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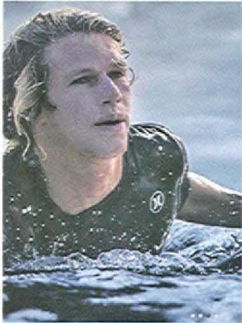
THE COMMUNITY OF BUSINESS™

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Ranks of Biggest Women-Owned Businesses Swell to 100-Strong

By **MEDIHA DIMARTINO**

Orange County's biggest women-owned businesses generated \$3.5 billion in revenue last year, notching a 5.6% increase and extending a streak of gains to five years.

This week's Business Journal list includes 100 businesses with an ownership structure that's at least 51% female and that takes in a minimum of \$5 million in annual sales. They combined to employ more than 26,460 workers, a 2.4% increase.

The businesses accounted for 6,794 jobs in Orange County, up nearly 7.2% from a year earlier. That's ahead of the pace of the largest private companies based here, which combined for 52,646



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local workers over the past year, a 4.5% uptick, according to Business Journal research.

Nearly half of the women-owned enterprises—43—reported revenue increases. Six were about flat from a year ago, and 19 posted decreases. The Business Journal estimated numbers for 32 of the companies.

The list has grown in recent years, due in part to improved research methods. This year's record total of 100 is up from 88 companies featured last year.

The range of women-owned businesses based here also compares well with our recent general list of privately held companies, with entries ranging from the health-

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Patel on Lockheed: "whenever they're ready, we're ready"

Graphene True Game Changer? OCWD Wants to Know

TECHNOLOGY: Hopes to test Lockheed product by year-end

By **CHRIS CASACCHIA**

The **Orange County Water District** is standing ready to test a new technology under development by **Lockheed Martin Corp.** that could be a game-changer on water treatment, with the potential to lower costs as municipalities and private businesses search for new ways to secure supplies in drought-stricken California.

The technology is based on a graphene mem-

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Women *in* **BUSINESS**

Buchan's High Bar

Graphene

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brane, a molecular offshoot of carbon that can be punched with microscopic holes of one nanometer or smaller—a standard sheet of paper is about 100,000 nanometers thick. It's the thinnest and strongest material in existence that can conduct heat, nearly transparent and so dense that helium—the smallest gas atom—can't pass through it.

Much less energy is needed to push water through the microscopic holes in graphene than with traditional methods. It's nonetheless strong enough to trap salts, minerals and other matter. That means less energy is needed for the treatment process, bringing down costs.

Large-scale filtration membranes, a segment dominated by a handful of manufacturers, such as Dow, Hydranautics, Toray and CSM, are the heart of water treatment and desalination systems around the globe. Standard membranes are primarily made of the synthetic material polyamide and are used in the process of reverse osmosis, the gold standard in water treatment since its introduction in the 1960s.

Bethesda, Md.-based Lockheed is developing the graphene technology at its San Jose operation. The aerospace and defense giant, which posted revenue of \$45.6 billion last year, announced plans two years ago to develop a graphene membrane branded as Perforene and has since won at least four related patents.

Lockheed caused a brief splash with some early proclamations of its vast potential. The company has been quiet lately, though, with its engineers working to clear hurdles as they work to create a viable commercial test unit, essentially a 2-inch-by-2-inch piece of material known as a coupon.

Lockheed declined to comment on this story.

OCWD officials sound cautiously optimistic.



Advanced Water Quality Assurance Laboratory: R&D center on Orange County Water District's campus in Fountain Valley

"Whenever they're ready, we're ready," said **Mehul Patel**, program manager of OCWD's ground water replenishment system. "We're hoping within this calendar year we get something."

Interest in Academia

Graphene has managed to keep a low profile nearly everywhere except academia and high-tech circles. One example: A representative of the **Los Angeles Department of Water & Power** recently told the Business Journal that the city-owned agency isn't pursuing research and development of the material.

Interest has been intense at some leading research institutions, though, including the **Massachusetts Institute of Technology**, **King Fahd University of Petroleum and Minerals**, and the **University of Manchester**.

Manchester researchers **Andre Geim** and **Konstantin Novoselov** received the Nobel Prize in physics in 2010 for extracting and isolating graphene.

Orange County's main effort in graphene is in the hands of scientists at the Engineering Research Center on the water district's 20-acre campus on Ward Street in Fountain Valley. They want to test the material on three primary fronts: life span, energy efficiency and fouling, a degradation process exacerbated

when a solution or particles get caught in the membrane.

Cost will be a major factor if the technology proves successful. The OCWD's vast network of 22,000 membranes that fit snugly into 40-inch cylinder filters costs about \$40 each, roughly about \$9 million for the entire system. Most of the membranes are purchased from Hydranautics and Dow, according to Patel.

Filtration membranes typically have a life span of four to five years and have advanced little in the past 30 years. Polyamide, an easily manufactured material, has been the standard for fabricating membranes but has limitations, namely its short life span and vulnerability to damage by certain chemicals, such as chlorine, which makes cleaning difficult.

"Those technologies have kind of reached their limit in terms of innovation," Patel said.

Graphene has already beaten the odds in some respects to get the attention of scientists at the 3,000-square-foot facility's outdoor testing area, which handles all pilot programs and tests using the same water as the main treatment plant to mimic current conditions.

The OCWD is approached with claims of a potential breakthrough four or five times a month, some completely exploratory, others product ready. Typically one pitch makes it through the cut in any given year, with only a few "that will come of something," according to Patel, who's in his 18th year at the water district.

"I can't say the success rate is high."

Desalination

The OCWD's ground water replenishment system, a joint effort with the **Orange County Sanitation District**, takes highly treated wastewater and purifies it through a three-step process of microfiltration, reverse osmosis and ultraviolet light with hydrogen peroxide, resulting in near-distilled quality water. It relies on a network of water resources beyond the Advanced Water Quality

Assurance Laboratory on the OCWD's campus, including injection wells along the Sea-water Intrusion Barrier in Huntington Beach and Fountain Valley, as well as three large scale basins, recharge basins and several lake reservoirs in Anaheim.

The OCWD recently completed a \$142 million expansion to produce 100 million daily gallons of high-quality water, enough to meet the yearly demands of about 850,000 people in north and central Orange County.

The agency, which manages a vast ground-water basin that runs from Seal Beach east to the Anaheim area and as far down the coast as Huntington Beach, supplies water to more than 20 cities and water agencies serving more than 2.4 million residents.

The customers receive about 23% of their water from the ground water replenishment system. The remaining water is acquired through several other sources, including importation, the Santa Ana River, storm catch basins, and rainfall.

Graphene membranes are likely five to 10 years away from commercialization, a short time frame when it comes to water policy, conservation, treatment and analysis, which is thought of more in decades, or even longer.

The life cycle of a typical water treatment facility is about 50 years, so the need to update and improve equipment and technology is constantly in the minds of operators.

"This technology that we're using is not going to be the best technology forever," Patel said. "If we look forward, we need to look at a 10-year horizon. We need to look at longer windows."

The development of graphene comes as Boston-based **Poseidon Water** is scheduled to open the world's largest desalination plant in Carlsbad in November.

Poseidon's proposed desalination plant in Huntington Beach, slated to be larger than the Carlsbad operation, is awaiting a key approval from the California Coastal Commission before the company can proceed with the \$1 billion project. ■