



GUROBI
OPTIMIZATION



WHITE PAPER

Optimize Your Business Today, While Preparing for a Quantum Future

With decision intelligence technology, you can achieve quantum outcomes, without the wait.

The world is abuzz about quantum computing, and rightfully so. By exploiting the power of subatomic phenomena, quantum computing has the potential to solve some of humanity's greatest challenges—and companies and governments want to be ready to take full advantage of these capabilities.

As a result, organizations are investing heavily in quantum computing. According to Precedence Research, the global quantum computing market size is projected to hit around USD 125 billion by 2030 and is poised to reach a CAGR of 36.89% from 2022 to 2030.

The Promise of Quantum Computing

Quantum computing promises to be the solution to today's most complex problems, and it's expected to make an especially transformative impact in simulation problems—such as organic chemistry, materials science, and biochemistry—and security.

But optimization is the area where quantum computing is expected to create breakthrough performance first. This is of particular interest to business leaders, in particular, since optimization can solve common business problems—enabling organizations to do more with their limited resources.

Some common quantum optimization use cases include:

- Factory layout planning
- Renewable energy grid optimization
- Investment portfolio optimization
- Solving the last mile resupply problem
- Route planning and optimization
- Traffic flow optimization
- Flight gate assignment
- Telco network optimization

Even just a 1% improvement in these areas can translate into millions in annual cost savings for an organization.

