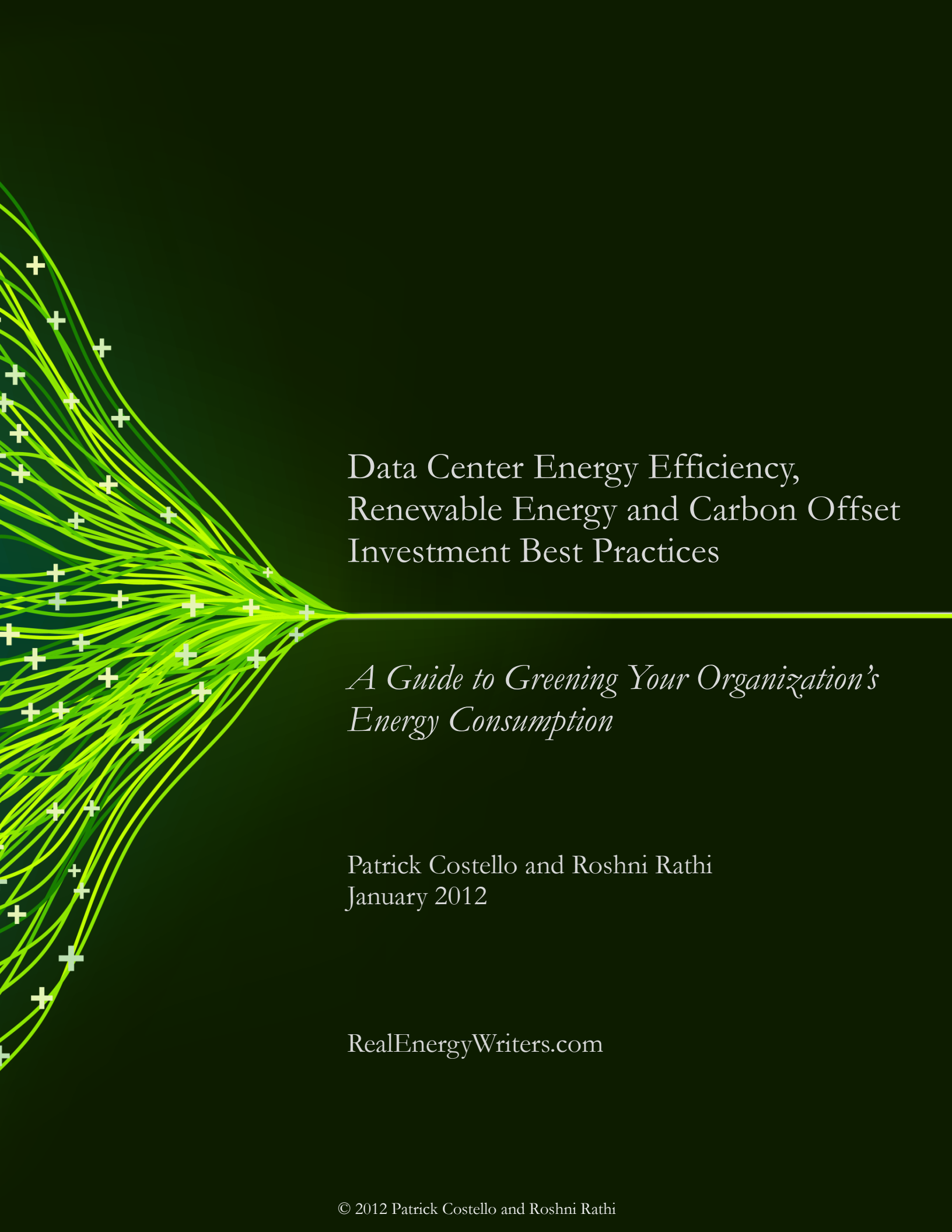

Data Center Energy Efficiency, Renewable Energy and Carbon Offset Investment Best Practices

A Guide to Greening Your Organization's Energy Consumption

Patrick Costello and Roshni Rathi
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Executive Summary

Organizations can benefit immensely by lowering their energy use and greenhouse gas emissions through strategic investments in data center energy efficiency, renewable energy, and carbon offsets. A well-executed greening plan can bolster an organization's public image, enhance employee satisfaction, and reduce the cost of operations. This guide aims to help organizations, particularly those with energy-intense data center operations, develop successful greening plans. It explores a wide range of green investment options that can reduce an organization's energy consumption-related environmental impact.

