

TECHNO-LEGAL ISSUES PERTAINING TO WATER-ENERGY- CLIMATE NEXUS

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ABSTRACT

India, which has 18% of the world's population but just 4% of the water supply, is one among the nations with the greatest water limitations in the world. Due to the rapidly expanding population and increased energy consumption, the country already faces challenges integrating the water, energy, and climate systems. Water resources will be impacted by climate change, which will then have an impact on overall sectoral end-use demand patterns. Energy and water consumption have both expanded as a result of India's recent economic growth, placing a growing strain on both interdependent resources and making the relationship between them crucial to the nation's ambitions for energy security and transition. The current study work focuses on this nexus and seeks to comprehend the intricate relationships among climate, energy, and water at the state level. The paper further discusses the International and National legislative framework available to deal with the legal issues pertaining to the deficit of energy due to water shortage and simultaneously assessing what would be the impact on climate after excess water consumption needed for power generation.

Keywords: Water, Climate Change, Energy, Law, Judiciary

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INTRODUCTION

The fundamental, simple truth is that humankind, across the full surface of Earth, finally realized that our survival required enormous shifts in how we conducted our affairs. Climate change accelerated, warming the planet, eradicating entire classes of living things and altering available water supplies. Adaptation to survive as a species, and in harmony with other living things, became the controlling principle. Cooperation and collaboration overcame our competitive instincts; survival of the whole of humankind, rather than the individual, became the ethical mandate on which governance and justice were constructed.¹

According to the Sustainable Development Goals, for everyone to have access to contemporary amenities, they should all have access to clean water and proper sanitation, cheap, dependable, ecological energy.

India is at a pivotal point right now.² To match the soaring ambitions of its people, it requires enormous expenditures on infrastructure, employment, and housing. India has been receiving loans from the World Bank for projects including water and irrigation, agriculture, electricity, health, and rural and urban development. India received 27 percent of all World Bank funding for flood, sanitization, and water programs then finance is 19 percent, transportation, and education is 11 percent, public administration and law is 10 percent, agriculture is 8 percent, and health and social service is 4 percent, information and communication is 2 percent and energy, and mining is 1 percent.³

The probability of natural disasters has grown, however, as a result of the rising temperatures. Further, when sea levels rise due to melting polar ice caps and rising temperatures, coastal communities will be inundated. Major financial losses would result from this. The fact that developing nations lack the necessary resources and technology to effectively tackle rising sea levels and other natural disasters explain why they will suffer more harm than developed nations.⁴

¹ Jeffrey Ritter, "Digital Justice in 2058: Trusting Our Survival to Artificial Intelligence, Quantum and the Rule of Law" 8 *Journal of International Commercial Law* 333 (2021).

² Vivek Sehrawat, "Reforming the World Bank to Transform India" 10 *NUJS Law Review* 3 (2017).

³ Chaitanya Mallapur, "India Received the Most Loans from World Bank in the Past 70 Years", *Scroll.in*, January 14, 2016, available at: <https://scroll.in/article/801808/india-received-the-most-loans-from-world-bank-loans-in-the-past-70-years> (last visited on July 20, 2024).

⁴ William Nordhaus, *A Question of Balance: Weighing the Options on Global Warming Policies* (Yale University Press, New Haven, 2008).

The present research paper is investigating the facts relating to impact of climate change on water availability and how the several developed and developing countries are making efforts to maximise the utilization of energy sources by bringing into regulations and following the international norms to achieve the above-mentioned sustainable development goals. The discussion includes the role of different government's of the world to mitigate the circumstances leading to wastage of drinking water due to adverse impact on energy rejuvenation and climatic conditions.

SIGNIFICANCE OF THE DISCUSSION

According to the dharma philosophy, owing to the restricted resources on Earth and its capacity to replenish them is also finite, low-income areas must cut back on their energy consumption and natural resources so that minimal and disadvantaged groups may use these resources equally. Using the concept of Earth Democracy, the paper explores the requirement for comprehensive environmental solutions that are neither fragmented nor self-serving, which embodies Rawls' original perspective.⁵ All people and animals are treated equally in an earth democracy and have the same access to the planet's resources for survival. These resources are a component of the natural commons, which belong to everyone and are governed by the State and its authorities. An Earth Democracy is in violation when one community overuses its natural resources to the detriment of another community. This is known as dharma. One may argue that using the concept of dharma, the Government and its authorities must draw a distinction between social equality and environmental justice, while emphasizing socialistic values and environmental justice in the Indian context.⁶

WATER AND CLIMATE CHANGE

The possible interference with the climatic changes on our planet and the viability of an economy reliant on fossil fuels are at odds with the 21st century's central problem of climate change.⁷ Due to climate change, the water industry is confronting enormous problems on a global scale. The long-term design and management of drinking water utilities must take

⁵. Konrad Ott, "Institutionalizing Strong Sustainability: A Rawlsian Perspective" 6 Sustainability 894 (2014).

