EVPP 434: Food-Energy-Water Nexus

Spring 2022

Tuesdays 4:30 - 7:10 pm

Instructor

Dr. Jennifer Sklarew
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Hours: Tuesdays, 3:15 pm to 4:15 pm by appointment

Course description: Food, energy and water systems face individual challenges to their sustainability and resilience. Linkages between these systems can generate additional challenges, exacerbated by climate change. These linkages also can enable integrative solutions. In EVPP434/534: Food Energy Water Nexus, we'll discuss resilience and sustainability challenges that involve the food-energy-water nexus and climate change interconnections, as well as innovative solutions to these challenges. Our discussions will bridge multiple disciplines, as we examine the technological, economic, and institutional dimensions of the nexus in various places around the globe at local and national scales, as well as relevance to the UN Sustainable Development Goals (SDGs). Guest speakers include U.S. government officials, NGO leaders, an aquaponics farm founder, and researchers examining food-energy-water issues in overseas low income communities. All students will choose a place of interest to you -- city/town, state, country, or organization -- to research for your individual semester project, creating your own case studies.

Course Learning Objectives:
1) Ability to define linkages between food, energy and water systems;
2) Ability to describe interlinked challenges facing these systems;
3) Ability to identify some existing solutions to these challenges;
4) Ability to analyze existing and new solutions to these challenges;
5) Ability to explain how the parameters for 1-4 vary for different places.
6) Ability to develop a case study of a place or organization's food-energy-water nexus challenges, solutions to them, and challenges facing the solutions.

Weekly Learning Objectives:
Weekly learning objectives will help us to move toward our course learning objectives.

Readings:
Required text:
Dodds, Felix, and Jamie Bartram, Eds. 2016. *The Water, Food, Energy and Climate Nexus: Challenges and an agenda for action*. Routledge.

Weekly readings and videos: All students must read all of the required readings and watch the required videos. Graduate students must also read the optional readings marked with **.

Assignments:

1) **Article for discussion:** Once during the semester, each student will find one article (newspaper, journal, magazine, website posting, etc.) on the session topic for discussion in class. It cannot already be listed in the syllabus course readings. By midnight the Saturday before class, please send to me via email a) the article as a PDF and b) 2-3 questions for the class to discuss, so I can distribute them for everyone to read before class. Be prepared to lead a 15-minute discussion of the article and your discussion questions in class, starting with a brief summary of the article and how it relates to that week's topic. If you submit your article and/or questions after the deadline, you will receive a 10-point late penalty. If you do not submit them by the Sunday evening before the discussion, you will receive a zero, unless you receive the instructor's prior written approval of an extension.

2) **Semester project and interim assignments**:
The semester project will enable you to explore the food-energy-water nexus challenges in a place or organization you choose. You also will examine solutions that leverage these systems' interdependencies. You will have the opportunity to apply your own specific research interests.

Semester project:
Comprised of 2 linked interim (graded, not draft!) assignments assignments that you will combine at the end of the semester to comprise your final paper, the overall assignment will a) examine food-energy-water nexus challenges in a place or organization you choose; and b) assess existing solutions and identify and assess new solutions to these challenges. If you choose a place/organization that already has resolved nexus challenges, you can conduct a case study of this place, including challenges they overcame and applied solutions.

Interim assignments:
1. 3rd week: Project topic selection: Provide via email a) the name of an organization, city, county, state or country that is facing or has faced a food-energy-water nexus challenge; b) an overview of the challenge(s) you expect to examine. Everyone in the class must choose a different place and submit their choice via email for approval. This is not a graded assignment, but you must submit your choice by the week 3 deadline. The late penalty for this assignment will be applied to your grade for assignment 2. You must submit your choice and receive approval from me via email in order to submit assignment 2.

2. 7th week: Nexus challenge and actors involved: (3-5 pages)
a. Describe the food-energy-water nexus challenge on which you will focus in the organization or place you selected. Describe the ecological, economic, and institutional aspects of the challenge.
b. Describe the actors involved in creating the challenge, including government, private sector, NGOs, citizens, and other entities. Describe these actors' roles in creating the challenge.
c. Describe the actors affected by the challenge, including government, private sector, NGOs, citizens, and other entities. Describe how they are affected.
d. References/citations

3. 14th week: Nexus solutions, actors involved, and challenges to the solutions: (6-8 pages)

a. Describe any solutions already attempted, and propose your own solution(s). These can include technical, economic, institutional, and other aspects.
b. Describe the actors involved in these solutions, including government, private sector, NGOs, citizens, and other entities.
c. Describe the actors affected – positively or negatively – by these solutions.
d. Assess challenges to these solutions, including technological, economic, and institutional aspects.
e. References/citations
4. 16th week: Turn in final papers incorporating identifiable (track changes, highlighting, bold, underline, etc.) revisions of all interim assignments, including revisions to the roadmaps based on what you've learned about challenges.