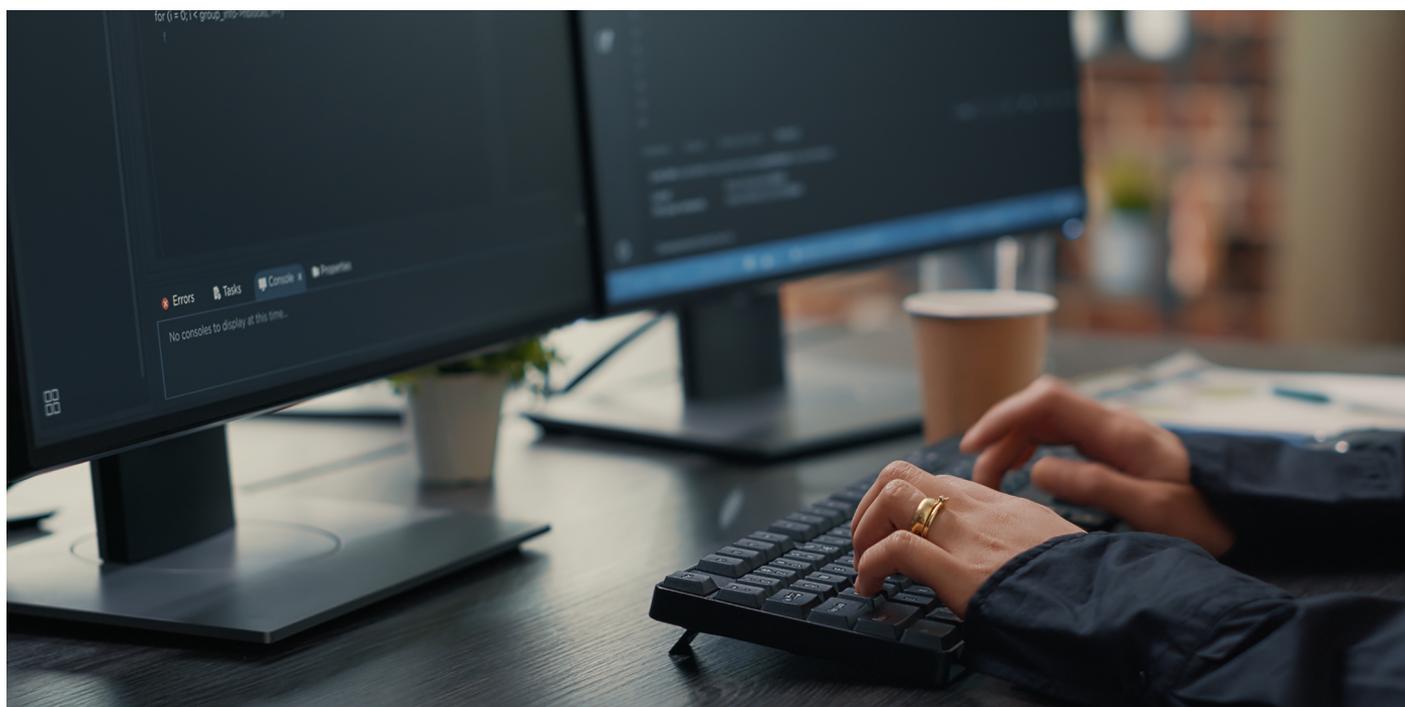


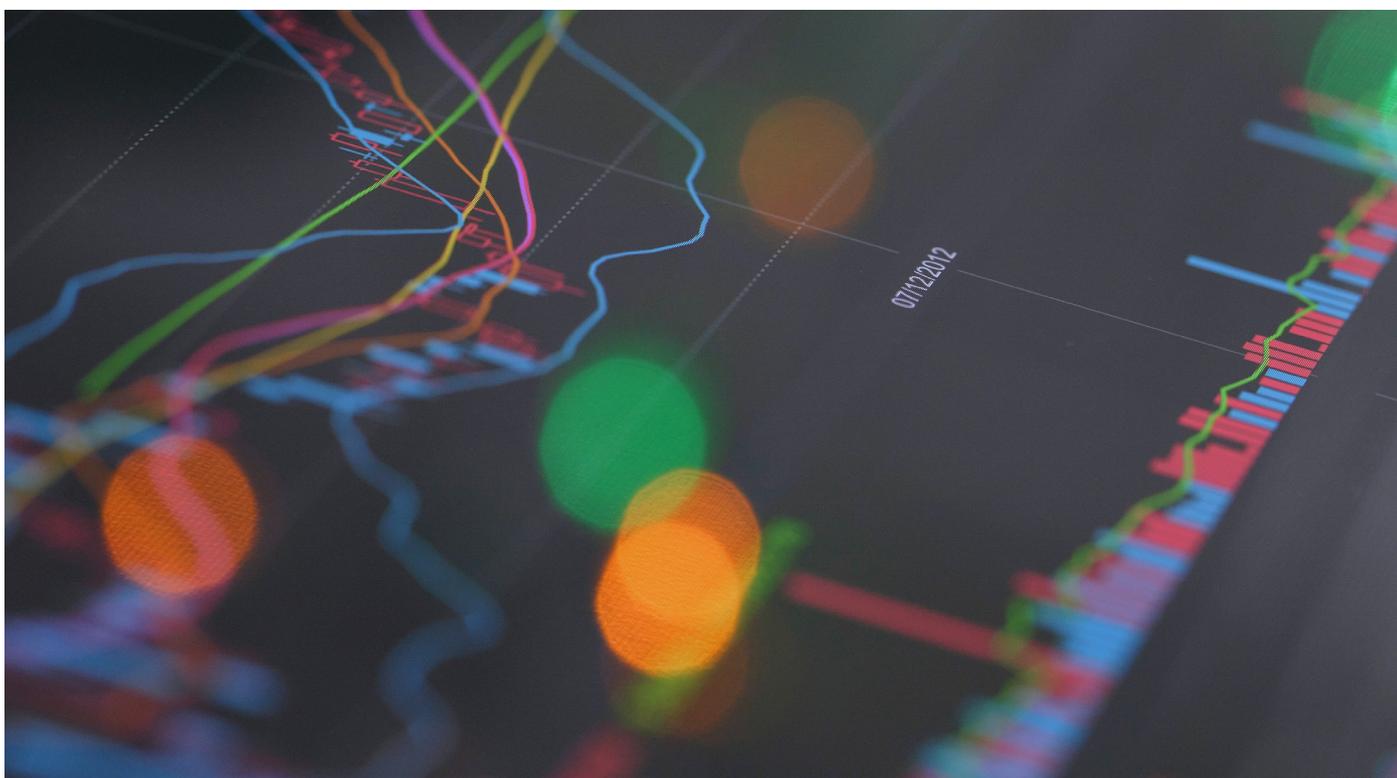
The Challenges of Quantum Computing

Despite large investments and high expectations, quantum computing faces a steep uphill battle. Although it's understood from a theoretical point of view—and it has been shown to work with working prototypes and machines—quantum computing has yet to scale to an industrial-size machine that can be used.

Some of the specific reasons behind this challenge include the following:

- There are many "flavors" of quantum computing, and it's unknown which will win out.
- Quantum computing requires pushing the boundaries of human-controllable physics, with some fundamental problems still unsolved.
- Uncertainty is an inherent part of quantum computing—and that makes it a struggle to get reliable, reproducible results.
- So far, very few algorithms have the potential to take advantage of quantum computing.
- There is not yet an exact algorithm for quantum optimization





As a result, real-world benefits could still be decades away. According to McKinsey & Company: “While quantum computing promises to help businesses solve problems that are beyond the reach and speed of conventional high-performance computers, use cases are largely experimental and hypothetical at this early stage. Indeed, experts are still debating the most foundational topics for the field.”

What About QUBOs?

When it comes to quantum computing for solving optimization problems, the focus has been primarily on quantum annealing, which can only solve “quadratic unconstrained binary optimization” (QUBO) problems.

QUBOs are not always effective in practice, though. In particular, they cannot directly:

- Support common real-world situations, such as continuous variables (e.g., prices, commodity flow)
- Support constraints (e.g., max/mins, price cannot exceed a certain value)
- Prove optimality (e.g., you can't be sure you've identified the best solution)



Quantum Optimization Outcomes, Without the Wait

Especially in today's economic climate, organizations are looking for ways to do more with their limited resources. And they can't wait decades for the promises of quantum optimization to become a reality.