⁶. Yashaswini Mittal, "Role of Indian Regulatory Authorities in Integrating Environmental Justice into Industrial Siting Decisions" 15 NUJS Law Review 18 (2017).

⁷. J.B. Ruhl and John Nagle, *The Practice and Policy of Environmental Law* 1322 (Foundation Press, New York, 4th edn., 2016).

climate issues into account; they must also become climate ready. Several factors prevent water utilities from accomplishing their objectives, including outdated water infrastructure, costly maintenance and treatment expenses, more strict environmental rules, and insufficient finance.⁸

In the context of this conversation, it's critical to examine how potential climate change—particularly where it may result in a substantial decline in water availability—might affect present power generating tactics, as well as any accompanying hydrological changes.⁹

The creation and processing of fuels, the creation of electricity, the cooling of power plants, the storage of energy, and other energy-related processes all include the usage of water. But projecting how the low-carbon economy will interact with water resources is difficult, both because there are inherent uncertainties in climate scenarios and water supply estimates, and because it is difficult to foresee the future technological capability and uptake of essential technologies.¹⁰

It should be highlighted that water shortages caused by climate change are already having an impact on energy generation in many locations, often prompting power plants to reduce output or shut down. Droughts and summertime, when power consumption is high and water supply is low, are already causing acute water-energy conflicts. For instance, in Uganda, a drought in 2006 caused a reduction in the hydro-power capacity by one-third, resulting in a lack of energy.¹¹ Furthermore, officials in Germany and France reduced nuclear power output in 2003 as a result of elevated river water temperatures brought on by a heat wave—4,000MW in France alone.¹² As a result of climate change, many regions are predicted to experience increased droughts and periods of high heat.¹³

One of the numerous problems caused by climate change that we confront on a global scale is drought. Water demand is being impacted by hotter weather and drier land, while water supply is being impacted by shifts in the timing and location of water supplies. Water corporations that provide drinking water as well as other water users are forced to adapt to the changing

⁸. Isabella Polenghi-Gross, *et al.*, “Water Storage and Gravity for Urban Sustainability and Climate Readiness” 106(12) *Journal (American Water Works Association)* E539–E549 (2014).

⁹. Jerald L. Schnoor, “Living with a Changing Water Environment” 38(3) *The Bridge* 46–54 (2008).

¹⁰. Victoria Clark, *et al.*, *Water in a Low-Carbon Economy: Resource Scarcity, Climate Change and Business in a Finite World* (Stockholm Environment Institute, Stockholm, 2012).

¹¹. Anon., *Tracking Progress on Food and Agriculture-Related SDG Indicators 2021: A Report on the Indicators under FAO Custodianship* (Food and Agriculture Organization, Rome, 2021).

¹². Anon., *Policy Brief: Water in a Low-Carbon Economy—Resource Scarcity* (2022), available at: <https://www.jstor.org/stable/resrep00424> (last visited on November 4, 2024).

¹³. J. Macknick and R. Newmark, *A Review of Operational Water Consumption and Withdrawal Factors for Electricity Generating Technologies* (National Renewable Energy Laboratory, Golden, CO, 2011).

environment, a newly developed idea that comprises incorporating climatic issues into long-term utility planning and administration, as population increase will further exacerbate these issues (USEPA, 2012).¹⁴ The inability of water utilities to accomplish their objectives owing to a variety of reasons, including an old water infrastructure, expensive maintenance and treatment expenses, more strict environmental rules, and insufficient finance.¹⁵

A changing climate (alterations in rainfall patterns and drought). Because of the global climate change, dry regions frequently become drier and wet parts frequently become wetter.¹⁶ The comparatively little amount of soil moisture evaporates more quickly in arid regions under hotter circumstances, leading to more frequent and severe droughts. As a result of increased ocean water evaporation and the ability of a warmer atmosphere to store more moisture, clouds are growing, and the rate of rainfall throughout the world is increasing. Conversely, humid and arid regions are getting wetter due to more extreme precipitation events and flooding. Climate change's twin juggernauts of too little and too much water make water supplies unsustainable.