3) **Presentation:** At the end of the semester, each student must give a 15-minute presentation that explains their semester project results**.** More details will be provided later in the semester. You will submit your slides the day before the last class (week 16).

4) **Class discussion of FEW nexus challenges and solutions:** One class session will be dedicated to class discussion of challenges and solutions from your semester project research.

5) **Extra credit presentation:** Sometime during the semester, you may give a short guest lecture on a topic related to the food-energy-water nexus, but not already covered in class or in semester projects (up to two extra credit points).

Deadlines: In fairness to all students, I will lower your grade by ten points for each day that any assignment is late without a previously approved extension, starting from the time of the deadline. E.g., if you hand in your assignment within 24 hours after the deadline, 10 points off; within 2 days, 20 points off, etc. Extensions will be granted only for written requests that involve an emergency or other reason deemed valid by the instructor.

Class participation/Group discussion: Aside from the textbook readings, I will post on Blackboard all of the required readings and videos, including the article of the week chosen by you, along with questions for you to consider while reading/watching. We'll discuss these questions in class. Optional readings marked with ** are required for 534 students, who will summarize them in class. Your participation grade is based on your attendance in class and your active participation, which enables me to assess your understanding of the readings and concepts. You receive a participation grade for each class session, which is based on how actively you contribute to the discussion and whether you incorporate course readings in your comments. One class session during the semester will be dedicated to discussion of FEW nexus challenges and solutions discovered through students' semester project research.

Attendance:

- Missing class: If you need to miss class due to illness, travel, family obligations, etc., please notify me ahead of time via email**. To receive credit for the missed class, please choose two of the reading questions and email your responses to me within two days after the missed class or by a deadline approved by me**. If you have an unexcused absence and do not send answers to the questions, you will receive a zero for that day. If you have an excused absence but do not answer the questions, the class will not count toward your grade.
- Late arrival: If you are more than 15 minutes late to class without a valid explanation, your participation grade for that day will be reduced by 10 points.
- (For vitrtual) Non-attendance with login: If you join the class session but do not participate orally or via the comment box, I will contact you to ask whether you were attending class for the entire session.

Course Materials and Student Privacy:

- All course materials posted to Blackboard or other course site are private and must not be shared with anyone not enrolled in this course.
- By federal law, any materials that identify specific students (via their name, voice, or image) must not be shared with anyone not enrolled in this course.
- Videorecordings of class meetings that include audio, visual, or text information from other students are private and must not be shared with anyone not enrolled in this course.
- Live Video Conference Meetings (e.g. Collaborate or Zoom) that include audio, visual or text information from other students must be viewed privately and not shared with others in your household or recorded and shared outside the class.
- Videorecordings of class meetings that are shared only with the instructors and students officially enrolled in a class do not violate FERPA or any other privacy expectation.

Diversity, Inclusion and Respect:

- This course aims to create a learning environment that fosters respect for people across identities. We welcome and value individuals and their differences, including gender expression and identity, race, economic status, sex, sexuality, ethnicity, national origin, first language, religion, age and ability. I encourage all members of the learning environment to engage with the material personally, but to also be respectful when hearing experiences or views different than their own.
- If you wish, please share your name and gender pronouns with me and how best to address you in class and via email. I use she/her/hers for myself, and you may address me as "Dr. Jen" or "Dr. Sklarew" in email and verbally.
- Mason recently implemented a policy enabling students to update their profiles in PatriotWeb to reflect their preferred name, their pronouns, and their gender identity. For more information, please check here: https://registrar.gmu.edu/updating-chosen-name-pronouns/#.

Basis of Grading:

Class participation	10%
Article Discussion Leadership	5%
Interim paper 1: 3-5 pages	15%
Interim paper 2: 6-8 pages	20%
Semester Paper: 10-15 pages	25%
Final Presentation: 15 minutes	25%

Grade table (General grading criteria for writing assignments, class participation and presentation will be provided separately, and specific criteria for each assignment will be provided during the semester.)

