

Environmental Finance: Financial Innovation for Green Growth

Environmental Markets, Sustainable Investment, and Financial Technology

**CEE/ChE/ENSCEN 588
NRE 401-014**

Course:

Fall 2018
MW 4:30-6:00 PM
1303 EECS (North Campus)

Instructor:

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Background

After the Paris Climate Accords, two agreements were launched that focus on financing environmental sustainability and climate risk mitigation: Mission Innovation (public sector) and the Breakthrough Energy Coalition (private sector). The Trump Administration decided to not commit, in part because of the perceived cost to business, and in part because of unwillingness to commit public resources to address the issue. The US Administration seeks to engage private sector capital. This course will explore the opportunities for public-private partnerships (PPP) and private investment vehicles to advance green growth and sustainability.

According to the UN-Principles of Responsible Investment (UN-PRI), as of 2017, over 1,500 asset managers with \$ 70 trn. of global assets under management (AUM) incorporate Environmental, Social, and Governance (ESG) mandates in investment decision-making. This renders sustainability investing one of the single largest investment mandates, crossing all asset classes, including (public and private) equity, credit, and bond markets. Even though dedicated CleanTech venture capital (e.g. Chrysalix) and sustainability investing (e.g. Generation Investment Management) started a decade ago, most of the shift has taken place in the last five years.

Importantly, environmental finance has driven new entrepreneurial opportunities in financial innovation of green technologies, assets, and economic growth. Examples such as green institutional crowd investments, solar asset-backed securities, green bonds and impact bonds were non-existent just a few years ago. Green FinTech, the application of big data science and artificial intelligence to green finance, saw its first mention in the media just in 2017.

Objective

This course will review innovations in processes, investment mandates and financial basics of Environmental Finance across traditional (stocks and bonds) and alternative asset classes (real assets, private equity, hedge funds, and structured products). It will examine how structures and financial return characteristics inform capital allocations to environmental and sustainability objectives. We will explore how blockchain is starting to disrupt the environmental finance space.



Class Project.

The class project will focus on analyzing and restructuring the UM Endowment as an environmentally-tilted portfolio of investments and compare its risk/return profile before/after. We will rely on information published by the endowment (see Canvas).

Course Materials.

Because of the rapidly evolving dynamics of the field, we will use articles from leading industry magazines or blogs: Greenbiz.com, Environmental Finance (www.environmental-finance.com), Institutional Investor (<http://www.institutionalinvestor.com/>), Responsible Investor (www.responsible-investor.com/home/), as well as chapters that will be uploaded separately. The first lecture each week will set the stage by surveying the topical area and investment tools. The second lecture will be either a discussion led by an invited expert, a workshop on recent financing events, or a 'flipped classroom'-type lecture.

Audience.

The target audience is Master's level environmental engineering, environmental science and business students with an interest in careers such as: Environmental policy design, financial analyst, portfolio manager, financial product development; Investment and management consultant; Venture capitalist, private equity or real estate investor; Credit and insurance risk analysts. The perspective provided will be valuable for students that are looking to engage in innovation opportunities and are interested in becoming leaders in this rapidly growing field.

Lead Instructor



Dr. Adriaens is Professor of Environmental Engineering and Finance, Professor of Entrepreneurship and Strategy in the Ross School of Business, and Professor in the School for Environment and Sustainability (SEAS). He has served as President of the Association of Environmental Science and Engineering Professors (AEESP), is a member-by-eminence of the American Academy of Environmental Engineering (AAEE), and Member of the Belgian Royal Academy of Applied Sciences. He has held distinguished Professorship appointments in China (Suzhou) and Europe (Finland), and serves as a member of the UN's advisory board on financial innovation for implementation of the Sustainable Development Goals (SDGs). As co-founder and acting CEO of Equarius Risk Analytics LLC (www.equariusrisk.com), a financial technology firm, I lead a team on equity and portfolio risk analytics related to water for the indexing and ETF market.

Grading Structure

The grading structure involves both a paper and in class participation (this can be substituted with on line forum activities on Canvas):

1. Project paper: 60%
2. In class participation (demonstrate you have read the assigned materials): 20%
3. Forum activities: 30%

Office Hours

Each Monday and Wednesday before class (3-4:30) in 175 EWRE (1351 Beal Ave). Alternative times can be arranged upon request (adriaens@umich.edu).

