Dr. Chris Wedding
Executive in Residence: Duke University, Nicholas School of the Environment
Founder & Managing Partner: IronOak Energy Capital
chris.wedding@duke.edu | 919.274.7988

TA: Annie Jung, ann.jung@duke.edu, 661-714-7625

Class Meeting Times:
Wednesday 8:00 to 9:30pm

Office Hours - Professor:
Thursday 5:15 to 5:45 pm

Office Hours - TA
Mondays 7:00 to 8:00 pm
Course Description:

Green building has become one of today’s most significant forces in real estate development and corporate sustainability. Moreover, the boundaries of green real estate are now expanding to cover smart cities as well.

However, these changes in the built environment are not really about environmental ambitions. Instead, they are about increasing building value, reducing operating costs, improving the health of building occupants, attracting and retaining talent to a workforce, gaining market share, and building corporate brand.

Consider a few statistics: In the last 15 years or so, green building has expanded from 2% to roughly 50% of new non-residential real estate market share. It includes billions of square feet certified as green in 160+ countries. Leading industry adopters include Bank of America, Wells Fargo, Toyota, Adobe, Google, Starbucks, Boston Properties, Jones Lang LaSalle, ProLogis, Skanska, Turner Construction, CBRE, and many more.

Course content will follow two parallel paths that run throughout class. The first path focuses on perspective; the class offers insights on green building from the point of view of entrepreneur, investor, business owner, engineer, architect, and/or product manufacturer. The second path concentrates on content; the class covers green buildings topics in the categories of costs and benefits, marketing, site and community context, materials and health, energy and water.

Students will explore these topics through the lenses of business strategy, corporate sustainability drivers, challenges and risks, global megatrends, investor perspectives, entrepreneurship, measures of success, and implementation tools. Teaching methods will include case studies, practice-oriented assignments, readings from industry and thought leaders, structured group discussions, and skill building such as professional memo writing.

Students that are interested in working directly or indirectly in the green building industry should consider pursuing their LEED Green Associate (LEED-GA) or LEED Accredited Professional (LEED-AP) designation. This will help prepare students for these tests, but additional self-study is required. This would take place after this course is complete, and is at the discretion of the student. For more information, see this website: www.gbci.org.
Select Course Objectives:

After taking this course, students should:

- Be skilled in making the business case for or against a green building or smart city project, product, policy, partner or initiative
- Be able to define green building and smart cities in terms of current practice, the leading edge and where the industry is headed
- Understand broadly how verification of green building occurs (e.g., processes, organizations, eco-labels, etc.)
- Improve their ability to sell, market, and communicate about green building and smart city trends, projects and innovations
- Have a grasp of salient resources in the field for further learning, including websites, tools, books, individuals, and organizations
- Learn to think critically about innovations in the field (risks and challenges, too) and not be distracted by the “shiny object” syndrome
- Be motivated to generate ideas for potential new businesses in the growing field of green building

Skills that students should learn to do the following:

- Construct professional memos making the business case for or against a finance strategy
- Summarize environmental business ideas in the Business Model Canvas tool
- Collaborate efficiently remotely among teams of different ages and disciplines

---

Course Outline and Readings

The Harvard Business Publishing case studies course pack can be purchased at this link.

When you have questions:

I do not want any student to fall behind or remain confused. (Some confusion though is good. That might be a temporary step to greater learning.) Please do not wait too long to get answers.
There are seven ways to get your questions answered, in order of preference:
1. Ask your question to me during or after class.
2. Ask your question to your peers before or after class.
3. Email the TA with questions: Annie Jung, ann.jung@duke.edu
4. Set up a time to meet with the TA during office hours.
5. Post any questions you have after class in the Discussion Board under “General Q&A.”
6. Email me with your question: chris.wedding@duke.edu.
7. Schedule a time to call me during my office hours.

To facilitate helpful class discussions

I expect students to come to class prepared to share their ideas and questions from the readings. To help students prepare and focus on certain parts of the readings below, I will share some specific questions for class ahead of each class in Framing questions for Wed. night class.

To facilitate retention of key lessons

In any university course, including this one, we will cover many pages of reading and many topics of discussion. It can be difficult to decipher the most important points for each class.

