstrates a high probability of satisfying demand with a significantly lower environmental impact and by committing to an assorted and dispersed clean energy infrastructure can assist to ease miscellaneous pressing challenges like energy security[2]. The pandemic has certainly also represented a big challenge for the micro inverter and house installations sectors as the cost of raw commodities substantially rose, in addition to the closing border restrictions that heavily impacted the supply chain and transportation of goods and raw materials. Nevertheless, Enphase Energy and SolarEdge remained the most two dominant suppliers in the micro inverters and power optimizers sectors, as they both accounted for 78% and 88% of microinverters and power optimizers shipments respectively in the United States in 2020[2].

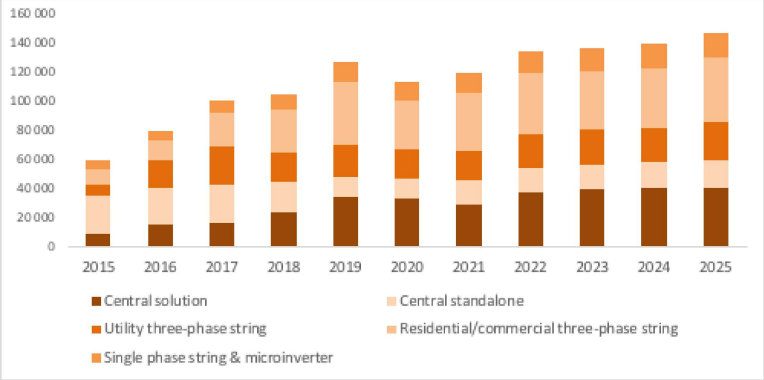
In the same year, the United States brought total installed solar capacity to account for 43% of new generating capacity, which established a new high record of 19.2 GW of solar photovoltaic capacity[3], mainly due to a major reduction in coal use for power generation purposes in the United States, as well as a steady growth in solar and wind energy usage. However, while the two leading companies mentioned

[1] Center for Sustainable Systems, Michigan: https://css.umich.edu/sites/default/files/Renewable%20Energy_CSS03-12_e2021.pdf
[2] S&P Global: https://ihsmarkit.com/research-analysis/global-market-for-microinverters-and-power-optimizers-forecast.html
[3] Center for Sustainable Systems, Michigan: https://css.umich.edu/sites/default/files/Renewable%20Energy_CSS03-12_e2021.pdf

above keep extending their portfolios, the competitiveness in the solar house installations sector is expanding as new entrants are entering the market since grid limitations are alleviated. In the same direction, the US Department of Energy's SunShot Initiative seeks to cut down the cost of solar energy by half, resulting in solar power meeting 33% of electricity demand by 2030 and along with an 18% reduction in electrical sector greenhouse gas emissions by 2050[2].

The shipments of central solutions and residential/commercial three-phase string inverters are expected to dominate the worldwide solar inverter market as they are expected to reach 33,000 and 34,000 MW alternating current, which means that they would represent the largest proportion of shipments by 2025[1]. Meanwhile, single phase strings and microinverter shipments are expected to reach only 34,000 MW alternating current in 2025 (Figure 29), which means that Enphase's products would still be outperformed by other types of inverters for their particularity.

Figure 29: Estimated solar PV inverter and optimizer shipments worldwide from 2015 to 2025 (in megawatts, alternating current), Source: Statista



Furthermore, the renewable energy industry in the United States is now heavily reliant on international supply networks, especially Chinese subsidies, since the US imports for years now solar panels generating private and commercial energy[2]. Moreover, within 15 years, the United States' solar energy will be able to supply up to 40% of the entire country's electricity, which represents a considerable increase compared to the current 3% solar capacity, nevertheless the latter would necessitate important measures implementation along with a significant capital requirement in order to update the electric grid through federal investment[3]. As the micro inverter sector is expected to keep growing parallelly to the growing demand for solar energy, we believe that Enphase should take these target numbers into consideration in order to improve its products and make them relatively affordable

[1] https://www.statista.com/statistics/790664/solar-pv-inverter-and-optimizer-global-shipments/
[2] https://www.americanprogress.org/article/creating-domestic-u-s-supply-chain-clean-energy-technology/
[3] https://apnews.com/article/business-climate-environment-and-nature-united-states-climate-change-c5cc5de8c77a7f3d0888a6b25abf1866

for the end users to incentivize them to consider paying the “premium” for a long-term sustainable solar technology.

Regulatory Framework

The main environmental and economic advantages of adding renewable energy to a state's portfolio are mainly using fossil fuels to generate electricity that creates no greenhouse gas emissions and lowers some forms of air pollution, in addition to increasing energy diversity and lowering reliance on foreign fuels[1]. However, renewable energy installations are subject to many constraints mainly cost competitiveness, especially that barriers to increasing renewable energy are frequently regulatory, and hence within governmental control.