COURSE CONTENT

Week 1 (09/05). Environmental Finance - Overview

Course overview and expectations. Review of course materials and organization. Setting the stage. What is environmental finance?

Readings:

1. <https://www.linkedin.com/pulse/climate-finance-public-discourse-literacy-gaps-from-k-12-adriaens?published=u>
2. Facts, figures, and trends (Bloomberg NEF, 2018; UNPRI Annual Report, 2016; Canvas)
3. Video – Norwegian Sovereign Wealth Fund (<https://www.nbim.no/>)

Week 2 (09/10 & 09/12). Traditional vs. Alternative Investments in Environmental Finance

Financial asset classes and buy/sell investors. Structures, return characteristics and scalability.

Topics:

- The environmental finance & investment value chain – system components
- Facts, figures, and trends (Bloomberg NEF, 2015; UNPRI Annual Report, 2016)
- Mainstreaming environmental finance

Readings:

1. Introduction to Environmental Finance (Canvas)
2. Credit Suisse: Conservation Finance - From Niche to Mainstream: The Building of an Institutional Asset Class (Canvas)
3. Chapter on 'Alternative Investments'

Relevant Weblinks:

1. Environmental Finance (www.environmental-finance.com)
2. Sustainable Investment Forum
3. UN Environment Program – Finance Initiative

Case Application and Discussion:

Traditional vs. alternative investments: Solar energy – “More than one way to skin a cat”.
Student web search & feedback

Week 3 (09/17 & 09/19). Stocks and Impact Funds: ESG-based Investing

Integrating ESG factors into fundamental investment analysis. Spectrum of impact investing and return characteristics.

Topics:

- An investors perspective on the ESG issues impacting financial value
- Climate change – the ultimate environmental finance issue
- Who is making the link? Analysts, asset managers, pension funds, WBCSD, UNEP
- Review of academic studies on ESG/RI/SRI performance

Required Reading:

- Bob Massie, 2016 (<http://www.institutionalinvestor.com/article/3535562/investors-pensions/welcome-to-the-esg-evolution.html#.WZHf4dPysxg>)
- Textbook, Chapter 2 (Sustainable Equity Investing: The Market Beating Strategy) and Chapter 4 (Sustainability Analysis)
- Investor Responsibility Research Center, 2012. ESG Metrics that Matter.

Suggested Resources:

1. US Sustainable Investment Forum (SIF); <http://www.ussif.org/esg>
2. New Alpha Source for Asset Managers: Environmentally-Enhanced Investment Portfolios. http://www.sristudies.org/bib_gl2.html
3. UNEP Finance Initiative: <http://www.unepfi.org/publications/investment/index.html>

Case Application and Discussion:

ESG-based investing. Comments from Lydia Miller, Dana Investment Advisors or Cyrus Loffipour, Vice President, ESG Research at MSCI Inc.

Week 4 (09/24 & 09/26). Green Bonds: Tracking Green Performance

In depth overview of green bonds, issuance, assurances and rating. Innovations and new business development in green bond structuring and rating.

Topics:

- Corporate green bonds – who is issuing?
- Green bonds – who is buying?
- Standardization of green bonds
- Green bond underwriting and auditing

Required reading

Climate Bonds Taxonomy (<http://www.climatebonds.net/standards/taxonomy>)
 Bonds and Climate Change (HSBC and the Climate Bonds Initiative)

Suggested sources

OECD (2016), A quantitative framework for analyzing potential bond contributions in a low-carbon transition (Canvas)

Case Application and Discussion:

Municipal bond: DC Water Authority Green Performance Bond (<http://www.goldmansachs.com/media-relations/press-releases/current/dc-water-environmental-impact-bond-fact-sheet.pdf>) Comments from Eric Letzinger, CEO Quantified Ventures (not confirmed)

Week 5 (10/01 & 10/03). Project Finance: Leveraging Debt and Equity

Overview of project finance, investment model, and carbon offsets

Topics:

- Kyoto Protocol; EU Emissions Trading System (ETS) and the role of the Clean Development Mechanism (CDM) and JI (Joint Implementation)
- Buying and selling offsets
- Project finance structures and special purpose entities (SPE)