In order to help students remember the critical takeaways for each class, I will share about 4-5 of these takeaways for each Module. I will also invite students to post their own takeaways, too. This contributes towards your Class Participation portion of your grade. There is a Forum question for this in each Module.

<table>
<thead>
<tr>
<th>Dates</th>
<th>Readings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 1: Industry Overview</td>
<td>McKinsey - <a href="https://www.mckinsey.com/business-functions/sustainability/our-insights/organizing-for-purpose">Profits with purpose: How organizing for sustainability can benefit the bottom line</a> - Read all</td>
</tr>
<tr>
<td>Wed. 1/16</td>
<td>GreenBiz - <a href="https://www.greenbiz.com/article/state-green-business-2018">State of Green Business 2018</a> - Read (as least) pages 8-14, 22-24, 36-39 - there is a lot more great material to read here if you make time</td>
</tr>
<tr>
<td>Module 1: Industry Overview</td>
<td><a href="https://www.breakthroughenergycoalition.org/">Landscape of Innovation (Breakthrough Energy Coalition)</a> - Read all</td>
</tr>
<tr>
<td></td>
<td>Smart Cities Dive - <a href="https://www.smartcitiesdive.com/">How rising global temperatures will</a></td>
</tr>
<tr>
<td>Date</td>
<td>Topic</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>Wed. 1/23</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Module 2:</td>
<td>Business Case</td>
</tr>
<tr>
<td>Module 2:</td>
<td>Business Case</td>
</tr>
<tr>
<td>Wed. 2/6</td>
<td></td>
</tr>
<tr>
<td>Wed. 2/13</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Module 3:</td>
<td>Energy - Renewables</td>
</tr>
<tr>
<td>Wed. 2/20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Module 4:</td>
<td>Transportation &amp; Land planning</td>
</tr>
<tr>
<td>Wed. 2/27</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Module 4: Transportation &amp; Land planning</td>
<td>Car Ownership - Read pages 8-60</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Wed. 3/6</td>
<td>IronOak Energy Capital - Electric Vehicle Leveraged Finance Opportunities, Challenges, &amp; Solutions (IronOak Energy Capital) - Read pages 6, 8-9, 10-16, 19, 21, 29-54, 69-70, 73-74, 79</td>
</tr>
<tr>
<td></td>
<td>Bloomberg NEF - Electric Vehicle Outlook 2018 (Bloomberg NEF) - Read all</td>
</tr>
<tr>
<td></td>
<td>RethinkX - Rethinking Transportation - Read pages 6-27, 32-33, 49-55</td>
</tr>
</tbody>
</table>

**SPRING BREAK**

<table>
<thead>
<tr>
<th>Module 5: Sites &amp; Water</th>
<th>Deloitte - The aging water infrastructure: Out of sight, out of mind?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wed. 3/20</td>
<td>The Guardian - Access to drinking water around the world – in five infographics</td>
</tr>
<tr>
<td></td>
<td>ImagineH2O - Portfolio companies - Click and study 5 companies, and ask, “Why are they unique in solving a water challenge?</td>
</tr>
<tr>
<td></td>
<td>USGBC - LEED v4 - Skim pages 50-62</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 5: Sites &amp; Water</th>
<th>IEEE - The Green Promise of Vertical Farms - Read all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wed. 3/27</td>
<td>Architecture 2030 – 2030 Palette - Click and read Region,” District,” and “Site” for 45 minutes.</td>
</tr>
<tr>
<td></td>
<td>USGBC - LEED v4 - Skim pages 30-49</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 6: Materials &amp; Health</th>
<th>BuildingGreen – What Makes a Product Green - Read all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wed. 4/3</td>
<td>World Green Building Council – Health, Wellbeing and Productivity in Offices – Read pages 6-16</td>
</tr>
<tr>
<td></td>
<td>Architecture 2030 – 2030 Palette - Click and read “Materials” for 30 minutes.</td>
</tr>
<tr>
<td></td>
<td>USGBC - LEED v4 - Skim pages 85-137</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 6: Materials &amp; Health</th>
<th>Terrapin BrightGreen - The Economics of Biophilia - Read sections 1.1, 1.2, 1.3, (scan section 2.0), 3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wed. 4/10</td>
<td>Michael Green (TED) - Why we should build wooden skyscrapers?</td>
</tr>
<tr>
<td></td>
<td>Biomimicry 3.8 – AskNature – Spend 30 minutes on the site. Make note of 5 things that you found relevant to your past or future work.</td>
</tr>
</tbody>
</table>
Module 7: Social Equity
Wed. 4/17

- Majora Carter (TED) – [Greening the Ghetto](#)
- Smart Cities Dive - [To build an inclusive smart city, look through an age-friendly lens](#)
- USGBC - [Social equity within the community](#)

Course Format, Assignments, Grading, and Expectations

The course will consist of live and recorded lectures, Discussion Board, and shared summaries of key takeaways.

