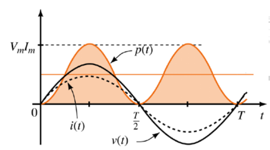
# A better bridge forward

*SPARQ Systems and its innovative mousetrap.*




SPARQ Systems is in the business of power engineering, the OG of hi-tech. When the field emerged, back in the 19th century, we saw the emergence of the likes of GE and Siemens, the Apple and Cisco of their day and the explosive growth that followed. Power generation was rolled out and the grid got built out. People turned on their lights and plugged in their blenders and thought nothing of it. The field of power engineering eventually matured.

The rise of renewable energy has made power interesting anew. The grid that we have become accustomed to runs on alternating current (AC), as do most of the devices that draw power from the grid. By contrast, renewable sources of power – solar in particular – naturally generate electricity in the form of direct current, or DC. To connect DC to the grid we need to convert DC to AC. The device that does this is called an inverter.

Inverters aren't new; the term was indeed coined almost 100 years ago. But until recently, these devices tended to big, bulky, and expensive — not the kind of thing you'd put on your roof. It is into this space — rooftop solar in particular, but more generally bridging renewable power to the grid — where SPARQ aims to make an impact.

—+—

String inverters have been the standard technology for DC/AC conversion for rooftop solar installations. Here, the solar panels (or PVs) are connected in series (like a string of Christmas lights) and then looped back into a large box – the actual inverter – in the garage or the side of the building, preferably out of sight. The advantages of this approach include a lower upfront cost, ease of troubleshooting, and a long history of proven operation. On the downside, string inverters will limit the productive capacity of the solar panel array to the to the least productive panel in that array. Thus, if one of the panels finds itself in the

**Figure 1:** *This is a Siemens Electric lab back in 1905, when power engineering was hip. In the last quarter of the 19th century large scale electric distribution quadrupled. This power wasn't just used for lighting—and insofar as it was, it had a dramatic effect on social behaviour—but additionally to run machinery. The impact was profound. From an investing perspective, this was a place to be.*

shade running at 70% capacity, all the panels will run at 70% capacity. String inverters also suffer from a lack of panel-level monitoring, elevated safety issues and a single point of failure: like Christmas lights, if one panel fails, all of the panels fail. They are also big and bulky. See figure 2.

Fifteen years ago, Enphase (ENPH-Q) developed the microinverter, a DC/AC device that is affixed to the panel itself. This allowed the capture of optimum power for each PV in the array, no matter how they were tilted or shaded or covered in leaves. Apart from greater efficiency, microinverters were safer (no high voltage DC on the roof), more fault tolerant (a failure in one panel does not bring the whole array down) and allowed for panel level monitoring and greater extensibility. At around the same time SolarEdge (SEDG-Q) developed a hybrid approach that kept the string inverters but deployed "power optimizers" to regulate the PV output. These two companies have now taken, from a standing start, upwards of 80% of the US residential solar market share. Performance in the respective share markets speak to as much.

SPARQ feels it has developed a better mousetrap, a microinverter that is cheaper, more reliable and more capable of addressing a broader marketplace. Two aspects of the design form the basis of these advantages: i) a novel signal processing technique

Douglas Pollitt

Toronto, Ontario
May 9, 2022

**Figure 2:** *Here we see a bank of string inverters on a garage wall. As is clear, string inverters are big and heavy and not something you would put on your roof.*

*Unlike semiconductors, shrinking power devices is* **hard**. *Consider your cell phone. Even has your phone itself has shrunk and its capabilities expanded tremendously, your phone charger has stayed about the same size and done about the same thing.*

*SPARQ's value derives from the innovative way it has found to shrink inverter devices. The immediate application is rooftop solar, but the technology has legs beyond that.*

that obviates the need for large, semi-perishable parts; and ii) a programmable digital controller that lends the device "open-architecture" capabilities. These are discussed in turn.

