Second Life

A late-1970s vintage power station was faced with obsolescence, but rather than replacing it, Wien Energie revamped it to double capacity, raised its efficiency, and reduced its specific emissions.

By Eric Johnson

Better, stronger, faster: new components at the heart of Simmering combined-cycle power plant.

Photo: Philipp Horak / Agentur Anzenberger

"We can rebuild him. We have the technology." Fans of science fiction will remember these lines from the legendary 1970s television series *The Six Million Dollar Man*, and its protagonist, who after a debilitating crash had his body reconstructed. Steve Austin's 6 million dollar set of "bionic" spare parts made him "better than he was before – better, stronger, faster."

Much the same applies to the Simmering power plant, a gas-fired behemoth in a Viennese suburb that also dates from the 1970s. Early in the new millennium, though, the unit was lagging behind current norms of scale, efficiency, and environmental performance. Instead of replacing it, owner/operator Wien Energie chose to repower Simmering, bolting new components onto old to make it, well, better than it was before. Call it, if you will, the "300 Million Euro Power Plant."

Waste Not, Want Not

Although by 2003 it was clear that a major expansion at Simmering was needed to meet Vienna's growing hunger for power and heat, "tearing down the original plant would have been a shame," comments Michael Heinrici, who led the project for operator Wien Energie. "Technically it was still running well, it had been treated properly over the years, and it had been online only about 110,000 hours – about half of its design-rated lifetime." There were other reasons, too: ease of permitting, optimal use of a crowded site, and minimal downtime. "Public acceptance is almost certain to be greater for a repowered plant than a new one," observes Martin Wilkening, who led contract negotiations for Siemens. For Simmering, which squats along a heavily traveled freeway in an industrial zone just 5 kilometers from Vienna's center, this was critical. "Permitting turned out to be easy," recalls Heinrici, "there were no significant slowdowns or problems."

Simmering's urban setting also favored reuse over scrap and rebuild. The site has been generating power (and district heating) for almost 110 years, which means that most available space already is occupied. Without ripping down some existing structures beforehand, there simply was not enough room on site for a conventional expansion. For repowering, however, which requires less space, there was enough room to go around. The knock-on effect was that downtime stayed down. Instead of district-heating service (for which there is no alternate economic supply) being offline for five years, as it would have been with a new plant, it was interrupted for less than two. And even for that period, the old plant was jury-rigged to deliver about half of its pre-repowering heat capacity.

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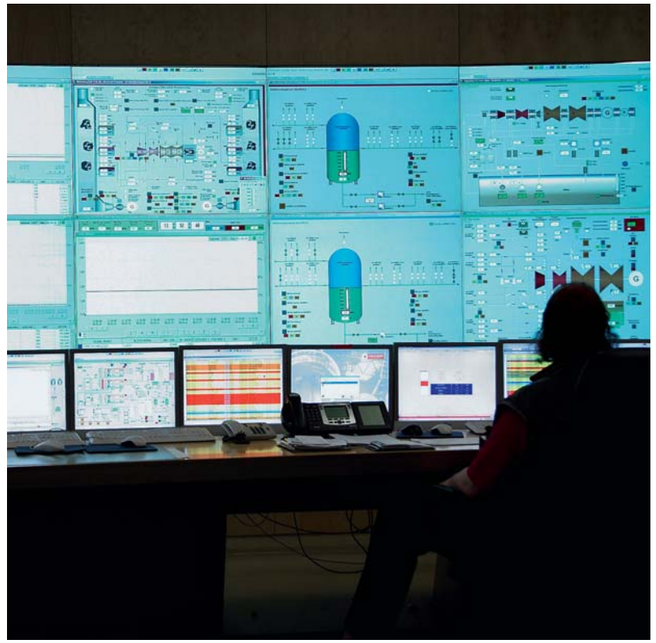
>
> Michael Heinrici, Project Manager, Wien Energie

Convinced by this combination of reasons, Wien Energie decided to repower rather than scrap and build. After a call for tenders approved by the EU, the general-contractor job was awarded to Siemens in 2005. "There are only four or five qualified bidders in this niche," notes Heinrici. "Siemens clearly had an edge, because they had already supplied the centerpiece of the project – steam turbine, generator, and condenser – plus much of the rest of the original plant."