Recordings of our Wednesday night calls will be posted in a folder in Resources.

Assignment Due Dates:

<table>
<thead>
<tr>
<th>Date</th>
<th>Assignment Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 28</td>
<td>Trend Summary #1 (2 pages of bullets)</td>
</tr>
<tr>
<td>Feb. 11</td>
<td>Trend Summary #2 (2 pages of bullets)</td>
</tr>
<tr>
<td>Feb. 25</td>
<td>Trend Summary #3 (2 pages of bullets)</td>
</tr>
<tr>
<td>Mar. 25</td>
<td>Assignment #1: Certify a Green Building or Development Project (Mock)</td>
</tr>
<tr>
<td>Apr. 29</td>
<td>Final Project: Green Building or Smart Cities Startup 101</td>
</tr>
</tbody>
</table>

---

20% of Class Grade:
Trend Summaries

Due Dates -- Jan. 28, Feb. 11, Feb. 25 | Monday by midnight
These short briefings provide a mechanism for students to watch for and understand current events regarding green building and smart cities.

A written “Trends Summary” (<2 pages, bulleted format) contains five sections:

1. Your hypothetical company and job title.
2. Summary of the green building and smart cities news headline -- What is the environmental and business opportunity that it represents? Why is it better than status quo? How does it help solve a challenge with few solutions today?
3. Pros (benefits) for your organization.
4. Cons (risks) for your organization.
5. Your recommendation as to what your hypothetical organization should do regarding the green building and smart cities news or trend about which you are writing (e.g., ignore it, act on it, implement a variation on the theme). What is the general timeline for next steps and implementation of the plan?

Some students will be picked during most classes to present their Trend Summaries in front of the whole class. This will be random.

Google searches are not the method to find relevant articles for this assignment. Instead, students should at first rely on the pre-vetted sources listed below.

**Green building and smart cities specifically:**

- Journal of Sustainable Real Estate
- ULI | Urban Land Institute
- American Institute of Architects
- Green Building Advisor
- LEEDUser
- Smart Cities Dive
- Living Building Challenge
- USGBC | U.S. Green Building Council
- BuildingGreen
- GreenSpec
- U.S. Energy Star
- Environmental Design & Construction Magazine
- NAIOP | Commercial Real Estate Development Association
- BOMA | Building Owners and Managers Association International
Green building and real estate, as well as other sustainability topics:

- Greenbiz
- Sustainable Business
- Environmental Leader
- National Renewable Energy Laboratory
- U.S. Energy Information Administration
- U.S. Energy Efficiency and Renewable Energy Office
- Grist
- Huffington Post Green
- New York Times Green Inc
- Worldchanging
- TED

Use this **Trends Summaries template** to make this exercise easier.

---

**25% of Class Grade:**
**Discussion Board**

Given the online nature of this class, the Discussion Board is a critical platform for learning the concepts in this class. Please see the grading rubric at the end of the Syllabus for expectations.

---

**25% of Class Grade:**
**Assignment #1:**
**Certify a Green Building or Development Project (Mock)**

There are many types of third-party certification programs for green building and development. They are all different. Some focus only on energy or are regionally specific. Others are stringent, while a few aim for mainstream projects.

While scoring well on third-party certification programs is not the goal, but these function as useful tools and methods of communicating strategy and tactics among larger teams.
Your project has four components:

1. Pick a real or hypothetical building or development – This could be your house, office, or some other location
2. Pick a third-party certification program to use – This could be a program from the USGBC (e.g., one of the LEED options), US EPA (e.g., Energy Star), the International Living Future Institute (e.g., Living Building Challenge), or another one
3. Describe how your project would likely score (e.g., LEED Gold) on the third-party certification program
4. Decide who will be the audience for presenting your assessment

For your deliverable, you should:

- Explain why you chose the third-party certification program that you selected
- Discuss which points or credits your project would obtain, a few challenges that exist to scoring higher, how a few points could be “gamed” if relevant, and the general approach you would take to earning each point or credit (but you do not need to go into great detail)

For format, you could use Excel, Word, PPT, and/or other software as you see fit to communicate your work.