That's why they're turning to classical optimization for solving their complex, real-world business problems today—while also building a strong foundation for a quantum future. They're becoming truly “quantum-ready,” with value to show for it. This involves two key steps:

Step 1: Identify Your Business Use Cases

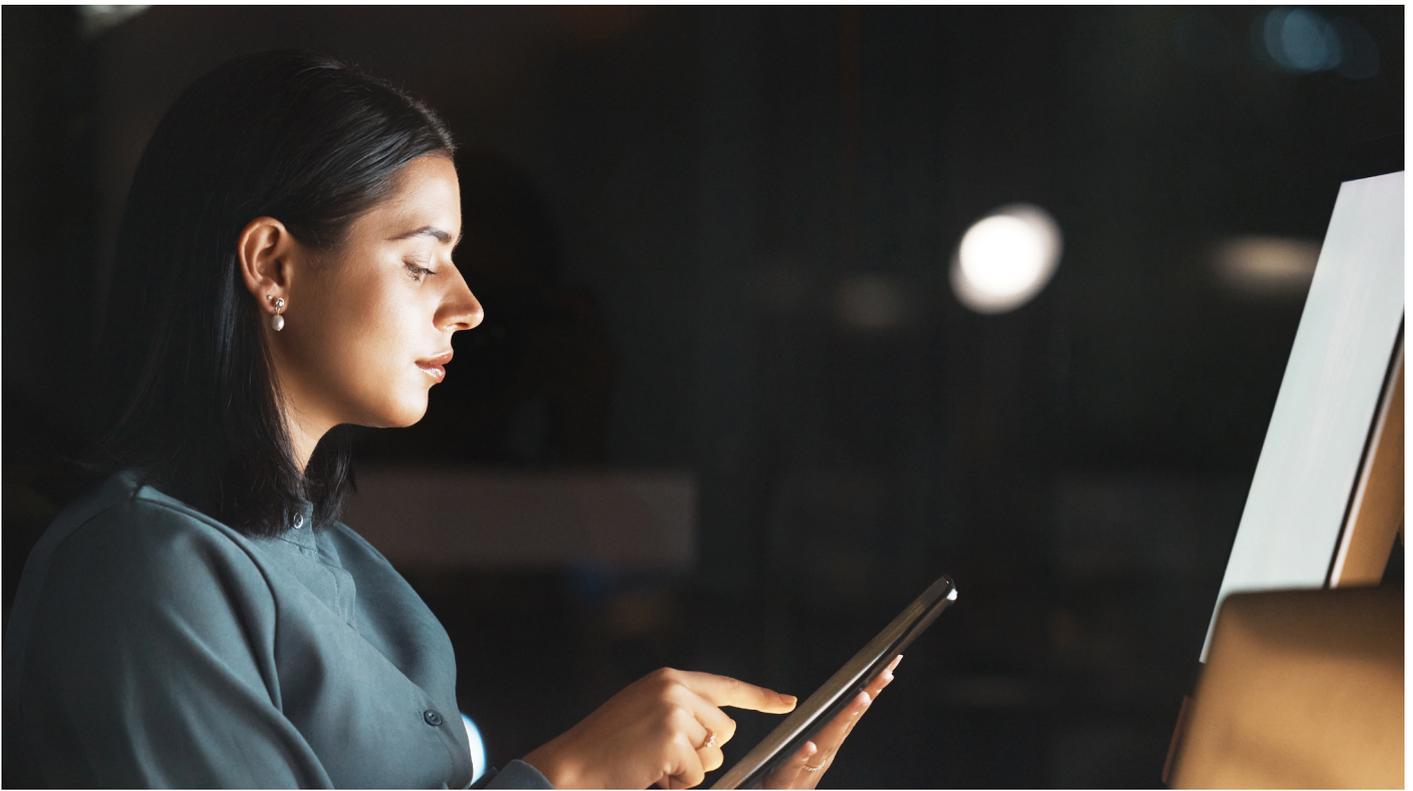
Whether you're preparing for a classical optimization project or a quantum optimization one, you will always start here. You start by taking a hard, quantitative look at your business, in order to:

- Develop a deep understanding of your constraints and drivers of growth, costs, and complexity
- Identify those areas that could be transformed and the problems that could be addressed with this new technology

Step 2: Learning to Leverage Advanced Analytics Software

By implementing and using optimization (or any other advanced analytics software, for that matter), your organization will be able to:

- Express your business problems in a software language so that computer hardware (classical today and quantum tomorrow) can understand those problems and solve them
- Create a culture of optimal, data-driven decision-making across your organization



Start Your Quantum Optimization Journey

By leveraging optimization technology today, you can bring the promises of quantum optimization into your present-day business situations—while preparing for the quantum possibilities of tomorrow.

- Gurobi delivers precise optimization, today.
- Gurobi handles continuous and integer variables.
- Gurobi implements constraints directly.
- Gurobi’s exact algorithms can verify solution quality.

Plus, Gurobi customers achieve a 518% return on investment, with payback in under six months. (Forrester Total Economic Impact Report 2022)

Over 2,500 global customers across 40+ industries run on Gurobi, including 70% of the Fortune 10 and 70% of the largest European companies by revenue.



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Savings for airport gate and stand assignments



92%
Faster product shipment scheduling



+\$1MM
Annual cost savings for steel production



\$20B
Revenue generated from spectrum reallocation



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Faster financial portfolio optimization



2000%
Increase in game scheduling capacity



20%
Retail inventory reduction



99%
Faster runtime for subscription box service

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