Required reading:

Sustainable Investing, Chapter 5: Observations from the Carbon Emissions Markets: Implications for Carbon Finance
Groobey et al. (2010). Project finance primer for renewable energy and cleantech projects (Canvas)
Project finance teaching note, Wharton Finance Department (Canvas)

Relevant weblinks:

1. CDP (formerly: Carbon Disclosure Project; <https://www.cdp.net/en>)
2. Carbon Tracker (<http://www.carbontracker.org/>)

Case Application and Discussion:

Special purpose vehicle (SPV) for investment in waste-to-energy facilities. Comments from Jonas Englund, VP Market Sales, SEB Enskilda (Swedish Commercial Bank)

Week 6 (10/08 & 10/10). Real Asset Impact Investments: 1. Yieldco's and Green Real Estate Investment Trusts (REITs)

Financing the transition to a green economy through green assets. Innovations in low-carbon investments and business models.

Topics:

- Real estate investment trusts (REIT)
- Yieldco's: Investment vehicles to protect investors from regulatory changes

Required reading:

A Sustainable Yield; Environmental Finance (<https://www.environmental-finance.com/>)
The new carbon economy: Financing a low carbon future
(<http://newclimateeconomy.report/finance/>)
Cambridge Associates, 2017: Impact Investment Benchmark/Real Asset Impact Performance (Canvas)

Suggested Reading:

Carbon Capital: Financing the low carbon economy (Accenture; Canvas)

FALL BREAK 10/15-16

Week 7 (10/17). No Class

Professor Adriaens at London Water Investment Summit.

Week 8 (10/22 & 10/24). Real Asset Impact Investments: 2. Master Trusts and Asset-backed securities

Bundling and securitization of 'green' assets. Unlocking 'liquid capital' for real assets.

Topics:

- Securitization: Benefits, Risks and Process
- Asset backed solar and energy efficiency securities
- Collateralized debt obligations and project bonds

Required reading:

What is securitization (Canvas)
National Renewable Energy Laboratory. Securitization in Solar PV Finance (Canvas)

Suggested Resources:

Asset-backed securitization (http://people.stern.nyu.edu/igiddy/articles/abs_risks.pdf)
Energy efficiency securities (<http://www.citigroup.com/citi/news/2015/150615a.htm>)

Case Application and Discussion:

Smart Watersheds: Securitizing investment in smart agricultural drains by connecting agricultural technology, crop productivity, and futures markets. Adriaens to lead discussion.

Week 9 (10/29 & 10/31). Real Asset Impact Investments: 3. Insurance and derivatives

Enterprise Risk Management and managing weather-related risk. Innovations in weather derivatives and hedging mechanisms.

Topics:

- Enterprise risk management (ERM) – basic principles
- Integrating sustainability in ERM processes
- Climate change impacts: physical & operational
- Hedging climate change risk: insurance, weather derivatives, catastrophe bonds

Required reading:

Carbon Finance, Chapter 8: Adapting to Adverse and Severe Weather (Canvas)
The Price on Nature (Richard Sandor): <https://www.youtube.com/watch?v=rW-ovT6z5e8>
Brookings. Efficiently regulating the Carbon Derivatives Market (Canvas)

Suggested Resources:

- The Finance of Climate Change, Chapter 14: Weather Derivatives and Carbon
- Emissions Trading Environmental Finance: www.environmental-finance.com
- Weather Risk Management Association <http://www.wrma.org>

Case Application and Discussion:

Meyer et al., 2016. Designing A Great Lakes Shipping Derivative (Canvas)

Week 10 (11/05 & 11/07). Real Asset Investments: 4. Venture Capital and Private Equity

Risk and valuation in venture capital and private equity financing of CleanTech and environmental projects

Required Reading:

International Finance Corporation: Private Equity – Developing Countries (Canvas)
MIT. 2016. Venture Capital and CleanTech: The wrong model for clean energy innovation? (Canvas)

Suggested Resources:

Brookings. <https://www.brookings.edu/research/cleantech-venture-capital-continued-declines-and-narrow-geography-limit-prospects/>
CleanTech Group (www.cleantech.com)
The Global CleanTech Innovation Index (Canvas)

Case application and discussion:

SkySpecs. Developer of an automated, aerial data collection and analytics platform (Ann Arbor). Comments from Ryan Waddington, Huron River Ventures.