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1. Effects of Climate Change

The expected consequences of changing climate on renewable water supplies and water demand have been the subject of much research and are still being pursued. Strong evidence points to the consequences already being felt and likely to get worse. Predictions suggest that rainfall and runoff will be higher at higher latitudes and lower in tropical and medium to lower latitudes (Intergovernmental Panel on Climate Change, 2013).¹⁸ In turn, meltwater flow will be lessened as the amount of water that glaciers hold in them declines. Evaporation of soil and dew formation on exposed water surfaces will rise with higher temperatures, which will intensify water pollution issues in rivers and lakes. Increased flooding in urban areas and waterways will be a result of more frequent and powerful downpour events. Urban areas will

¹⁴ Anon., *2012 Guidelines for Water Reuse* (United States Environmental Protection Agency, Washington D.C., 2012), available at: <https://www.epa.gov/sites/default/files/2019-08/documents/2012-guidelines-water-reuse.pdf> (last visited on August 4, 2024).

¹⁵ Yuntao Zhou, Anna M. Michalak, Dmitry Beletsky, *et al.*, "Record-Breaking Lake Erie Hypoxia during 2012 Drought" 49(2) *Environmental Science & Technology* 800–807 (2015).

¹⁶ *Supra* note 8.

¹⁷ Thomas F. Stocker, Dahe Qin, Gian-Kasper Plattner, *et al.* (eds.), *Climate Change 2013: The Physical Science Basis (Working Group I Contribution to the Fifth Assessment Report)* (Cambridge University Press, New York, 2013).

¹⁸ Anon., *Climate Change 2013: The Physical Science Basis—Summary for Policymakers* (2013), available at: https://www.ipcc.ch/site/assets/uploads/2018/03/WG1AR5_SummaryVolume_FINAL.pdf (last visited on July 6, 2024).

see greater temperature rises than the rest of the world, which will cause a 72 percent increase in the need for air conditioning worldwide (Sivak, 2013).¹⁹

New methods to prepare for climate change. Dongtan in China and Masdar City in Abu Dhabi were developed as a result of the International Water Association's (IWA) Cities of the Future project and ambitious ecocity plans, and these are just a few recent examples of the numerous new ways of thinking that have emerged in the field of urban water management. A city or area thereof that strikes a balance between economic, social, and environmental concerns, the triple bottom line, to achieve sustainable development is what Novotny & Novotny (2011) refer to as an "ecocity," a term that was first coined by Register in 1987.²⁰ Urban systems that traditionally have been major consumers of nonrenewable resources and producers of trash are being replaced with systems that emphasize recycling garbage and using renewable resources. New ideas on urban sustainability are centered on water.

The majority of managers of urban water and wastewater utilities have been putting into practise policies that are informally referred to as "demand management" or "water conservation." These actions include implementing processed wastewater recycling and minimising leakage in water distribution systems. Additionally, utilities have urged their consumers to install water-saving home appliances and collect rainwater for non-potable use. In order to minimize the cost of their major water supply, utility companies will increasingly hunt for water from sources that are less expensive to secure and that offer resilience to the impacts of climate change and weather extremes. Therefore, if we want to stop global warming, we must make the necessary energy decisions to leave the age of fossil fuels behind. In order to assist people escape poverty and generate jobs, we must manage land and energy responsibly. We cannot solve the water problems resulting from urban growth without curbing growing population and migration to metropolises. Furthermore, we cannot ensure clean water for a population that is expanding without a global socialist agenda that builds strong societies and empowers them to deal with new issues.²¹

¹⁹. B. Schoettle and M. Sivak, "The Reasons for the Recent Decline in Young Driver Licensing in the United States" 15(1) *Traffic Injury Prevention* 6–9 (2013).

²⁰. V. Novotny, "Water and Energy Link in the Cities of the Future – Achieving Net Zero Carbon and Pollution Emissions Footprint" 63(1) *Water Science and Technology* 184–190 (2011).

²¹. Jerald L. Schnoor, "Water Unsustainability" 144(3) *Daedalus* 48 (Summer 2015).

WATER AND ENERGY

The term energy-water nexus refers to the relationship of interdependence between energy and water. A conceptual framework for understanding how decisions concerning energy policy may affect our country's water resources is provided by the energy-water nexus, and how the deterioration of all these resources may impede efforts to implement energy-based policy.