In regards to (i), the central design challenge with DC/AC conversion relates to the fact that the sine wave generated propagates back and interferes with the pure DC input signal. This is called the 'ripple" effect and it degrades the system's ability to optimize power from the panels. You need to isolate as best you can one side from the other and the way you do this is through the use of capacitors, which might be thoughts of as dampers or "shock absorbers." These are devices, almost mechanical in nature, that, depending on the voltage at which they are operated, tend to be big and bulky and, not that reliable. The higher the voltage, the less the required capacitance, the smaller your capacitors.

But operating at high voltage causes other issues; namely, the process throws off a raft of spurious harmonics. Getting rid of this noise is a hard problem, a hard problem that SPARQ, through the use of some fancy mathematics, claims to have solved. Apparently, this was a pretty big breakthrough.

The net result can be seen in the layouts of the two respective boards (see figure 3.) On the left is the Enphase board, on the right are four SPARQ board. The four cylindrical objects sticking out of the top of the Enphase board are the capacitors; in particular, these are electrolytic capacitors. According to one supplier: "The aluminum electrolytic capacitor has a limited life span." A power supply manufacturer notes: "[E]lectrolytic capacitors are the only component in the power supply that wears out." By contrast, SPARQ uses film capacitors which have a much longer service life. Reliability is very important for this application, not so much because the part is prohibitively expensive, but rather because replacing a part involves a technician making a service call and climbing up on to your roof. Enphase provides a 25-year warranty, but you'd rather have a microinverter that lasts as long as your roof does, a microinverter that you never have to think about again. SPARQ boards are thought to have a much longer lifespan.

Then there is the package size issue. The boards shown in figure 3 are roughly to scale. You need one Enphase board for each solar panel; a SPRQ board, by contrast will handle four panels. This means less cabling, quicker installs and lower overall costs. On a per-kilowatt basis, SPARQ boards, all in, are about 35% cheaper.

The smaller capacitor requirement helps to reduce the form factor and cost, but so does the digital controller. Enphase uses AISC chips, which are designed for a specific application and which are inflexible in their functionality; one AISC is needed per panel. SPARQ uses FPGA chips which, unlike AISCs, are programmable—their functionality can be tweaked or altered "on the fly." (One FPGA manages four panels.) The ramifications of this distinction might be significant.

A rooftop solar installation consists of the panels, the inverters, the cabling, a battery along with some monitoring software. Enphase provides these components, all of which are designed to work with each other, as a package deal -- it's like Apple: the MacBook works with the iPhone which works with the iBuds and, importantly, do not work with components from third-party suppliers. Which is to say, Enphase takes a walled garden approach.

By contrast, SPARQ works more like an Android. On the back of the greater inherent flexibility of