In the United States, electric utility wholesale sales and transmission rates in interstate commerce, natural gas transportation and sale in interstate commerce, and the licensing and inspection of private, municipal, and state hydroelectric projects are all under the jurisdiction of the Federal Energy Regulatory Commission. Additionally, the lack of common interconnection standards, as well as standardized methods and technical criteria for accessing and installing clean energy systems to the electric utility's grid, can turn the connection of renewable energy systems into a hurdle.

The amount of renewable energy installations varies dramatically between states, indicating specific state or regional preferences rather than resource or technical capabilities. A variety of policies have been enacted by states to encourage increased investment in and use of renewable energy technology[2].

The U.S government has set a large number of incentives and programs for citizens and businesses in order to promote the use of renewables as their efficiency has proven to be significantly contributing to reduce greenhouse gas emissions, we have selected below the most promoted and popular incentives, among others:

- Public Benefits Funds for Renewable Energy
- Output–Based Environmental Regulations
- Interconnection Standards
- Feed–In Tariffs
- Property Assessed Clean Energy (PACE)
- Financial Incentives

Trends

- Commercial and Industrial sectors Growth:

The solar energy sector has known a major rise of its market share as different players of the renewable energy industry are starting to consider switching to

[1] U.S Environment Protection Agency: https://www.epa.gov/statelocalenergy/state-renewable-energy-resources
[2] U.S Environment Protection Agency: https://www.epa.gov/statelocalenergy/state-renewable-energy-resources

sustainable sources of energy in order to meet their electricity demand, which strongly contributes to the growth of the solar inverters market. Additionally, industries are becoming more aware of the importance of ESG integration into their decision-making, which pressures them to reduce their environmental impacts and improve their social considerations towards societies[1]. Several governments have created renewable energy strategy plans, such as the Renewable Portfolio Standard, in order to enable future generations to adequately make use of energy resources, as the demand for energy is continuously rising due to globalization and technological developments that require a high amount of energy usage especially in commercial and industrial segments.

- Global Solar Inverter Market dominated by APAC region:

As currently being the largest worldwide producer of solar energy, China is expected to keep dominating the market for solar inverters with its very high demand for energy in the Asia-Pacific region for the coming years, which makes the region the leader in the solar PV inverter market[2]. The Asia-Pacific region has indeed got ahead with solar power generation due to all the technological advancements in its emerging countries such as the power plant capacities' expansion and power plant production's reduction, among others[2].

- ESG Integration:

The importance of including several ESG standards in a company's decision-making process from all point of views. It is true that Enphase Energy operates in the renewable energy sector, but it should consider those factors in its entire supply chain. The solar technology company reports yearly its ESG inclusion by quantifying it and developing its contribution to reduce greenhouse gas emissions and climate change by being socially responsible and opting for sustainable investments. Most of investors nowadays rely on ESG ratings to make an investment decision, therefore Enphase should keep disclosing their ESG culture.

Valuation

Revenue Model

In order to forecast our revenue between 2022 and 2026 we have used two different formulas. The first formula corresponds to the revenue forecast for 2022. As the Q1 results for 2022 of Enphase Energy are disclosed as well as the company's expected results for Q2 2022, we have opted for using the average growth of revenues from Q1 2021 and Q1 2022 and the growth of revenues from

[1] https://www.researchandmarkets.com/reports/5331029/solar-pv-inverter-market-global-industry-trends
[2] https://www.marketsandmarkets.com/Market-Reports/inverter-market-263171818.html

Q2 2021 and Q2 2022 as a proxy for the overall revenue growth of the company in 2022. The equation is:

(EQ 1) $R_{2022} = R_{t-1} * (1 + (G_{Q1} + G_{Q2})/2)$

Such as R stands for revenue, G_{Q1} is the realized growth of revenues of Q1 2022 compared to Q1 2021, and G_{Q2} is the estimated growth of revenues of Q2 2022 compared to Q2 2021 revenues based on the average of Q2 2022 revenues range estimated by Enphase Energy in its latest quarterly report.

We have used the 2021 split of revenues between the US and the rest of the world of 80% and 20% respectively in to estimate the revenue for each region in 2022 to be the base for the revenue estimation for each region in the 2023-2026 period.

The second equation concerns the revenue forecast from 2023 to 2026, for each year of the period, the same equation is used:

(EQ 2) $R_{US} + R_{ROW} = R_{ENPH;}$ R: revenue

(EQ 3) R_{US} (t=0) = $R_{t-1}*(1+ RG_{US})$, RG: Revenue growth rate

(EQ 4) $RG_{US} = 0.8 * CAGR_{SED} + 0.2 * CAGR_{EV;}$

$CAGR_{SED}$: The compounded annual growth of the solar energy demand in the US 2022-2027.

$CAGR_{EV:}$ The compounded annual growth of the Electric Vehicles market 2022-2028.