Grade	Percent
A	93-100%
A-	90-92.9%
B+	87-89.9%
B	83-86.9%
B-	80-82.9%
C+	77-79.9%
C	73-76.9%
C-	70-72.9%
D	60-69.9%
F	<60%

Writing Assistance

Mason's Writing Center can provide tutoring and guidance on structure and grammar for course assignments, theses, and other projects. They provide in-person and on-line services. They are located in Robinson Hall, room 114A. Please see http://writingcenter.gmu.edu/ or contact them at wcenter@gmu.edu or 703-993-1200.

Plagiarism Statement:

What is it? Plagiarism means using the exact words, opinions, or factual information from another person or source without giving that person or source credit. This includes paraphrasing without in-text attribution.

Plagiarism and the Internet**:** Copyright rules also apply to users of the Internet who cite from Internet sources. Information and graphics accessed electronically must also be cited, giving credit to the sources. This material includes but is not limited to e-mail (don't cite or forward someone else's e-mail without permission), newsgroup material, and information from Web sites, including graphics. Even if you give credit, you must get permission from the original source to include any graphic that you did not create on your web page. Shareware graphics are not free. Freeware clipart is available for you to freely use. If the material does not say "free," assume it is not. Putting someone else's Internet material on your webpage is stealing intellectual property. Making links to a site is currently acceptable, but getting permission is strongly advised, since many websites have their own requirements for linking to their material. (Source: http://mason.gmu.edu/~montecin/plagiarism.htm)

How to avoid it? Authors must credit original sources through accepted documentation styles, such as parenthetical citation, footnotes, or endnotes; a listing of books and articles is not sufficient. Direct quotations always require citations. So do paraphrases and summaries of opinions or factual information formerly unknown to the writers or which the writers did not discover themselves. Exceptions include factual information that can be obtained from a variety of sources; the writers' own insights or findings from their own field research; and what has been termed common knowledge. Common knowledge can be difficult to determine, so feel free to ask. Work that requires citations is not limited to text. Templates, data (facts/figures) for charts, and even cartoons used in presentations require citations! If you are uncertain about what to cite, please ask me before submitting your work.

Why avoid it? Plagiarism is a violation of Mason's Honor Code: https://oai.gmu.edu/mason-honor-code/. Mason instructors are required to report plagiarism to the Office of Academic Integrity. Sanctions include a zero for the assignment, potential F for the course, required plagiarism training, and mandatory visits to the Writing Center. You will face suspension or expulsion for a second or third violation of the Honor Code.

Honor Code and Academic Integrity:

The plagiarism guidelines in the Honor Code are accompanied by guidelines on cheating, lying and stealing. Lying includes providing false excuses for missing a class or assignment due date, as well as fabrication of sources, data, information, documents, and official correspondence.

General Support

Student Support and Advocacy Center (SSAC) and Resources for Crises: OSSCM -
- https://ssac.gmu.edu -- provides comprehensive (and confidential) services for your safety and well-being.

Counseling and Psychological Services (CAPS): provides a wide range of services to students by a staff of professional counseling and clinical psychologists, social workers, and counselors. CAPS individual and group counseling, workshops and outreach programs are designed to enhance students' personal experience and academic performance. http://caps.gmu.edu/

WAVES: helps students develop and maintain healthy lifestyles through one on one support, interactive programs and resources. Topics include healthy relationships, stress management, nutrition, sexual assault, drug and alcohol use and sexual health. http://waves.gmu.edu/

Gender-based/Sexual Discrimination: The 1-page George Mason University Title IX Resources sheet may benefit those of you seeking resources to prevent, address &/or recover from gender-based discrimination – including sexual harassment, sexual assault, stalking, domestic violence, and sexual exploitation. It includes 16 on- and off-campus sources of assistance, including confidential ones.

Safe Return to Campus:
All students taking courses with a face-to-face component are required to follow the university's public health and safety precautions and procedures outlined on the university Safe Return to Campus webpage (*https://www2.gmu.edu/safe-return-campus*).