... /3

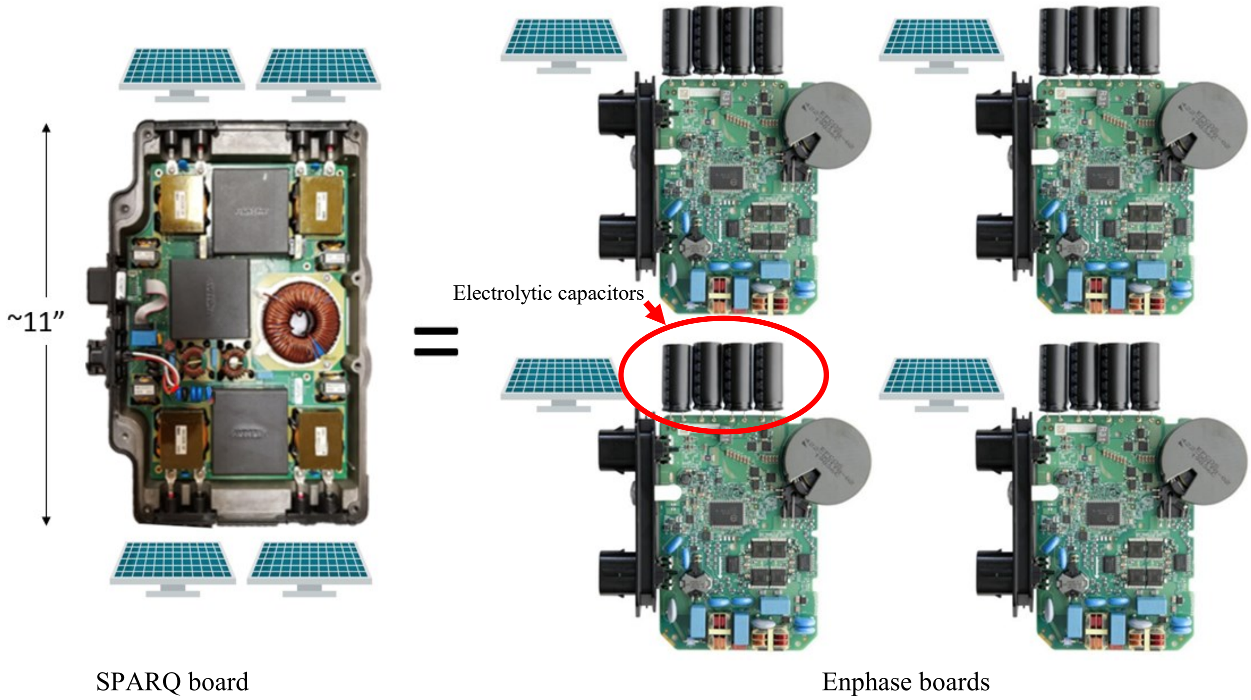



**Figure 3:** *On the left is a SPARQ microinverter board and on the right we see four Enphase boards. These are approximately to scale. The SPARQ board can manage four PVs (shown) while the Enphase board can manage but one. In this sense, one SPARQ board is functionally equivalent to four Enphase boards. One can clearly see the reduced form factor of the SPARQ kits; this would also translate into a cost saving as well. Taking up a lot of space on the Enphase boards are the electrolytic capacitors, the set of four black cylinders sticking out of the top. As long as the DC/AC conversion is taking place at low voltage, these capacitors will remain bulky (and prone to failure.)*

FPGAs, SPARQ has the capacity to accommodate components that were not anticipated at design-time. This more open architecture speaks to a broader addressable market. Enphase’s backyard is mostly confined to developed countries – the household in Santa Monica wants a solar install and Enphase provides a system “that just works.”

But then there is a place like India. The first big dough you make in India goes towards the purchase of a fridge and, because the grid rarely works all the time, a battery. Needless to say, there is now a large installed base of batteries in India, very few of which will work with Enphase gear and most of which will, with some tweaking, be available for a SPARQ install. Android did very well in developing countries, this as suppliers could slap the operating system on any inexpensive handset. There is the potential for this same pattern to repeat with small-scale solar and SPARQ, with its more flexible solution, is well-positioned to take advantage of it.

The more programmable nature of SPARQ’s boards will also facilitate product migration within the existing application domain along with product development in different application domains. As to the former, SPARQ has introduced a new model every year since 2018, each with expanded functionality. A microinverter to drive pump motors for an agricultural application in India has also been developed. This is notable progress for a relatively small team.

The immediate focus at the Company has been on rooftop solar. But the underlying technology would not be limited to this application. For example, the global fleet of electric vehicle (EVs) is expected grow dramatically. Each EV, in addition to being a vehicle, also a unit of energy storage (i.e. a battery.) The “Vehicle to Grid” (“V2G”) movement sees car owners charging their batteries from the grid at night when power is cheap and then selling it back to the grid during the evening when it is dear. To do this vehicles need DC/AC capacity and, because it is automotive, that capacity must be lightweight and very reliable. We are not aware that SPARQ is pursuing this market; we only point it out to underscore the broad applicability of the underlying technology.