Therefore, in EQ 3 which is part of EQ2 we estimate the US revenues for each year based on $CAGR_{SED}$ which is 17.32%[1]. Since the revenue of Enphase in the U.S is highly dependent on the demand for solar energy as well as the $CAGR_{EV}$ of 24.4%[2] as Enphase has just added EV charges to their product portfolio by the end of 2021 after acquiring ClipperCreek and is expected to start offering this product in the US first. In addition, we will assume EV revenues to make up 20% of the company's future revenues as can be shown in EQ 4.

Lastly, to estimate the R_{ROW} of the EQ 2 we set up the following equation:

R_{ROW} (t=0) = $R_{t-1} * (1 + CAGR_{MI})$; $CAGR_{MI}$: The compounded annual growth of the microinverter global market from 2020 to 2025.

Thus, we used the global Micro-inverter market CAGR of 20.8%[3] according to business wire to grow the company's future revenues since Microinverters sales are the main value driver for Enphase Energy on a global level.

1 According to: https://www.mordorintelligence.com/industry-reports/united-states-solar-energy-market#:~:text=Market%20Overview,from%2096.19%20GW%20in%202020.

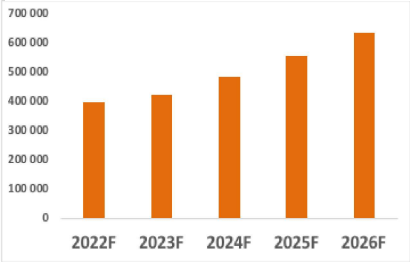
2 Globalnewswire article: https://www.globenewswire.com/news-release/2022/03/15/2403398/0/en/At-24-5-CAGR-Global-Electric-Vehicle-Market-Size-Share-to-Surpass-US-980-Bn-by-2028-EV-Industry-Trends-Growth-Forecast-Report-by-Facts-Factors.html#:~:text=As%20per%20the%20analysis%20shared,2028%2C%20based%20on%20primary%20research

3 We used the global Micro-inverter market CAGR according to business wire to grow the company's future revenues since Microinverters are the main value driver of Enphase Energy

Discounted Cash Flow (DCF)

In order to determine the fair value that Enphase captures to its shareholders through its investments, we decided to use a discounted cash flow model which consists of discounting the forecasted cash flows of the company at the WACC. We believe that our thorough analysis of the solar technology company's financial statements along with our detailed assumptions regarding the different industry trends and forecasts that can potentially impact its future cash flows enabled us to reach a reasonable proxy of its future Unlevered Free Cash Flows. In fact, an important reason for choosing DCF is our assumption that Enphase would stay close to their current D/E ratio which we have kept **constant at 60% Debt-to-Enterprise Value against 40% Equity-to-Enterprise Value**.

Figure 30: Enphase Energy's Forecasted Unlevered FCF, Source: Analyst estimates



Our estimations have led us to reach increasing Unlevered Free Cash Flows for the forecasted period 2022-2025, as the FCF will gradually rise from **236.274 million dollars** in 2022 to reach **636.079 million dollars** by 2026 (Figure 30), mainly due to the increase in revenues and investments in capital expenditures as the global micro inverter sector is significantly growing. Additionally, we assumed a **perpetual growth rate of 3%** which is equal to the global GDP growth rate as we believe that Enphase Energy will perpetually grow at the same level of the global GDP, thus using this proxy along with a **WACC of 5.85%** made us reach a **terminal value of 22.966 billion dollars,** and an operating levered **enterprise value of 20.098 billion dollars.**

Therefore, we added the non-operating levered EV to the operating one and subtracted **financial debt value of 1.001 billion** dollars from the operating EV in order to obtain a company **equity value of 20.532 billion dollars.** Considering that Enphase Energy's number of shares outstanding will constant at 130.030 million shares, we reached a **target share price of $152.06** for the year-end 2022.

Finally, we expect Enphase energy to not pay dividends as they never did in the past, therefore we compared the target price of $152.65 to the current price of **$165.54** which yields to a total return of **-13.55%.** Consequently, our valuation model issues a **SELL** recommendation for Enphase Energy stock.

WACC Calculation

- **Cost of Debt:**

Despite being public, Enphase Energy has no attributed credit rating that would contribute to the cost of debt calculation which let us to consider determining the Z''s score in order to reach a score that we would eventually translate to an equivalent S&P credit rating. Following this first approach, the score obtained was unrealistically high (in the thousands range) due to the high market capitalization

of Enphase Energy and would most probably translate to the highest S&P rating (AAA). However, the solar technology company doesn't hold any bonds in the market, only convertible notes, in order for us to determine all the necessary elements to compute the cost of debt using the following formula:

*rD = YTM – Probability of Default * Recovery Rate*

For the same reason of the unavailability of bonds in Enphase's financials, we couldn't compare its "potential" bond yield to the yield curves of the various credit ratings to have a proxy of its potential credit rating. Therefore, we assumed that it would be more accurate, given our assumptions and the reasons listed above, to estimate Enphase Energy's cost of debt through its past-year interest rate along with that of its peers. We identified the company's comparables based on their geographic positioning, market size and industry, which all had to be approximately similar to Enphase's. We then calculated the interest rates as of 2021 for each of the following identified peers, including Enphase Energy: **Generac Holdings Inc.**, **SolarEdge Holdings Inc.**, **Advanced Energy IR** and **SunPower**, and we allocated a specific weight to each one of them based on how close is their capital structure to that of Enphase. Finally, we used an average weighted approach, such that the peer with the most similar capital structure to Enphase would have the greatest weight, in order to derive the final cost of debt for Enphase which ended up equaling: **3.87%.**

- **Cost of Equity:**

In order to estimate the cost of equity, we started by computing the raw beta of Enphase energy by running a regression analysis of the company's share price against **Nasdaq Composite Index,** using the last 60 days available share prices, meaning that the oldest price used was on 31-05-2017. The output of the regression resulted in a r**aw beta of 1.87** with a confidence interval of **[0,69, 3,03].**

Since we obtained a large confidence interval for Enphase's beta, we decided to perform the same regression on Enphase's peers, the same ones used for the cost of debt estimation, but also accounting for an additional German peer "SMA Solar Technology AG" that we regressed against **SDAX.** After reaching the raw betas for each of the peers, we unlevered them in order to exclude the capital structure effect of each company and get an unlevered beta that can be used for Enphase Energy.

Additionally, we attributed different weights to the comparable companies based on how close their market capitalization is to Enphase Energy, such that **SMA Solar Technology AG** was given the lowest weight of **5%** since it operates in a different geography and has the lowest market capitalization compared to other peers and Enphase Energy was given the highest weight of **40%**, as it is clearly the most comparable company to itself. We then applied an average weighted

formula using the unlevered betas of all comparables, including Enphase, which ended up resulting in an **unlevered beta of 0.66** that we relevered using Enphase Energy's 60:40 debt-to-equity ratio to obtain a **levered beta of 1.44.** Afterwards, we adjusted the raw equity beta by using the following formula:

*Adjusted Beta Equity = 2/3*Beta Equity + 1/3*1*

Lastly, in order to estimate the **cost of equity of 10.04%** for Enphase Energy we applied the CAPM formula below using the resulting **adjusted equity beta of 1.29:**

*Re = Risk-free + Adjusted Equity Beta * Market risk premium*

- **Weighted Average Cost of Capital (WACC):**

In order to be able to construct a DCF valuation model that will enable for the determination of the company's current performance and market positioning, we started by identifying the risk-free and market risk premium rates that constitute a basis to help determine the weighted average cost of capital. We used as a proxy for the risk-free rate the **10Y US Treasury Bond Yield of 2.92%,** and a market risk premium of **5.5%.**

As previously mentioned, we used the target 60:40 debt-to-equity ratio as an assumption for the WACC calculation. Therefore, we applied the formula below to obtain a **WACC value of 5.85%,** such that we considered the corporate tax rate to be equal to 21% and we inputted the previously estimated cost of equity of 10.04% and cost of debt of 3.87%:

*WACC = (E/V * Re) + [D/V * Rd * (1 – Tax Rate)]*

Multiples Valuation

Although DCF is considered the most accurate and insightful valuation approach, we decided to additionally conduct a multiples analysis for the purpose of summarizing and testing our valuation. In order to measure how Enphase Energy is valued relative to its peers, we selected the same peers as the ones used in our cost of debt estimation based on their capital structure, industry and size, then carefully analyzed their EV/EBITDA and P/E multiples that we retrieved from Bloomberg. Although it is widely used as part of multiples analysis, the P/E multiple is commonly known to be distorted by the non-operating gains and losses and the capital structure of the company since for instance a company with high level of debt in comparison to its comparables would have a lower P/E, we decided to conduct our valuation based on the EV/EBITDA multiple.

After a thorough analysis, we decided to exclude **SunPower Corp** from our analysis as the company has negative EBIT and EBITDA, which would disturb our

calculations, and we retained: **Generac Holdings Inc.**, **SolarEdge Holdings Inc.** and **Advanced Energy IR,** including **Enphase Energy**.