A Look behind the Façade

That edge proved critical, because as construction progressed, the project team repeatedly faced unexpected challenges. "You don't know the true condition of the existing equipment until you disassemble," says Siemens'



Top left: Tech talk – Michael Heinrici shows Simmering to author Eric Johnson. Top right: Steering the ship – in the quiet hum of the control room. Bottom right: Generator with exciter and steam turbine in the refurbished turbine hall. Bottom left: The combined-cycle power plant includes old and new elements.

Photos: Philipp Horak / Agentur Anzenberger

Wilkening. At that point, you have to work with what you find – which in some cases may be worse than expected. Particularly troublesome were some condenser pipes and low-pressure turbine blades that needed replacing. Then, during commissioning, a bypass inlet to the steam turbine cracked.

Existing knowledge shortened all these possible delays. In the most extreme case – the bypass inlet – Siemens designed, manufactured, and installed a replacement within two months. Equally important was the willingness of both project leaders, Wien Energie and Siemens, to cooperate in finding solutions. "If either side had taken an adversarial attitude toward the unexpected," comments Michael Kainz, Siemens' Technical Leader for Simmering in Vienna, "we could have spent years tied up in legal arguments. Instead, both sides focused not on blame, but on solutions." Wien Energie's Heinrici echoes the sentiment: "There were many tough decisions to make as to how to proceed, and every time, they were negotiated in a constructive, and reasonable, yet hard-headed way."

Both sides emphasize that this is the only viable option for a repowering job. "We weren't installing an 'off-the-rack' power plant," states Heinrici. "It was a tailored, one-off engineering challenge. Partnership was the only way to approach it." That partnership is obvious, even to those visiting the site for only a few hours. Heinrici and Kainz clearly are on familiar, friendly terms, as are others in the Wien Energie-Siemens team. They have undergone a trial by fire – and come through it together.

Happy Together

Today, those challenges are history. By spring of 2010, a year into on-target operations, the success of repowering is written in Heinrici's face. As he proudly points to two gleaming gas turbines in the new part of Simmering, he smiles: "This has become a reference plant for how to make new from

Before and After: Simmering's Story in Figures

Full load condensing mode		Plant after repowering	Old plant before repowering
Electrical power output (net)	MWel	820	430
Electrical efficiency (net)	%	57	42
Specific NO_x emissions	g/kWh	0.113	0.226
Specific CO_2 emissions	g/kWh	377	538

Full load with maximum heat extraction		Plant after repowering	Old plant before repowering
Electrical power output (net)	MWel	700	360
District heating output	MWth	450	280
Electrical efficiency (net)	%	49	35
Fuel utilization factor	%	81	62
Specific NO_x emissions (electric and thermal)	g/kWh	0.082	0.139
Specific CO_2 emissions (electric and thermal)	g/kWh	273	331

Source: Wien Energie; el: electric, th: thermal

Born Again – What Repowering Is About

Revamping, debottlenecking, renovating – the idea of repowering is to convert aging gas-/oil- or coal-fired equipment to meet the state of the art. Onto old foundations are grafted new components, most significantly a gas turbine and a heat-recovery steam generator (HRSG), which boost capacity and efficiency while lowering unit emissions.

Ideal candidates are those power plants that, like Simmering, were built in the late 1970s or early 1980s, with under 120,000 hours on the operating clock, and featuring an impeccable operations and maintenance record. Especially, the steam turbine/generator need to be in good shape. "A plant that has been beaten to squeeze out every last bit of performance," observes Wien Energie's Michael Heinrici, "probably won't suit itself to repowering."

The Vienna Model is based on efficient plants and networks, sustainable sources of power and heat, and district heating and cooling.

old. It's a great demonstration of the art of engineering."
This is confirmed by its impressive figures. Through repowering, Simmering has nearly doubled its capacity and increased electrical efficiency by more than 35 percent, while cutting nitrogen-oxide and carbon-dioxide emissions by about 50 percent per kilowatt-hour. And here is the kicker: Simmering cost far less than a new plant, which Wien Energie estimates would have been some 20 to 30 percent more expensive. Not only is the "300 Million Euro Power Plant" better than it was before, it also came at a bargain at that time.