Due Date -- Mar. 25 | Monday by midnight

---

25% of Class Grade:
Final Project:
Green Building or Smart Cities Startup 101

Group Assignment: 2-3 students

There are many inefficiencies and complaints within the green building and smart cities sectors. These present the opportunity for new businesses to solve these problems.

In this hypothetical scenario, pretend that you work for a business incubator run by a university in collaboration with a network of private high net worth
individuals. Your job is to conceive of and help launch new startups in order to employ university graduates, leverage university talent, and generate financial returns for the angel investors.

Use this template for completing and submitting parts 1, 2 and 3 of your assignment.

For this project, there are several steps:

1. **Initial list:** Make a list of five inefficiencies and complaints that you have read about or experienced firsthand. What is the frustration? Who feels it? What paints does it create (e.g., time lost, dollars lost, brand impacted, etc.)?
2. **Validation and refinement:** Create a framework to assess which of the five business ideas above. What variables will determine the best opportunity? Validate one or more of your ideas via informal primary research (e.g., in person, phone, or electronic surveys) or secondary research (e.g., third-party research from trusted sources). Pick one idea on which to focus.
3. **Business planning:** Use the Business Model Canvas to create a one-page business plan around your concept. Use the Excel template provided in by the professor.
4. **The pitch:** Create a 6-10 slide PPT designed for the investor audience. It should include the following. Create your own PPT for this. There is no template.
   - Cover slide
   - 1-line summary of the business
   - Amount of investment requested
   - How the investment dollars will be used
   - Timeline with 7-10 steps for getting the first product or service to market, with paying customers
Due Date -- Apr. 29 | Monday by midnight

---

**5% of Class Grade:**

**Class Engagement**

Students are expected to be active learners and come to class with comments and questions. Questioning what you read, making it relevant to your professional goals, and explaining it to others contribute greatly to the learning process. A positive attitude also goes a long way. Always assume good intentions.

All students will receive a 2 (on a scale of 1 to 3, see “Grading” below) by default. If you stand out or underperform, then this will be changed to 1 or 3, respectively. Regardless, this is a very small consideration in your overall grade. I nor the TAs will debate this part of your grade. (But no worries because I know you will also do your best!)

---

**Grading**

Grading will be based on the rubric below.

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Where Submitted</th>
<th>How Graded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly Calls</td>
<td>Attend or watch the recorded version</td>
<td>Scale: 1-3</td>
</tr>
<tr>
<td>Trends Summaries</td>
<td>Online via Sakai</td>
<td>3 = highest, great job</td>
</tr>
<tr>
<td>Assignment #1</td>
<td></td>
<td>2 = average</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = lowest, try harder</td>
</tr>
</tbody>
</table>

---
Grading is based on the following:

- **Insight** - e.g., original commentary, breadth of perspectives, “beyond the headlines and buzz words”
- **Rigor** - e.g., number of footnotes, validity of citations, depth of arguments, awareness of challenges / cons, excelled compared to peers
- **Polish** - e.g., formatting, typos, writing quality
- **Structure** - e.g., followed directions
- **Presentation / Q&A (for Trend Summaries)** - e.g., loud voice, eye contact, thoughtful response to questions

Late assignments will be penalized with one lower letter grade, unless students notify the professor or TA before the assignment’s due date, and the excuse is reasonable, unusual, and not recurring.

I want you to strive for excellence in my class, where the goal is to learn as much as you can. In contrast, I am not especially focused on your grades, and I do not expect you to worry about grades. If you must, you can discuss grades with the TAs, but please only plan to discuss non-grading topics with me (e.g., course content, professional interests, internships, or job searches).

**Other Topics**

**Come see me**

I hope that every student comes to see me in my office, or plans a short meeting with me after class. I want to learn more about your path to Duke, your plans after Duke, and how I might help you. When you come visit me, my goal is to provide each of you with 1-2 professional introductions that might support your
internship, job, or job hunt. (It helps if you also get your resume and one-paragraph professional bio updated with help from Nicholas School Career Center staff.)