Figure 31: Peers Forward-Looking EV/EBITDA, Source: Bloomberg

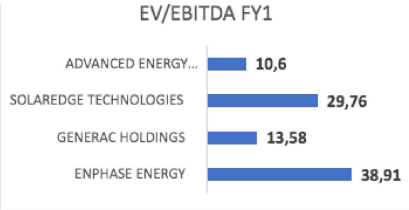
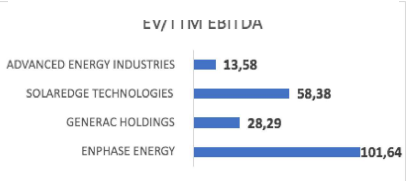


Figure 32: Peers Trailing Twelve Months EV/EBITDA, Source: Bloomberg



We figured that it would be practical to consider both the Trailing Twelve Months and Forward-Looking EV/EBITDA multiples in order to derive Enphase's Enterprise Value and reach valuable conclusions. We first computed the average of the **EV/EBITDA FY1 (23.21x),** using the multiple for each peer as shown in Figure 31, in order to multiply it by the YE2022 EBITDA for Enphase resulting in an Enterprise Value of **11.952 billion dollars,** which ended up being almost twice lower than our DCF estimation of **21.533 billion dollars.** The share price resulting from using the forward-looking EV/EBITDA is **$81.11**, which is much lower than our **DCF target price of $152.06,** therefore we believe that the market has lower expectations or the company's future performance when using the EV/EBITDA FY1, using the multiple for each peer as shown in Figure 32. On the other hand, when we followed the same approach using the peer's average **Trailing Twelve Months EV/EBITDA (50.47x)** to obtain Enphase's Enterprise Value, we ended up with an **Enterprise value of 21.831 billion dollars**, which is close enough to our estimated Enterprise Value through the DCF valuation. Therefore, the resulting **share price is $154.26** which is not much different from our DCF target price: **$152.06.**

Finally, we believe that it is more appropriate to consider the TTM EV/EBITDA as it gives a better estimation and valuation for Enphase Energy, especially that it is in line with our DCF estimation. However, although the two approaches resulted in different share prices, we believe that they are both consistent with our final **SELL** recommendation as in both cases the share price is lower than the current share price of **$165.54,** which will result in a negative total return.

Appendix

Financial Statements

- Balance Sheet

(in thousands $)	2017	2018	2019	2020	2021	F2022	F2023	F2024	F2025	F2026
Operating cash	12,157	44,314	104,870	283,388	49,770	76,154	90,745	108,137	128,868	153,581
Accounts receivable, net	65,346	78,938	145,413	182,165	333,626	510,487	608,297	724,881	863,851	1,029,511
Inventory	25,999	16,267	32,056	41,764	74,400	113,841	135,653	161,652	192,642	229,585
Prepaid expenses and other	9,957	20,860	26,079	29,756	37,784	57,814	68,891	82,095	97,833	116,595
Operating current assets	**113,459**	**160,379**	**308,418**	**537,073**	**495,580**	**758,296**	**903,586**	**1,076,765**	**1,283,195**	**1,529,273**
Accounts payable	(28,747)	(48,794)	(57,474)	(72,609)	(113,767)	(174,077)	(207,430)	(247,186)	(294,574)	(351,065)
Accrued liabilities	(29,874)	(29,010)	(47,092)	(76,542)	(157,912)	(241,624)	(287,919)	(343,101)	(408,878)	(487,289)
Deferred revenues	(15,691)	(33,119)	(81,783)	(47,665)	(62,670)	(95,892)	(114,266)	(136,165)	(162,270)	(193,389)
Warranty obligations, current	0	(8,083)	(10,078)	(11,260)	(19,395)	(29,677)	(35,363)	(42,140)	(50,219)	(59,850)
Operating current liabilities	**(74,312)**	**(119,006)**	**(196,427)**	**(208,076)**	**(353,744)**	**(541,270)**	**(644,978)**	**(768,593)**	**(915,942)**	**(1,091,592)**
Operating Working	**39,147**	**41,373**	**111,991**	**328,997**	**141,836**	**217,026**	**258,608**	**308,172**	**367,253**	**437,681**
Net PP&E	26,483	20,998	28,936	42,985	82,167	109,051	144,731	192,086	254,934	338,345
Operating lease, right of use	0	0	10,117	17,683	14,420	17,216	20,553	24,538	29,295	34,974
Goodwill	3,664	24,783	24,783	24,783	181,254	181,254	181,254	181,254	181,254	181,254
Intangibles, net	515	35,306	30,579	28,808	97,758	97,758	97,758	97,758	97,758	97,758
Other assets	8,039	36,548	44,620	59,875	118,726	232,746	456,266	894,445	1,753,435	3,437,365
Deferred revenues, non-	(29,941)	(76,911)	(100,204)	(125,473)	(187,186)	(286,417)	(341,294)	(406,706)	(484,677)	(577,623)
Warranty obligations, non-	(22,389)	(23,211)	(27,020)	(34,653)	(53,982)	(82,599)	(98,425)	(117,289)	(139,774)	(166,579)
Other liabilities	(1,880)	(3,250)	(11,817)	(17,042)	(16,530)	(19,735)	(23,561)	(28,128)	(33,581)	(40,092)
Deferred tax assets	0	0	74,531	92,904	122,470	122,470	122,470	122,470	122,470	122,470
marketable securities	0	0	0	0	897,335	897,335	897,335	897,335	897,335	897,335
Excess Cash	16,987	61,923	146,539	395,991	69,546	182,568	217,548	259,242	308,942	368,188
Restricted cash	0	0	44,700	0	0	0	0	0	0	0
Total Funds Invested	**40,625**	**117,559**	**377,755**	**814,858**	**1,467,814**	**1,668,673**	**1,933,243**	**2,425,177**	**3,354,643**	**5,131,076**
Debt, current	17,429	28,155	2,884	325,967	86,052	83,030	96,194	120,672	166,920	255,312
Debt, noncurrent	32,322	81,628	102,659	4,898	951,594	918,174	1,063,752	1,334,434	1,845,866	2,823,334
Total debt	49,751	109,783	105,543	330,865	1,037,646	1,001,204	1,159,946	1,455,106	2,012,786	3,078,646
Total shareholder's equity	(9,126)	7,776	272,212	483,993	430,168	667,469	773,297	970,071	1,341,857	2,052,431
Total funds invested	**40,625**	**117,559**	**377,755**	**814,858**	**1,467,814**	**1,668,673**	**1,933,243**	**2,425,177**	**3,354,643**	**5,131,076**