—+—

From what we’ve seen we feel SPRQ has a better mousetrap, but that may or may not buy you a cup



… /4

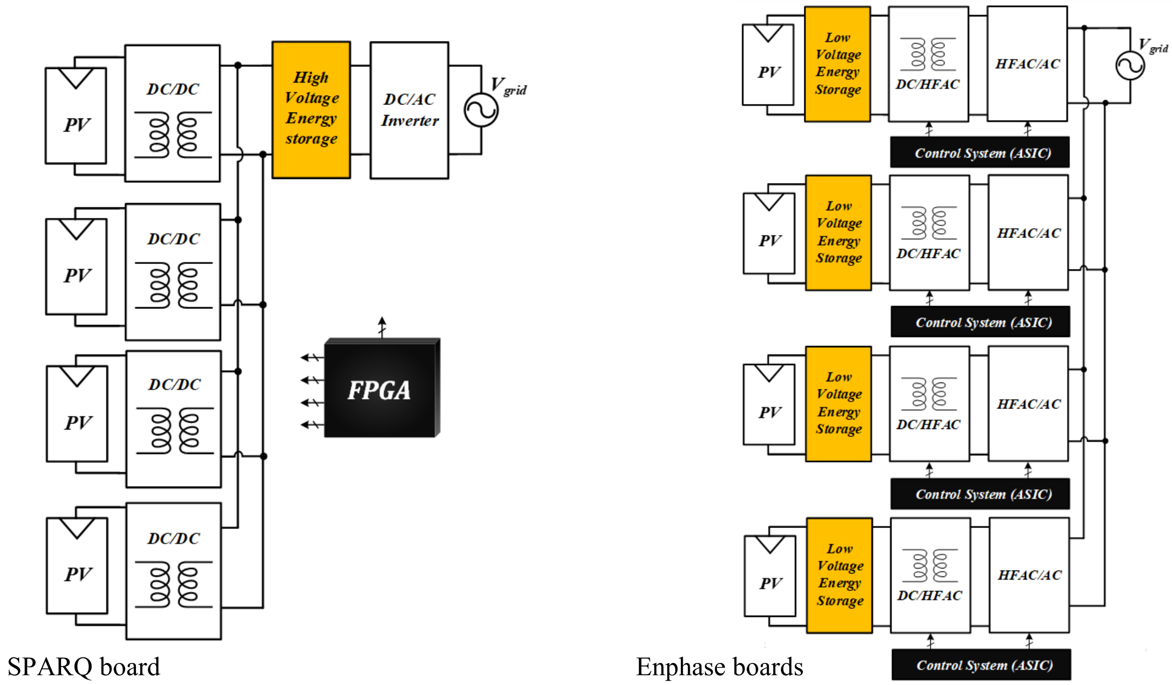



**Figure 4:** *One might ask why doesn't Enphase produce a 4-panel inverter? It could, but the result would be 4x as big and about 4x as expensive. The schematics for the two boards are given above. SPARQ uses one digital controller (the FPGA) and one capacitor block ("High Voltage Energy Storage) for four inputs. By contrast, the Enphase architecture would have to replicate its existing functionality four-times over. The schematics make the elegance of SPARQ's design that much more clear.*

of coffee. SPARQ is not a science project but neither is it a mature enterprise. The Company's first installation was in 2018 and since then ten thousand units have been installed in Mexico, India and Canada. The challenge before the company now is to ramp production and sales.

The former seems the greater challenge. Covid-related supply chain issues have throttled production of most everything containing a semiconductor and if car companies are having problems getting chips to the point where they have to shut down lines, then small start-up companies will have a somewhat bigger problem. A recently announced a manufacturing contract with Ti-Lane Precision Electronic Company out of China contemplates production capacity of 5000-10,000 units per month starting towards the end of this year. (Ti-Lane is also a SPARQ shareholder.) The Company reports: "As the Company's current manufacturing partner in Canada will not be able to produce inverters for the Company in sufficient quantities for this fiscal year, the Company does not foresee the generation of any material revenue until 2023."