- All students in face-to-face and hybrid courses **must also complete the Mason COVID Health Check**. The COVID Health Check system uses a color code system **and students will receive either a Green, Yellow, or Red email response. Only students who receive a "green" notification are permitted to attend courses with a face-to-face component. You must show me your notification for the day of class prior to the start of class. If you have not completed the health check, you will exit the classroom to complete it.**
- **If you suspect that you are sick or have been directed to self-isolate, please quarantine or get testing. Please do NOT come to class!**
- **Students are required to follow Mason's current policy about facemask-wearing. As of August 11, 2021, all community members are required to wear a facemask in all indoor settings, including classrooms. An *appropriate facemask* must cover your nose and mouth at all times in our classroom.**

General Plan for Class Schedule

Class discussion of readings and article of the week: 75 minutes
Break: 15 minutes. Please feel free to leave the room to eat and drink!
Class lecture by instructor or guest speaker and discussion of lecture: 1 hour
Discussion of applications to projects as needed: 10 minutes
Lead-in to next class: 5 minutes

Session Topics and Readings:

Week 1 (January 25): Syllabus Overview and Introduction: Defining the FEW Nexus

Session overview: We'll discuss the concept of the food-energy-water nexus and its relevance to policymaking and private sector challenges in different locations and at different scales.

INTERCONNECTIONS

Week 2 (February 1): System interconnections: overview

Session overview: We'll discuss broad connections between food, energy and water systems and connections to sustainable development at global, national and local levels.

Reading Questions:
1) What are some of the approaches to food-energy-water nexus thinking, and what are some key areas that connect these three systems?
2) How is the food-energy-water nexus linked to resilience and sustainable development?
3) What types of priorities drive private sector interest in the food-energy-water nexus?
4) How does the FEW nexus respond to shocks?

Required Readings and Videos:

1. Al-Saidi, Mohammed, and Lars Ribbe. (2017.) Development and Use of Nexus Assessments. In *Nexus Outlook Report: Assessing International Challenges*: 13-18.

2. SABMiller and WWF. (2014.) The Water-Food-Energy Nexus: Insights into resilient development.

3. Jones, Kristal, Nicholas R. Magliocca and Kelly Hondula. (2017.) *White Paper: An Overview of Conceptual Frameworks, Analytical Approaches and Research Questions in the Food-Energy-Water Nexus.* SESYNC White Paper, National Socio-Environmental Synthesis Center (SESYNC), University of Maryland, March 2017.

4. Redmon, Jennifer Hoponick, Justin Baker and A.J. Kondash. 2020. How the COVID-19 Pandemic Affects Food, Energy, and Water Systems in the U.S. RTI International Insights. May 13.
https://www.rti.org/insights/covid-19-impact-on-us-systems

Optional Reading:

** Bazilian, M., et al. (2011.) Considering the energy, water and food nexus: Towards an integrated modelling approach. Energy Policy 39: 7896–7906.

Week 3 (February 8): Ecological aspects

ASSIGNMENT 1 DUE

Session overview: We'll discuss nexus ecological aspects at global, national and local levels.

Reading Questions:
1) What are some of the ecological aspects of the food-energy-water nexus at different scales?
2) How do ecological aspects of nexus thinking differ in developing vs. developed nations, wealthy vs. impoverished communities, and rural vs. urban areas?
3) Which actors are interested in the ecological aspects of the food-energy-water nexus, and what are their priorities?

Required Readings and Videos:

1. Allan, Tony, and Nathanial Matthews. The Water, Energy And Food Nexus and ecosystems: The political economy of food and non-food supply chains. In Dodds and Bartram, Eds. Part 1, chapter 5.

2. Scanlon, Bridget, et al. 2017. The food-energy-water nexus: Transforming science for society. *Water Resources Research*, 3550-3556.

3. Liu, Q. (2016.) Interlinking climate change with water- energy-food nexus and related ecosystem processes in California case studies. *Ecological Processes* 5:14.

Optional Reading:
1. **Wang, Like, Yee Van Fan, Petar Sarbev Varbanov, Sharifah Rafidah Wan Alwi, and Jiri Jaromir Klemes. 2020. Water Footprints and Virtual Water Flows Embodied in the Power Supply Chain. *Water*. Vol 12. MDPI.

Week 4 (February 15): Economic aspects

Session overview: We'll discuss nexus economic aspects at global, national and local levels.

Reading Questions:
1) What are some of the economic aspects of the food-energy-water nexus at different scales?
2) How do economic aspects of nexus thinking differ in developing vs. developed nations, wealthy vs. impoverished communities, and rural vs. urban areas?
3) Which actors are interested in the economic aspects of the food-energy-water nexus, and what are their priorities?