- Income Statement

(in thousands $)	2017	2018	2019	2020	2021	2022F	2023F	2024F	2025F	2026F
Operating revenues	286,166	316,153	624,333	774,425	1,382,049	2,114,698	2,519,877	3,002,829	3,578,510	4,264,760
Revenues Growth		10%	97%	24%	78%	53%	19%	19%	19%	19%
Revenues from the United States	197,455	218,150	524,440	635,029	1,108,801	1,696,596	2,014,810	2,392,708	2,841,484	3,374,433
Revenues from the RoW	88,711	98,003	99,893	139,397	273,248	418,102	505,067	610,121	737,026	890,327
Cost of revenues	(230,123)	(221,714)	(403,088)	(428,444)	(827,627)	(1,266,367)	(1,509,004)	(1,798,216)	(2,142,957)	(2,553,911)
change of cost of revenues		-4%	82%	6%	93%	53%	19%	19%	19%	19%
Gross Profit	56,043	94,445	221,245	345,981	554,422	848,331	1,010,872	1,204,613	1,435,553	1,710,849
Gross Margin	20%	30%	35%	45%	40%	40%	40%	40%	40%	40%
Operating Expenses										
R&D	33,157	32,587	40,381	55,921	105,526	111,832	133,259	158,799	189,243	225,534
Depreciation and Amortization	(9,004)	(9,667)	(14,119)	(18,103)	(32,439)	(52,656)	(62,261)	(72,685)	(88,915)	(108,643)
Depreciation% of PPE					0	0	0	0	0	0
Depreciation	(8,604)	(7,987)	(9,392)	(13,011)	(22,939)	(30,444)	(40,405)	(53,626)	(71,171)	(94,458)
R&D (excluding D&A)	(24,153)	(22,920)	(26,262)	(37,818)	(73,087)	(59,175)	(70,997)	(86,114)	(100,327)	(116,891)
Sales and marketing	(23,126)	(27,047)	(36,728)	(52,927)	(128,974)	(197,345)	(235,157)	(280,227)	(333,950)	(397,991)
General and Administrative	(22,221)	(29,086)	(38,808)	(50,694)	(104,090)	(159,270)	(189,786)	(226,160)	(269,518)	(321,203)
Total operating expenses	(69,500)	(79,053)	(101,798)	(141,439)	(306,151)	(415,791)	(495,941)	(592,501)	(703,795)	(836,085)
EBITDA	(13,457)	15,392	119,447	204,542	248,271	432,540	514,932	612,112	731,758	874,763
Depreciation	(8,604)	(7,987)	(9,392)	(13,011)	(22,939)	(30,444)	(40,405)	(53,626)	(71,171)	(94,458)
Amortization	(400)	(1,680)	(4,727)	(5,092)	(9,500)	(22,212)	(21,856)	(19,059)	(17,744)	(14,185)
Operating Profit/EBIT	(22,461)	5,725	105,328	186,439	215,832	379,884	452,670	539,428	642,843	766,121
Restructuring and other charges	(16,917)	(4,129)	(2,599)	0	0	0	0	0	0	0
Other Income (expense)	1,973	(2,190)	(5,437)	(799)	6,050	6,050	6,050	6,050	6,050	6,050
Loss on partial settlement of convertible notes	0	0	0	(3,037)	(56,497)	(56,497)	(56,497)	(56,497)	(56,497)	(56,497)
Change in fair value of derivatives	0	0	0	(44,348)	0	0	0	0	0	0
Interest Income	0	1,058	2,513	2,156	695	695	695	695	695	695
Interest expense	(7,936)	(10,693)	(9,691)	(21,001)	(45,152)	(43,566)	(50,474)	(63,317)	(87,584)	(133,964)
Non-operating income (expense)	(22,880)	(15,954)	(15,214)	(67,029)	(94,904)	(93,318)	(100,226)	(113,069)	(137,336)	(183,716)
Income before tax	(45,341)	(10,229)	90,114	119,410	120,928	286,566	352,444	426,358	505,507	582,405
Corporate Income Tax	0	0	(18,924)	(25,076)	(25,395)	(60,179)	(74,013)	(89,535)	(106,156)	(122,305)
Tax adjustments	149	(1,398)	89,958	39,661	49,916	49,916	49,916	49,916	49,916	49,916
Income tax benefit (Provision)	149	(1,398)	71,034	14,585	24,521	(10,263)	(24,097)	(39,619)	(56,241)	(72,389)
Net Income	(45,192)	(11,627)	161,148	133,995	145,449	276,303	328,347	386,739	449,266	510,016