**Timely Feedback**

My goal is to be one of the best professors you have ever had. (I joke, but I am also serious.) If you have concerns, questions, or suggestions on how to improve student learning, please tell me immediately. I may be able to adjust class structure along the way. In contrast, if you wait to provide feedback when the class is over, then I am unable to help you or fellow students who may share similar thoughts on ways I can help you learn better.

**My speaking**

I am very passionate about environmental finance, so I sometimes speak quickly. For some students, especially those from countries outside of the U.S., this may add difficulty in understand new finance concepts.

If you find this to be true for you, please email or ask me in person to speak more slowly, or to explain idioms or expressions from the business or finance world that are not intuitive to you. I am happy to slow down, step back, and explain more clearly.

---

**Disclaimer:**

Content, schedules, and assignments in the syllabus may change slightly during the semester. If this happens, students will be notified accordingly.

**Honor Code:**

The honor code observed in the Nicholas School of the Environment (the “Nicholas School”) follows the principles set out in the Duke Community Standard. Its procedures draw on those developed by the Duke undergraduate judicial system. By enrolling in this class, you agree to abide by the Duke Community Standard and its application in the Nicholas School before you may enroll. Please find the full code here.
Professor Biography:

Dr. Chris Wedding’s professional focus is renewable energy project finance, green building strategy, early stage cleantech ventures, the electric vehicle market, opportunities in energy storage, entrepreneurship, and market research. He has over 20 years of experience in private equity, project finance, startup finance, executive education, and academia. He is an Executive in Residence with the Nicholas School of the Environment at Duke University; the Founder and Managing Partner of IronOak Energy Capital, an investment banking and advisory firm focused on exclusively on clean energy; a Registered Representative with Series 22, 63, 79, and 82 financial licenses via the Carolina Financial Group; a Professor of the Practice with the University of North Carolina at Chapel Hill (UNC) Kenan-Flagler Business School; Founder of The Invest for Impact Academy, an education platform for impact-driven business and finance; and one of the earliest LEED Accredited Professionals with the US Green Building Council. He was also a Director and Senior Advisor at Cherokee Investment Partners, a private equity firm that has raised over $2 billion in private equity funds and, separately, founded or invested in 150 startups and venture funds. He brings a global perspective, with experience in 21 countries and language abilities in Spanish, Japanese, and Creole. As one of the top 10% most viewed LinkedIn profiles, he is a connector, catalyst, and frequent speaker at national and global energy and finance conferences. Dr. Wedding received a BS summa cum laude in Environmental Science from Western Kentucky University, where he was a national Goldwater Scholar in Math and Science. At UNC, he earned an MS and PhD focused on business and strategy in real estate and energy.
Discussion Board Guidelines

Each 10-14 day module will be graded using the rubric below.

A post should be at least 2-3 sentences and no more than a few paragraphs. Word totals for each post should be in the range of 50-150 words. This is intended to serve as a guideline; however, content and quality will be the major considerations when assigning grades.

“A” Discussion – 5-6 posts per module
A-level postings:
- Are made in a timely fashion, giving others an opportunity to respond.
- Are thoughtful and analyze the content or question asked.
- Make connections to the course content and/or other experiences.
- Integrate outside resources, including websites, news articles, and other reports that you have read.
- Motivate group discussion, and present a creative approach to the topic.
- Extend discussions already taking place or pose new possibilities or opinions not previously voiced.

“B” Discussion – 3-4 posts per module
B-level postings:
- Are made in a timely fashion, giving others an opportunity to respond.
- Are thoughtful and analyze the content or question asked.
- Make connections to the course content and/or other experiences, but connections are unclear, not firmly established or are not obvious.
- Include outside resources, including websites, news articles, and other reports that you have read, but they are not well described in the post or thoroughly integrated into the conversation.
- Contain novel ideas, connections, and/or real-world application but lack depth, detail and/or explanation.

“C” Discussion – 2 or fewer posts per module
C-level postings:
- Are not made in a timely fashion.
- The information delivered is limited.
- Make vague or incomplete connections between class content and posting by other students.
- Summarize what other students have posted and contain few novel ideas.