Required readings and Videos:

1. von Braun, Joachim, and Alisher Mirzabaev. Nexus scientific research: Theory and approach serving sustainable development. In Dodds and Bartram, Eds. Part 1, chapter 3.

2. Asian Development Bank. (2013.) Executive Summary. In *Thinking about Water Differently: Managing the Water–Food–Energy Nexus*: vi-ix.

3. Becker, Rike, and Laura Margarete Simon. (2017.) The Water-Energy-Food Nexus: Challenges for Chilean agriculture. In *Nexus Outlook Report: Assessing International Challenges*: 22-29.

4. Conservation International Business and Sustainability Council. (2013.) Resources: The Energy-Water-Food Nexus.

Week 5 (February 22): Institutional aspects

Session overview: We'll discuss the institutional aspects of the nexus at global, national and local levels.

Reading Questions:
1) How do interactions between different actors and levels of government influence the food-energy-water nexus? Do they make it more challenging, more beneficial, or both?
2) How do institutional aspects of nexus thinking differ in developing vs. developed nations, wealthy vs. impoverished communities and rural vs. urban areas?

Required Readings and Videos:

1. Norman, David, and Stuart Orr. Building partnerships for resilience. In Dodds and Bartram, Eds. Part 6, chapter 16.

2. Dodds, Felix, and Cole Simons. Principles for the integration of the Nexus within business. In Dodds and Bartram, Eds. Part 6, chapter 18.

3. Nebraska Collaborative for Food, Energy, and Water Education. Food-Energy-Water-Nexus. https://www.unl.edu/nc-few/food-energy-water-nexus

4. Sklarew D. and J. Sklarew. (2018.) Integrated water-energy policy for sustainable development. *Foresight and STI Governance* 12(4): 10-19.

5. Explore the water-energy-food nexus resource platform:
https://www.water-energy-food.org/mission
https://www.water-energy-food.org/knowledge-hub

CHALLENGES

Week 6 (March 1): System challenges: overview

Session overview: We'll broadly discuss food, energy and water system interconnection challenges in the context of sustainability and resilience of all three systems at global, national and local levels.

Reading Questions:
1) How do food-energy-water nexus challenges influence resilience and sustainable development?
2) How do nexus challenges differ in developing vs. developed nations, wealthy vs. impoverished communities, and rural vs. urban communities?
3) Which actors are creating or contributing to these challenges?
4) Which actors are affected by these challenges, and how?
5) (534) What types of operational challenges to the nexus approach exist?

Required readings:

1. Grobicki, Ania. Water–food–energy–climate: Strengthening the weak links in the Nexus. In Dodds and Bartram, Eds. Part 3, chapter 9.

2. Lee, Sylvia. Natural resource security in an uncertain world. In Dodds and Bartram, Eds. Part 3, chapter 10.

3. Rodriguez, Diego, Anna Delgado Martin and Antonia Sohns. Adding to complexity: Climate change in the Energy–Water Nexus. In Dodds and Bartram, Eds. Part 4, chapter 13.

4. The National Academies of Sciences, Engineering and Medicine. Environmental Engineering for the 21st Century: Addressing Grand Challenges (2019.) Chapter 3: Grand Challenge 1: Sustainably Supply Food, Water, and Energy
The National Academies Press. 8-top of 24.
https://www.nap.edu/read/25121/chapter/3

5. Smedly, Tim. (2013.) Can 'nexus thinking' alleviate global water, food and energy pressures? *The Guardian*.

Optional Readings

** Liu, J., H. Yang, C. Cudennec, A.K. Gain, H. Hoff, R. Lawford, J. Qi, L. de Strasser, P.T. Yillia & C. Zheng (2017) Challenges in operationalizing the water–energy–food nexus, *Hydrological Sciences Journal*, 62:11, 1714-1720

Week 7 (March 8): Ecological aspects

ASSIGNMENT 2 DUE on Tuesday by midnight

Session overview: We'll discuss ecological aspects of food, energy and water system interconnection challenges at global, national and local levels.

Reading Questions:
1) What are some of the ecological aspects of food-energy-water nexus challenges at different scales?
2) How do these ecological challenges differ in developing vs. developed nations, wealthy vs. impoverished communities, and rural vs. urban areas?
3) Which actors are creating or contributing to the ecological aspects of these challenges, and why?
4) Which actors are affected by these challenges, and how?