- Cash Flows

(thousand $, 31st Dec.)	2020	2021	2022F	2023F	2024F	2025F	2026F
EBIT	186,439	215,832	379,884	452,670	539,428	642,843	766,121
Notional taxes on EBIT	(39,152)	(45,325)	(79,776)	(95,061)	(113,280)	(134,997)	(160,885)
Adjustments	39,661	49,916	49,916	49,916	49,916	49,916	49,916
NOPLAT	186,948	220,423	350,024	407,525	476,064	557,762	655,151
Depreciation	13,011	22,939	30,444	40,405	53,626	71,171	94,458
Gross operating Cash Flow	**199,959**	**243,362**	**380,469**	**447,931**	**529,689**	**628,933**	**749,609**
Change in operating current assets	228,655	(41,493)	262,716	145,290	173,179	206,430	246,078
Change in operating current liabilities	(11,649)	(145,668)	(187,526)	(103,708)	(123,614)	(147,349)	(175,650)
(-) Change in Net Working Capital	(217,006)	187,161	(75,190)	(41,582)	(49,564)	(59,081)	(70,428)
Change in property, plant and equipment	14,049	39,182	26,884	35,680	47,354	62,848	83,411
Change in operating lease, right of use asset	7,566	(3,263)	2,796	3,338	3,985	4,757	5,679
Depreciation	13,011	22,939	30,444	40,405	53,626	71,171	94,458
(-) Net CAPEX	(34,626)	(58,858)	(60,124)	(79,423)	(104,965)	(138,777)	(183,548)
Change in Goodwill	0	(156,471)	0	0	0	0	0
Change in deferred revenues, non-current	25,269	61,713	99,231	54,878	65,411	77,971	92,946
Change in warranty obligations, non-current	7,633	19,329	28,617	15,826	18,864	22,486	26,805
Change in other liabilities	5,225	(512)	3,205	3,826	4,568	5,453	6,510
Change in intangibles	1,771	(68,950)	0	0	0	0	0
Amortization	5,092	9,500	22,212	21,856	19,059	17,744	14,185
Change in non current operating free cash flows	44,990	(135,391)	153,264	96,386	107,902	123,654	140,446
Unlevered Operating Free Cash Flows	**6,683**	**236,274**	**398,419**	**423,311**	**483,062**	**554,730**	**636,079**

Disclosures and Disclaimers

Report Recommendations

Buy	Expected total return (including expected capital gains and expected dividend yield) of more than 10% over a 12-month period.
Hold	Expected total return (including expected capital gains and expected dividend yield) between 0% and 10% over a 12-month period.
Sell	Expected negative total return (including expected capital gains and expected dividend yield) over a 12-month period.

This report was prepared by Aya Benlakhder and Sanae Chaabi, Master in Finance students of Nova School of Business and Economics ("Nova SBE"), within the context of the Field Lab – Equity Research.

This report is issued and published exclusively for academic purposes, namely for academic evaluation and master graduation purposes, within the context of said Field Lab – Equity Research. It is not to be construed as an offer or a solicitation of an offer to buy or sell any security or financial instrument.

This report was supervised by a Nova SBE faculty member, acting merely in an academic capacity, who revised the valuation methodology and the financial model.

Given the exclusive academic purpose of the reports produced by Nova SBE students, it is Nova SBE understanding that Nova SBE, the author, the present report and its publishing, are excluded from the persons and activities requiring previous registration from local regulatory authorities. As such, Nova SBE, its faculty and the author of this report have not sought or obtained registration with or certification as financial analyst by any local regulator, in any jurisdiction. In Portugal, neither the author of this report nor his/her academic supervisor is registered with or qualified under COMISSÃO DO MERCADO DE VALORES MOBILIÁRIOS ("CMVM", the Portuguese Securities Market Authority) as a financial analyst. No approval for publication or distribution of this report was required and/or obtained from any local authority, given the exclusive academic nature of the report.

