KULIM, Malaysia — Tucked away in this former tin-mining town, past the small farms of banana trees and oil palms, is one of the solar industry’s best-kept secrets. The six factories here with cavernous rooms up to one-third of a mile long constitute the production backbone of First Solar. Working alongside minivan-size robots adapted from car assembly plants and other industries, 3,700 employees produce five-sixths of the American company’s solar panels. Workers in Ohio make the rest.

The list of manufacturers is long. Panasonic of Japan has a solar panel factory a mile down the road. SunEdison makes wafers 60 miles away in Chemor. Hanwha Q Cells and SunPower have giant factories even farther south, while Solexel, a Silicon Valley start-up, is preparing to build an $810 million solar panel factory in stages.

Malaysia, a Southeast Asian nation with just 30 million people, is the biggest winner in the trade wars that have embroiled the solar sector. As Chinese companies have been hit with American tariffs and European quotas, Malaysia has increasingly attracted multinationals with its relatively low labor costs, lucrative tax breaks, warm relations with the West and abundance of English-speaking engineering talent.

Malaysia is now the world’s third-largest producer of solar equipment, trailing China by a wide margin but catching up rapidly with the European Union. And Malaysia’s role in the global solar trade is only likely to increase in the coming months if the American government broadens tariffs on panels made in China next Tuesday as expected.

“We liked Malaysia because it was a cross between just a straight low-cost play and a high-engineering play — it was sort of in the middle, where it was lower-cost but good engineering,” said Tom Werner, the chief executive of the California-based
SunPower, which manufactures half its solar panels in Malacca, Malaysia.

The solar manufacturing boom in Malaysia has been almost invisible, a rarity in an industry known for heavily promoting even the smallest factory opening or new solar panel farm as progress toward cleaner energy.

Manufacturers don’t want to draw attention to moving production offshore. The factories here are almost entirely owned by American, European, South Korean and Japanese companies that much prefer to talk about operations in their home countries.

Hanwha Q Cells, for example, produces 1,100 megawatts a year worth of panels in Malaysia and just 200 megawatts in its home market in Germany. But the company highlights that the engineering work is still done at its headquarters in Thalheim, Germany.

Production in Malaysia “gives us the flexibility to reliably address very different and dynamic international market needs with high-quality products ‘Engineered in Germany,’ ” said Jochen Endle, a company spokesman.

It is a common theme. The technology comes from overseas, but the employees and most of the materials are Malaysian.

Except for two expatriates in the finance department, all of First Solar’s 3,700 employees on three shifts are local hires. A few materials are imported from the United States, like certain electrical cables. But most others are now bought from Malaysian suppliers, like cord plates.

“Localization of materials is part of our strategy of continuous cost reduction,” said AR. Jeyaganesh, First Solar’s plant manager, walking across an immaculate floor at one of the 24 production lines here, each an exact replica of the company’s four lines in Perrysburg, Ohio.

Multinationals are also hustling to introduce their latest inventions just as quickly here as in their home markets, to maintain standardized production techniques and quality. “When the decision is made” to add more robots or make other production changes, Mr. Jeyaganesh said, “it happens almost simultaneously in Perrysburg and here.”

Malaysia’s surge in the solar industry has irritated some of the original backers of American trade action against China. Critics say the goal was to create jobs in the United States, not Southeast Asia.

“In solar, a key technology to achieve our energy efficiency goals, the
administration needs to implement a more aggressive and comprehensive trade strategy,” said Michael R. Wessel, a member of the U.S.-China Economic and Security Review Commission, an advisory group created by Congress. “If not, we’ll simply trade our historical dependence on foreign oil for a dependence on foreign energy technologies and products.”

Trade wars have helped some American companies. SolarWorld, a big manufacturer that has led trade litigation against China, recently said that it was expanding capacity by 150 megawatts and adding 200 jobs at its main solar panel factory in Hillsboro, Ore. It partly pointed to the trade actions that had slowed the flood of Chinese imports.

But production in Malaysia, already triple the United States’ output, is rising faster. The latest project underway in Cyberjaya, Malaysia, is an 800-megawatt solar module factory for Hanwha Q Cells. First Solar is putting the finishing touches on a 100-megawatt factory here to supply the Japanese market.

Malaysia is a beneficiary of the complex interaction of global trade rules, economic competitiveness and environmental policies in the solar industry. Tariffs have had the most immediate effect.

Solar prices started plummeting during the global financial crisis in 2009, as Chinese factories swiftly increased production, buoyed by large loans from state-owned banks at preferential interest rates, and free or nearly free land from local governments. Chinese manufacturers were also dumping panels, or selling them for less than it cost to make and ship them.

A flood of cheap Chinese exports caused two dozen solar manufacturers in the United States and Europe to go bankrupt or close factories. The United States responded in 2012 by imposing stiff anti-subsidy and anti-dumping duties totaling about 30 percent on panels from China. The European Union set import quotas and minimum prices for Chinese panels last year.

On Tuesday, the Commerce Department is widely expected to broaden its steep duties on solar panels from China. Pending litigation would impose duties on panels made partly in China and partly in Taiwan, closing a loophole that allowed some Chinese companies to bypass the original duties.

The plunge in prices through 2013, which leveled off as Chinese giants like Suntech Power and LDK Solar began going bankrupt from underpricing their panels, put a heavy emphasis on cost competitiveness. China’s rapidly rising wages, together
with mounting geopolitical tensions, prompted multinationals to look elsewhere as well.

That gave an edge to Malaysia, with its fairly low pay for skilled engineers and machinery operators.

Malaysian wages were much higher than those in China for years, but the disparity has now disappeared or even reversed. According to Malaysian government statistics, median nationwide monthly pay last year was $765 for factory technicians and $400 for machinery operators and assembly-line workers. That is similar to or lower than pay scales these days in coastal provinces of China with large export industries.

Malaysia also has some of Asia’s lowest costs for electricity, even after raising prices for industrial users 14.9 percent last January. Prices are so low partly because the country is a large producer of natural gas, exporting what it cannot burn at home.

One of Malaysia’s biggest attractions is the 10-year exemption from corporate taxes for large domestic and foreign investors. While some American states offer breaks, comparable holidays from federal taxes are not available.

The Office of the United States Trade Representative expressed concern this year about Malaysia’s tax breaks in a review of trade policies. The White House agency has asked Malaysia to provide details of how they work so other countries can assess whether the tax breaks violate a World Trade Organization ban on export subsidies.

Malaysia denies breaking any trade rules. “All of the incentives, all the things that we do, are W.T.O.-compliant,” said Senator Idris Jala, Malaysia’s minister for economic development and efficiency.

The tax break cinched the deal for First Solar to set up most of its production here, said Maja Wessels, an executive vice president at the company.

“That’s easy, the 10-year tax holiday,” she said. “When you look at solar manufacturing, and our manufacturing in particular, low labor costs contribute, but those taxes are critical.”

Diane Cardwell contributed reporting from New York.

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