Required Readings and Videos:

1. D'Odorico, Paolo, Kyle Frankel Davis, Lorenzo Rosa, Joel A. Carr, Davide Chiarelli, Jampel Dell'Angelo, Jessica Gephart, Graham K. MacDonald, David A. Seekell, Samir Suweis and Maria Cristina Rulli, (2018.) The Global Food-Energy-Water Nexus, *Reviews of Geophysics*, 56, 3, (456-531). Pages 456-497 (stop at "10. Resilience of the Food-Energy-Water Nexus").

Optional Readings:

**Wakeford, Jeremy & Mentz-Lagrange, Sasha & Kelly, Candice. (2016). Managing the Energy-food-water Nexus in Developing Countries: Case Studies of Transition Governance.

Week 8 (March 15): NO CLASS/SPRING BREAK

Week 9 (March 22): Economic aspects

Session overview: We'll discuss economic challenges associated with the nexus, including challenges specific to developing vs. developed nations and wealthy vs. impoverished communities.

Reading Questions:
1) What are some of the economic challenges of the food-energy-water nexus at different scales, and how do they intersect with ecological aspects of the challenges?
2) How do these economic challenges differ in developing vs. developed nations, wealthy vs. impoverished communities, and rural vs. urban areas?
3) Which actors are creating or contributing to these challenges, and why?
4) Which actors are affected directly or indirectly by these challenges, and how?
5) (534) How do these economic challenges intersect with technological challenges?

Required Readings and Videos:

1. Asian Development Bank. (2013.) The Water-Food-Energy Nexus. In *Thinking about Water Differently: Managing the Water–Food–Energy Nexus*: 6-18.

2. Spiegelberg, M., S. Hoshino, and S. Hashimoto. (2015.) Serving the underserved: the water–energy–food nexus in socio-ecological production landscapes. WIT Transactions on Ecology and The Environment, Vol 193. 183-191.

3. Treemore-Spears, Lara, J. Morgan Grove, Craig K. Harris, Lawrence D. Lemke, Carol J. Miller, Kami Pothukuchi, Yifan Zhang, Yongli L. Zhang. (2016.) A workshop on transitioning cities at the food-energy-water nexus. Journal of Environmental Studies and Sciences.

4. Givens, Jennifer E., Julie Padowski, Christian D. Guzman, Keyvan Malek, Rebecca Witinok-Huber, Barbara Cosens, Michael Briscoe, Jan Boll, and Jennifer Adam. (2018.) Incorporating Social System Dynamics in the Columbia River Basin: Food-Energy-Water Resilience and Sustainability Modeling in the Yakima River Basin. *Frontiers in Environmental Science*, 19 September 2018.

Optional Readings:

** Sperling, Joshua, and Philip Berke. (2017.) Urban Nexus Science for Future Cities: Focus on the Energy-Water-Food-X Nexus. FEW Nexus Workshop on Integrated Science, Engineering, and Policy: A Multi Stakeholder Dialogue, January 26 -27, 2017, College Station, Texas.

Gurría, Angel. (2014.) Water-Energy-Food: Taking on the Nexus. Opening Remarks delivered at the Global Forum on the Environment: New Perspectives on the Water-Energy-Food Nexus. November 27, 2014. Paris, France.

Week 10 (March 29): Institutional aspects

Session overview: We'll discuss institutional challenges associated with the nexus at local, national and global scales, including challenges specific to developing vs. developed nations and wealthy vs. impoverished communities.

Reading Questions:
1) What are some of the institutional aspects of food-energy-water nexus challenges at different scales, and how do they intersect with ecological and economic aspects of the challenges?
2) How do these institutional challenges differ in developing vs. developed nations, wealthy vs. impoverished communities, and rural vs. urban areas?
3) Which actors are creating or contributing to these challenges, and why?
4) Which actors are affected by these challenges, and how?

Required Readings and Video:

1. Pardoe, Joanna, Declan Conway, Emilinah Namaganda, Katharine Vincent, Andrew J. Dougill, and Japhet J. Kashaigili. (2017.) Climate change and the water–energy–food nexus: insights from policy and practice in Tanzania. *Climate Policy*, Volume 18, 2018, Issue 7: 863-877.

2. Taniguchi Makoto, Aiko Endo, Jason Gurdak, and Peter Swarzenskic. (2017.) Water-Energy-Food Nexus in the Asia-Pacific Region. *Journal of Hydrology: Regional* Studies, Volume 11:1-8.