The additional disclaimers also apply:

USA: Pursuant to Section 202 (a) (11) of the Investment Advisers Act of 1940, neither Nova SBE nor the author of this report are to be qualified as an investment adviser and, thus, registration with the Securities and Exchange Commission ("SEC", United States of America's securities market authority) is not necessary. Neither the author nor Nova SBE receive any compensation of any kind for the preparation of the reports.

Germany: Pursuant to §34c of the WpHG (*Wertpapierhandelsgesetz*, i.e., the German Securities Trading Act), this entity is not required to register with or otherwise notify the *Bundesanstalt für Finanzdienstleistungsaufsicht* ("BaFin", the German Federal Financial Supervisory Authority). It should be noted that Nova SBE is a fully-owned state university and there is no relation between the student's equity reports and any fund raising programme.

UK: Pursuant to section 22 of the Financial Services and Markets Act 2000 (the "FSMA"), for an activity to be a regulated activity, it must be carried on "by way of business". All regulated activities are subject to prior authorization by the Financial Conduct Authority ("FCA"). However, this report serves an exclusively academic purpose and, as such, was not prepared by way of business. The author - a Master's student - is the **sole and exclusive responsible** for the information, estimates and forecasts contained herein, and for the opinions expressed, which exclusively reflect his/her own judgment at the date of the report. Nova SBE and its faculty have no single and formal position in relation to the most appropriate valuation method, estimates or projections used in the report and may not be held liable by the author's choice of the latter.

The information contained in this report was compiled by students from public sources believed to be reliable, but Nova SBE, its faculty, or the students make no representation that it is accurate or complete, and accept no liability whatsoever for any direct or indirect loss resulting from the use of this report or of its content.

Students are free to choose the target companies of the reports. Therefore, Nova SBE may start covering and/or suspend the coverage of any listed company, at any time, without prior notice. The students or Nova SBE are not responsible for updating this report, and the opinions and recommendations expressed herein may change without further notice.

The target company or security of this report may be simultaneously covered by more than one student. Because each student is free to choose the valuation method, and make his/her own assumptions and estimates, the resulting projections, price target and recommendations may differ widely, even when referring to the same security. Moreover, changing market conditions and/or changing subjective opinions may lead to significantly different valuation results. Other students' opinions, estimates and recommendations, as well as the advisor and other faculty members' opinions may be inconsistent with the views expressed in this report. Any recipient of this report should understand that statements regarding future prospects and performance are, by nature, subjective, and may be fallible.

This report does not necessarily mention and/or analyze all possible risks arising from the investment in the target company and/or security, namely the possible exchange rate risk resulting from the security being denominated in a currency either than the investor's currency, among many other risks.

The purpose of publishing this report is merely academic and it is not intended for distribution among private investors. The information and opinions expressed in this report are not intended to be available to any person other than Portuguese natural or legal persons or persons domiciled in Portugal. While preparing this report, students did not have in consideration the specific investment objectives, financial situation or

particular needs of any specific person. Investors should seek financial advice regarding the appropriateness of investing in any security, namely in the security covered by this report.

The author hereby certifies that the views expressed in this report accurately reflect his/her personal opinion about the target company and its securities. He/ She has not received or been promised any direct or indirect compensation for expressing the opinions or recommendation included in this report.

[If applicable, it shall be added: *"While preparing the report, the author may have performed an internship (remunerated or not) in* [insert the Company's name]. *This Company may have or have had an interest in the covered company or security"* and/ or *"A draft of the reports have been shown to the covered company's officials (Investors Relations Officer or other), mainly for the purpose of correcting inaccuracies, and later modified, prior to its publication."]*

The content of each report has been shown or made public to restricted parties prior to its publication in Nova SBE's website or in Bloomberg Professional, for academic purposes such as its distribution among faculty members for students' academic evaluation.

Nova SBE is a state-owned university, mainly financed by state subsidies, students tuition fees and companies, through donations, or indirectly by hiring educational programs, among other possibilities. Thus, Nova SBE may have received compensation from the target company during the last 12 months, related to its fundraising programs, or indirectly through the sale of educational, consulting or research services. Nevertheless, no compensation eventually received by Nova SBE is in any way related to or dependent on the opinions expressed in this report. The Nova School of Business and Economics does not deal for or otherwise offer any investment or intermediation services to market counterparties, private or intermediate customers.

This report may not be reproduced, distributed or published, in whole or in part, without the explicit previous consent of its author, unless when used by Nova SBE for academic purposes only. At any time, Nova SBE may decide to suspend this report reproduction or distribution without further notice. Neither this document nor any copy of it may be taken, transmitted or distributed, directly or indirectly, in any country either than Portugal or to any resident outside this country. The dissemination of this document other than in Portugal or to Portuguese citizens is therefore prohibited and unlawful.