We think sales will be less of a problem. SPARQ has introduced its product into the Indian market through Tata Solar (a division of Tata Power, India's largest integrated power utility) and is working to sign on more soon. This market is big, early, has a dodgy grid and is mostly sunny. Utility-scale projects will likely be the big push but there is lots of room for micro-installation at the edges. And there are lots more countries like India.

—+—

The Company was founded in 2008 and has seen a total of \$18mm (for 44mm shares) of hard investment over the course of the last 14 years. This works out to a cost base of 41¢/shr. Additionally, another 18mm shares were issued to management / employee in exchange for \$28mm of services rendered (with an implied share price of \$1.59). The Company went public late last year via an RTO and \$10mm was raised concurrently at a price of 50¢/shr. There are now 82m shares outstanding and cash on hand of about \$9mm. The shares last traded at 40¢.

What is SPRQ worth? Let's first assume they get their production kinks out of the way (and we think they will) and the Company proceeds as a going concern. Internal projections suggest an operating profit of \$50k/MW after overhead. This figure seems to approximate Enphase's margins and is likely a good an estimate as any.

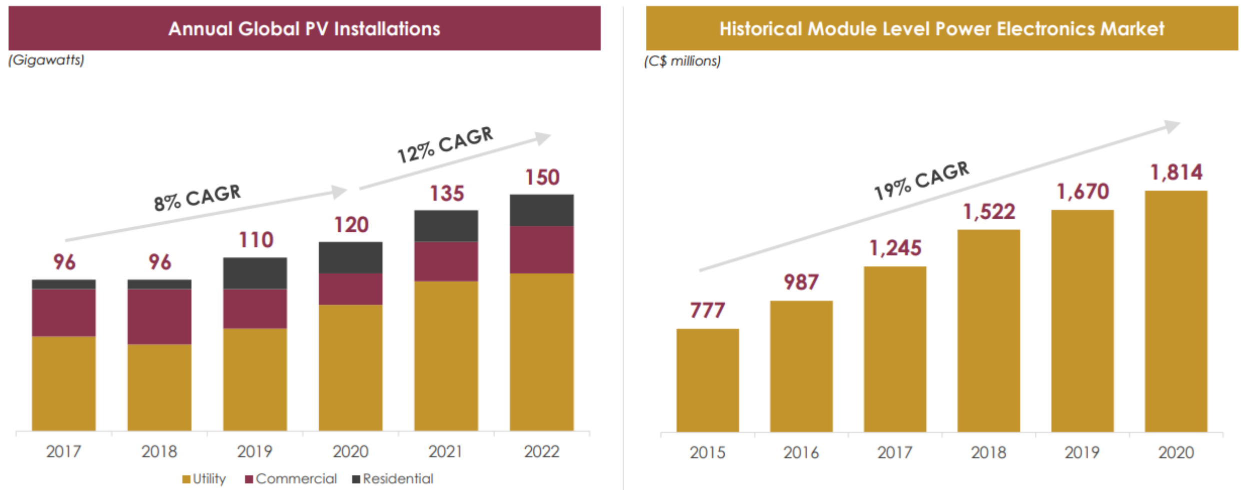



**Figure 5:** *These charts are from a Company slide using data taken from to IEA. This market has certainly been on a tear and the bigger it gets, all else being equal, given the increased scale, the more competitive it gets. Looking forward, higher interest rates may act as a drag on growth. Solar install are typical bought on time and as rates go up, so monthlies. Mitigating against this might be higher power costs.*

Then it comes down to how quickly SPRQ can grow. The same internal model projects about 1200 MW (and C$62mm in EBITDA) for 2025. This was before the supply chain glitch. According to the production agreement with Ti-Lane, up to 10,000 units/month (or about 150 MW) can be produced in 2023 to generate about C$4mm in EBIDTA. Presumably, production capacity can be increased from there.