3. White, Dave, et al. (2017.) Stakeholder Analysis for the Food-Energy-Water Nexus in Phoenix, Arizona: Implications for Nexus Governance. *Sustainability* 2017: 9.

Optional Readings:

**Sumagaysay, Marieta Banez. The Water-Energy-Food Nexus: Women's Lens for Fisheries Security. Gender in Aquaculture and Fisheries: Engendering Security in Fisheries and Aquaculture Asian Fisheries Science Special Issue 30S (2017): 221-229.

** Weitz, Nina, Claudia Strambo, Eric Kemp-Benedict, and Måns Nilsson. (2017.) *Governance in the water-energy-food nexus: Gaps and future research needs.* Stockholm Environment Institute.

SOLUTIONS

Week 11 (April 5): Solutions: overview

Session overview: We'll discuss broad solutions to food, energy and water system interconnection challenges in the context of sustainability and resilience of all three systems at global, national and local levels.

Reading Questions:
1) How do nexus solutions parameters differ in developing vs. developed nations wealthy vs. impoverished communities, and rural vs. urban areas?
2) How do food-energy-water nexus solutions influence resilience and sustainable development?
3) What types of actors are creating or contributing to these solutions?
4) How are different actors affected?
5) (534) How can nexus solutions address spatial, temporal, resource, and information challenges?

Required readings:

1. Wouters, Frank, and Divyam Nagpal. Renewable energy: Nexus-friendly pathways for growth. In Dodds and Bartram, Eds. Part 4, chapter 12. 163-175.

2. Drechsel, Pay, and Munir A. Hanjra. Green opportunities for urban sanitation: challenges through energy, water and nutrient recovery. In Dodds and Bartram, Eds. Part 5, chapter 15. 204-218.

3. D'Odorico, Paolo, Kyle Frankel Davis, Lorenzo Rosa, Joel A. Carr, Davide Chiarelli, Jampel Dell'Angelo, Jessica Gephart, Graham K. MacDonald, David A. Seekell, Samir Suweis and Maria Cristina Rulli, The Global Food-Energy-Water Nexus, *Reviews of Geophysics*, 56, 3, (456-531), (2018). Pages 497-514.

Optional Readings:

** K.J. Helmstedt, J.R. Stokes-Draut, A.E. Larsen and M.D. Potts. 2018. Innovating at the food, water, and energy interface, *Journal of Environmental Management*, 10.1016/j.jenvman.2017.12.026, 209, (17-22).

Week 12 (April 12): Technological aspects

Session overview: We'll discuss technological aspects of solutions to food, energy and water system interconnection challenges at global, national and local levels.

Reading Questions:
1) What are some examples of technological solutions to food-energy-water nexus challenges at different scales?
2) How do the parameters for these solutions differ in developing vs. developed nations, wealthy vs. impoverished communities, and rural vs. urban areas?
3) Which actors are creating or contributing to these solutions?
4) How are different actors affected?
5) In what ways are these solutions effective, and what challenges do they face?

Required Readings and Videos:

1. Food and Agriculture Organization of the United Nations. Water-energy-food nexus. http://www.fao.org/land-water/water/watergovernance/waterfoodenergynexus/en/

2. Sarni, Will. (2015.) Deflecting the scarcity trajectory: Innovation at the water, energy, and food nexus. *Deloitte Review Issue 17*.

3. Wolfe, M.L., Ting, K.C., Scott, N. et al. (2016.) Engineering solutions for food-energy-water systems: it is more than engineering. J Environ Stud Sci (2016) 6: 172.

Optional Readings:

Cansino-Loeza, Brenda, and Jose Maria Ponce-Ortega. (2019.) Involving the Water–Energy–Food Nexus in Integrating Low-Income and Isolated Communities. *ACS Sustainable Chemical Engineering*, 2019, *7* (1), pp 1399–1418.

Rao, Prakash & Kostecki, Robert & Dale, Larry & Gadgil, Ashok. (2017). Technology and Engineering of the Water-Energy Nexus. *Annual Review of Environment and Resources*. 42. 407-437. 10.1146/annurev-environ-102016-060959.

Week 13 (April 19): Economic aspects

Session overview: We'll discuss economic aspects of solutions to food, energy and water system interconnection challenges at global, national and local levels.