No Game for Amateurs

This is a major undertaking, typically costing hundreds of millions of euros and taking several years to complete. By contrast, an upgrade where, say, turbine blades are replaced, runs to just tens of millions and can be completed in a matter of months.
Moreover, as Wien Energie's experience shows, repowering requires a serious commitment of engineering. In most plants, it would not be economical to scope the project entirely before it starts, so some surprises in implementation are not only likely, they must be dealt with confidently and quickly. "You need to approach this with some flexibility and a cushion in your budget and schedule," Heinrici notes.
Still, for those cases where the approach is suitable, payoffs are powerful: more output for less fuel and pollution, at a cost well below that of construction from scratch. "Repowering is not for everyone or everyplace," says Siemens' Martin Wilkening, "but when it suits, the benefits are tremendous."

Optimizing Energy Infrastructures

Operators of energy infrastructures face increasingly strict environmental regulations as well as economic competition. Siemens can help to extend the lifetime of assets and reduce emissions, thus increasing both efficiency and profitability.
For instance, maintenance downtime can be reduced or even avoided with nondestructive diagnostic technology and online monitoring for predicting necessary repairs.

Expectations Fully Met

Susanna Zapreva-Hennerbichler serves as director and CEO of Wien Energie Wienstrom GmbH. She told *Living Energy* about her experiences in the project to repower the Simmering plant, which extended the lifespan of an old power plant well into the new millennium.

Wien Energie Wienstrom GmbH CEO Susanna Zapreva-Hennerbichler

Photos: Philipp Horak / Agentur Anzenberger, Wien Energie Wienstrom GmbH

Wien Energie Wienstrom GmbH is Austria's largest operator of thermal power plants. Is the notion of a caloric power plant in an urban setting still in line with modern standards?
Not only are such plants in line with modern standards, they are essential for our environment. Highly efficient thermal power stations are an integral part of the Vienna Model, which stands for efficiency and climate protection.

What exactly is the Vienna Model?
Its elements are a pool of modern power plants with optimum efficiency levels as regards power and heat generation, combined with heat from refuse recycling and a strong emphasis on renewable sources of energy. The model also includes the creation of supply networks for efficient, loss-free energy transmission, the development of district heating and cooling, and a customer advisory service focusing on energy consumption and efficiency.

What do you think are the most significant economic benefits of repowering in Simmering?
The investment required was considerably less than the cost incurred by the construction of a completely new plant.
The high fuel efficiency rate of 81 percent, achieved via energy recovery and the high efficiency level, results in an annual reduction of around 1.33 million tons of CO_2 and around 1,850 tons of NO_x compared to other plants in Austria where electricity and heat are generated separately in power plants and single-unit furnaces, respectively. Thus, the new power plant makes an important contribution to climate protection, and we save 20 million euros worth of CO_2 certificates a year.

The efficiency of the repowered plant has increased from 42 percent to a level of 57 percent. What does this mean in terms of ROI? How long is the investment's "payback period"?
Cogeneration means we are able to achieve a fuel utilization level of 81 percent. This naturally has a positive effect on the ROI. We estimate that this investment will have paid off in 15 to 20 years.

The plant has now been in operation for just over a year. Has it fulfilled the requirements and expectations? Is there room for improvement?
So far, the plant has fully met our expectations. However, technology continues to develop, so improvements are always possible. Our technicians collaborate continuously with the Siemens specialists in order to exploit this potential.

Is repowering also an option for other Wienstrom plants?
Specific prerequisites must be met in the case of repowering projects. These do not apply to other plants operated by Wien Energie Wienstrom GmbH at present. However, we might consider a similar project in the mid-term.

How long will the repowered Simmering plants continue to operate?
Nowadays, power plants are usually taken offline as a result of economic development, not because they have reached the end of their technical lifespan. The Simmering power plant should remain competitive for at least the next two to three decades.

***Eric Johnson** writes about technology, business, and the environment from Zurich.*

Further Information

www.wienenergie.at
www.siemens.com/energy