—+—

Praveen Jain is the CEO of SPARQ; he is also a full professor at Queen's University, IEEE Fellow and 2021 recipient of the IEEE Medal in Power Engineering "for contributions to the theory and practice of high-frequency power-conversion systems." His first breakthrough was the invention of "single-stage, high-frequency AC/DC resonant converters with near-unity power factor"; for the International Space Station his resonant technology was instrumental in shrinking the form factor of, among other things, the power supplies widely used in telecommunications. Before getting into academia Jain worked in industry so commercialization came naturally. His inventions on digital power management chips for computers were advanced by CHiL Semiconductor, which, in turn, was sold to International Rectifier in 2011 for $75mm.

—+—

Our interest in SPARQ is as follows:

- SPARQ has invented a better microinverter and did so by solving a hard problem in power electronics. The IP to protect this invention is in place.

- The field to which the invention is applicable is large and rapidly growing. Here we have mostly focused on solar, but most of renewable energy is dependent, one way or another, on converting DC to AC. This sector can evoke strong feelings but it now seems clear that the scale needed for favourable economics has been achieved. The double-digit growth rates that seen for the last decade can be expected to continue into the coming decades.

- Praveen Jain has done this before.

Enphase's trailing 12-month revenue was about $1.5b, up 425% over the last three years. Only 15% of this growth has been into international channels. This speaks no doubt to Enphase's ingenuity and execution, but it also speaks to the very robust market it is engaging. The market cap of Enphase is $22b. The market cap of SPARQ is C$36mm, or 1/780$^{th}$ of that of Enphase. Be it as a going concern or as a takeout, we feel, understanding the risk, that this represents value.

Douglas Pollitt

May 9, 2022
Toronto, ON

## Disclaimer

The information contained in this document is based on material obtained from what are deemed to be reliable sources, but no guarantee or promise, explicit or implicit, is given as to the accuracy and exhaustiveness of these sources. This report shall under no circumstances be considered an offer to buy or sell, or a request to buy and/or sell the stocks mentioned. Pollitt & Co. Inc. ("Pollitt") and/or its officers, directors, representatives, traders and members of their families may hold positions in the stocks mentioned in this document and may buy and/or sell these stocks on the market or otherwise. Pollitt may from time to time act as financial advisor, fiscal agent or underwriter for companies mentioned in this report and may receive remuneration for its services.

No part of this Pollitt report, information, opinions or conclusions, may be reproduced, further distributed or published or referred to, in whole or in part, without in each case the prior permission or consent of Pollitt.

The opinions, estimates and projections contained herein are those of Pollitt as of the date hereof and are subject to change without notice.

**Analyst disclosure:**

The research analyst who prepared this report certifies that this report accurately reflects his or her opinion of the subject securities. The analyst certifies that no part of his or her compensation was, is or will be directly or indirectly related to the specific recommendations or views expressed in this report with regard to the securities or companies found herein.

**Analyst compensation:**

The research analyst who prepared this report receives compensation based on criteria determined by management.

**Research dissemination policy:**

Pollitt's research dissemination policies can be obtained at www.pollitt.com. To receive Pollitt research please contact a Pollitt registered representative.

**Applicable disclosure details:**

Company name: Sparq System Inc.: Ticker symbol: SPRQ
Applicable disclosure: 2, 3.

1) In the last 12 months, Pollitt has managed or co-managed an offering of securities by the subject issuer.

2) In the last 12 months, Pollitt has received compensation for investment banking and related services from the issuer.

3) The research analyst or member of his/her household, or any associate or individual preparing the report, has a long position in the shares and/or the options of the subject issuer.

4) The research analyst or a member of his/her household, or any associate or individual preparing the report, has a short position in the shares and/or the options of the subject issuer.

5) Pollitt is a market-maker, or is associated with the specialist that makes a market in the securities of the subject issuer.

6) Pollitt owns more than 1% of any class of equity of the subject issuer.

7) The research analyst has viewed the material operations of the issuer.

8) A portion of the travel expenses of the analyst was paid or reimbursed by the issuer.