Reading Questions:
1) What are some of the economic solutions to food-energy-water nexus challenges at different scales?

2) How do the parameters for and challenges to these solutions differ in developing vs. developed nations and wealthy vs. impoverished communities?
3) Which actors are creating or contributing to these solutions, and how do their contributions differ from technological contributions?
4) How are economic and technological solutions intertwined?
5) In what ways are these solutions effective, and what challenges do they face?
6) (534) How does new water accounting address ecological, economic and institutional nexus challenges?

Required readings:

1. Brekke, Kathrine, and Jeb Brugmann. Operationalizing the Urban Nexus: Increasing the productivity of cities and urbanized nations. In Dodds and Bartram, Eds. Part 2, chapter 7.

2. Bieber, Niclas, Jen Ho Ker, Xiaonan Wang, Charalampos Triantafyllidis, Koen H. van Dam, Rembrandt Koppelaar, and Nilay Shah. (2018.) Sustainable planning of the energy-water-food nexus using decision making tools. *Energy Policy* 113: 586-407.

3. Deloitte. (2015.) Deflecting the scarcity trajectory: Innovation at the water, energy, and food nexus. *Deloitte Review* Issue 17. July 27..

Optional Readings:

**Asian Development Bank. (2013.) New Water Accounting. In *Thinking about Water Differently: Managing the Water–Food–Energy Nexus*: 19-24.

2. Lundy, Jeff, and Lawrence Bowdish. (2014.) *The Energy-Water-Food Nexus: Insights for the Business Community*. **Pages 1-28.** U.S. Chamber of Commerce Foundation Corporate Citizenship Center.

Week 14 (April 26): Institutional Aspects

ASSIGNMENT 3 DUE on Tuesday by midnight

Session overview: We'll discuss institutional aspects of solutions to food, energy and water system interconnection challenges at global, national and local levels.

Reading Questions:
1) What are some of the institutional solutions to food-energy-water nexus challenges at different scales?
2) How do the parameters for and challenges to these solutions differ in developing vs. developed nations, wealthy vs. impoverished communities, and rural vs. urban areas?

3) Which actors are creating or contributing to these solutions, and do they completely overlap with actors contributing to technical and economic solutions?
4) How are institutional solutions connected with economic and technological solutions?
5) In what ways are these solutions effective, and what challenges do they face?
6) (534) How can decision-makers balance divergent priorities for food, energy, water and climate in developing solutions to challenges?

Required readings:

1. You, Nicholas. The contribution of innovation in urban resilience and sustainability to realizing the urban Nexus. In Dodds and Bartram, Eds. Part 2, chapter 6.

2. Marker, Carolin, Sandra Venghaus, and Jurgen-Friedrich Hake. (2018.) Integrated governance for the food–energy–water nexus – The scope of action for institutional change. *Renewable and Sustainable Energy Reviews*, Volume 97, December 2018, 290-300.

3. United Nations. Food, Energy-Water (FEW) NEXUS Partnerships. https://sustainabledevelopment.un.org/partnership/?p=27246

Optional readings:

**Janssen, Davine N. G., Eunice Pereira Ramos, Vincent Linderhof, Nico Polman, Chrysi Laspidou, Dennis Fokkinga and Duarte de Mesquita e Sousa. (2020.) The Climate, Land, Energy, Water and Food Nexus Challenge in a Land Scarce Country: Innovations in the Netherlands. *Sustainability*.

Week 15 (May 3): Class Discussion of Nexus Challenges/Solutions

Session overview:
Class discussion/brainstorming on nexus problems and solutions discovered through your research for assignments 2 and 3. 534 students will provide 1 discussion question for the session: please send via email by May 1. Class discussion on the effectiveness of the nexus in framing food-energy-water challenges and solutions in different types of communities at global, national and local levels.

Week 16 (May 15):

ASSIGNMENT DUE:

FINAL PAPERS DUE on Sunday, May 15, by midnight. Via email, turn in one final paper that merges all of the interim assignments. Final papers should 1) incorporate revision of all interim assignments to address all of the instructor's comments/feedback and any new material

you wish to include; 2) indicate all changes and revisions of interim assignment text using track changes, highlighting, bold, underlining, etc.

Week 17: (May 17, 4:30 pm - 7:15 pm): Student presentations

ASSIGNMENT DUE:

PRESENTATION SLIDES DUE on Monday, May 16, by midnight