Readers will come to understand:

- Why some companies are criticized while others are commended for their data center efficiency and green energy investment campaigns.
- How investing in data center energy efficiency brings immediate, permanent reductions in greenhouse gas emissions, energy costs, and exposure to power market volatility.
- The significance of the Power Usage Effectiveness (PUE) and Carbon Usage Effectiveness (CUE) metrics and how to calculate them for a data center.
- The pros and cons of pursuing direct carbon emission reductions through efficiency investments versus pursuing indirect carbon emission reductions through purchases of environmental commodities.
- The value of using monitoring equipment, such as data loggers, as well as computer models to assess energy efficiency opportunities in a data center.
- The cascading benefits of investing in demand-side data center efficiency solutions.
- How investing in newer processing technology can offer substantial efficiency improvements.
- How server virtualization minimizes energy losses associated with powering and cooling idling servers.
- What exactly the "cloud" is, and the environmental advantages of outsourcing server operations to a network-based cloud computing service.

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- The types of cogeneration and fuel cell generation systems, their pros and cons, and how they can advance an organization's energy efficiency and environmental goals.

- The types of data center cooling systems (including free cooling) and methods of airflow management that maximize data center energy efficiency.

- The range of renewable energy investment options (including on-site generation) and the advantages and disadvantages of those options.

- Key cost, performance, and integration concepts involved in assessing the value of investing in on-site generation, particularly on-site solar PV generation.

- How the extent of environmental benefits provided by energy efficiency and green energy investments can vary substantially by region.

- How to distinguish between and benefit from investments in environmental commodities including voluntary renewable energy certificates (RECs), white tags, and carbon offsets

- The difference between, and pros and cons of investing in bundled RECs (through a green power program), unbundled RECs, and offsets sourced from renewable energy projects.

- The relative effective cost of Scope 2 emission reductions sourced from bundled RECs, unbundled RECs, carbon offsets, on-site fuel cell generation, and on-site solar PV generation.

- Best strategies to communicate green investments for maximum credibility.

Who Will Benefit from This Guide:

If you need to quickly make sense of the many available data center energy efficiency, renewable energy, and carbon offset investment options, then this report is for you. We have aggregated key insights from hundreds of resources and conducted independent analyses to provide a straightforward guide that will help you develop an integrated greening and communications strategy.

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About the Authors

Patrick Costello is an Associate at ICF International where he works in the Environmental Markets Group. There he provides a range of renewable energy market analyses, from project-level strategic support to broad market studies, for project developers, utilities, financial entities, and industry groups. Patrick regularly models renewable energy supply and demand in markets across the U.S. as part of a larger exercise in projecting long-term renewable generation development and renewable energy certificate prices under different market scenarios. Prior to joining ICF, Patrick served as a Development Associate at BP Alternative Energy, Wind Power Americas, where he provided market research and geographic siting analysis in support of BP's wind development efforts.

Patrick has authored and coauthored a number of publications that explore policy, technology, and market dynamics related to renewable energy generation, conventional energy generation, and energy efficiency investment strategy. Works that Patrick recently coauthored include the quarterly *Integrated Energy Outlook* (ICF International, 2011-2012), *Firming Renewable Electric Power Generators: Opportunities and Challenges for Natural Gas Pipelines* (Interstate Natural Gas Association of America, 2011), *The Future of Energy Efficiency: Technology and Strategies to Improve Energy Efficiency* (Business Insights, 2010), *Investment Decisions for Baseload Power Plants* (U.S. Department of Energy, 2010). Patrick has also contributed to the *Energy Efficiency Markets Newsletter* on several occasions.

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Roshni has conducted diverse analyses, such as estimating industrial and lifecycle greenhouse gas emissions, evaluating abatement costs for low-carbon technology options, and projecting the impacts of energy-efficiency policies. She has helped develop energy tracking and peer benchmarking tools, and has led corporate initiatives for employee engagement in sustainability. For the past three years, Roshni has assessed quantitative uncertainty in greenhouse gas emissions reported for various source categories in the U.S. Environmental Protection Agency's *U.S. Greenhouse Gas Inventory Report*.

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