Week 11 (11/12 & 11/14). Green FinTech and Real Assets: Crowd lending, crowd equity, P2P investing

Financial technology and 'green fintech'; Sustainable microfinance, lending and P2P investing.

Topics:

- Microfinance – its growing relevance as institutional investment
- Crowd-lending, crowd-equity and peer-to-peer (P2P)
- Discussion of future trends of crowd finance and the potential for environmental finance

Required reading:

Sustainable Investing, Chapters 9 (Fixed income and microfinance)
Cambridge University. Online alternative (crowd) finance (Canvas)

Suggested resources:

<https://www.insidephilanthropy.com/home/2017/5/2/crowdfunding-environment-worthwild>
<https://blogs.thomsonreuters.com/answeron/crowdfinancing/>

Case Application and Discussion:

Institutional Crowd Finance: Convergence. Comments by Markus Lampinen, Fintech Entrepreneur and Investment Professional; Founder, Crowd Valley, Inc (San Francisco); <http://www.crowdvalley.com/>

Week 12 (11/19 & 11/21). Green FinTech: The Blockchain Investment Model

Background on the blockchain model, initial coin offerings (ICO), and distributed ledgers

Required reading:

Deloitte. What is a blockchain (Canvas)
<https://hbr.org/2017/03/what-initial-coin-offerings-are-and-why-vc-firms-care>
<https://hbr.org/2016/05/the-impact-of-the-blockchain-goes-beyond-financial-services>

Suggested resources:

<https://www.technologyreview.com/s/604227/blockchain-is-helping-to-build-a-new-kind-of-energy-grid/>
<https://hbr.org/2017/03/how-utilities-are-using-blockchain-to-modernize-the-grid>

Case Application and Discussion:

Brooklyn Smart Grid – Blockchain-enabled:
<http://www.politico.com/magazine/story/2017/06/15/how-a-street-in-brooklyn-is-changing-the-energy-grid-215268>. Comments by Asheesh Birla, Co-Founder Ripple (not confirmed)

Week 13 (11/26 & 11/28). Systemic Economic Development. Multi-Asset Renewal Funds (MARF)

What is systemic economic development? Fund structuring and performance evaluation.

Topics:

- Sustainable value systems: cross-industry functional ecosystems
- Structuring funds: Investment objectives, investments and assets
- Examples: smart grid, smart mobility, green chemistry

Required reading:

Adriaens and Tahvanainen, 2016. Financial Innovation for Industrial Renewal, ETLA Press, Chapters 3 and 6 (free download at <https://www.etla.fi/en/publications/financial-technology-for-industrial-renewal/>)

Suggested resources:

Clusters for economic development (<http://www.clustermapping.us/>)
(required for case application) Ketels, 2016. Clusters and regional economic development for Great Lakes (Canvas)

Case Application and Discussion:

The Great Lakes and St. Lawrence Blue Growth Fund. Commentary by David Naftzger, President, Conference of Great Lakes and St. Lawrence Governors and Premiers

Week 14 (12/03 & 12/05). Hedge Funds. ESG and SRI Strategies

Types of hedge funds. Environmental strategies and integration of ESG/SRI

Topics:

- What is a hedge fund, and what type of asset classes does it comprise?
- How do hedge funds engage with environmental and impact issues

Required Readings:

- What are hedge funds (<https://www.thebalance.com/what-are-hedge-funds-3306246>)
- Alternative Investments, 3rd Edition, Chapter 2 pp 32-43 (Canvas)

Suggested Resources:

Hedge funds warm to responsible investment principles
(<https://www.ft.com/content/8d7df9f2-0a08-11e5-a6a8-00144feabdc0>)
<http://www.hedgefundmarketing.org/sustainable-and-responsible-hedge-funds-on-the-rise/>

Case Application and Discussion:

TBD

Week 15 (12/11). Overview of Environmental Finance Investment Models

Recap of the term.

Reading:

From the Margins to the Mainstream Assessment of the Impact Investment Sector and Opportunities to Engage Mainstream Investors (Canvas)