Clean water delivery, food production, industrial operation, residential, office, hospital, and school powering, as well as transportation, all depend on energy.²² Likewise, water is a need for our culture. For life to exist on earth, there must be water. It is essential to the conservation of biodiversity, the continuation of economic activity, and the smooth operation of the earth's ecosystem. It is also a vital part of producing energy and fuel, and as such, it will be crucial to determine whether we succeed in tackling climate change, achieve energy independence, and take the lead in developing clean energy technologies. The development of a sustainable energy economy fundamentally depends on water.²³

Achieving these national energy-based targets will be impossible without controlling the demand for water, which is a necessary component of creating a sustainable energy economy. Initiatives in the energy sector to improve output have traditionally been limited by water resource limitations, and these challenges are not influenced by the green energy industry.²⁴

Production of energy and the usage of water are closely related. Water is needed for almost every sort of energy production, whether it be for constructing and maintaining electrical plants, processing the raw materials used in energy facilities, or simply for producing the power itself. The extraction of raw materials, such sand, to build the plant and clean photovoltaic systems require water, despite the modest requirements of renewable energy sources like photovoltaic solar power and wind power. Even though the extraction of energy requires a significant volume of surface and groundwater, its water footprint is limited because of the lower water demand rates.²⁵

²². Ann E. Drobot, "Transitioning to a Sustainable Energy Economy: The Call for National Cooperative Watershed Planning" 41(3) *Environmental Law* 707 (Summer 2011).

²³. United Nations Conference on Environment and Development, *Agenda 21*, Annex II, arts. 18.1–18.3 (1992).

²⁴. Michael E. Webber, "Catch 22: Water vs. Energy" 18(4) *Scientific American* 34, 38 (2008).

²⁵. Tony Allan, Martin Keulertz and Eckart Woertz, "The Water–Food–Energy Nexus: An Introduction to Nexus Concepts and Some Conceptual and Operational Problems" 31(3) *International Journal of Water Resource Development* 301 (2015).

TRANSNATIONAL NEXUS ISSUES

When combined with current technology, water, sun, and wind are considered the primary energy sources to combat environmental issues. We must exercise caution while using these energy sources, specifically water, as hydroelectric power facilities have an impact on the natural and human environment. The building of these plants must thus be done with careful estimates.²⁶

The Water-Energy Team of the Climate Action Team, or WET-CAT, is an official entity that deals with the water-energy nexus concerns in California, US, but in Beijing, China, policy goals and implementation methods are established independently for each sector. Beijing does not use the same technical frameworks and statistics that Los Angeles uses for its water and energy policies.²⁷

The potential for solar energy and energy derived from feed stock is high in Libya, Egypt, Iraq, and the United Arab Emirates (UAE). These nations also have limited water resources and food production capabilities. Resource issues may be effectively handled using integrated management solutions based on the "Water Energy-Food Nexus" paradigm.²⁸

The resource situation in the aforementioned four countries is being made worse by global warming. The most current report from the UN's Intergovernmental Panel on Climate Change states that by the middle of the century, precipitation will be decreasing, there will be an increase in fire danger, and there will be more frequent droughts and drier conditions.²⁹ In the whole area, including Egypt, Iraq, Libya, and the UAE, increased temperatures will make the region's water supply more vulnerable. Because of the rising heat, crops will need more water. However, owing to increased rainfall in the nations where the Nile, Euphrates, and Tigris rivers originate, Egypt and Iraq will see greater water imports. In the coastal regions of Libya and the

²⁶ K. Bilen, O. Ozyurt, *et al.*, "Energy Production, Consumption, and Environmental Pollution for Sustainable Development: A Case Study in Turkey" 12(6) *Renewable and Sustainable Energy Review* 1537 (2008).

²⁷ Annette Huber-Lee and Laura Handly, *The Water-Energy Nexus: Comparing How Los Angeles and Beijing Integrate Policies across Sectors* (Stockholm Environment Institute, Stockholm, 2019).

²⁸ Martin Keulertz and Rabi Mohtar, *The Water-Energy-Food Nexus in Libya, UAE, Egypt and Iraq* (Istituto Affari Internazionali (IAI), Rome, 2022), available at: <https://www.iai.it/en/pubblicazioni/water-energy-food-nexus-libya-uae-egypt-and-iraq> (last visited on July 20, 2024).

²⁹ Jippe Hoogeveen, *et al.*, "GlobWat – A Global Water Balance Model to Assess Water Use in Irrigated Agriculture" 19(9) *Hydrology and Earth System Sciences* 3829 (2015).

UAE, there will likely be significant impacts, which might further saline the groundwater aquifers and reduce the amount of water available.³⁰

Improved attention must be paid to the interconnectedness of energy and water in the water-food-energy-climate nexus. In actuality, it is crucial to understand that encouraging energy efficiency and water efficiency may assist to reduce energy use and that enabling energy recovery and savings can help to ease water emergencies.³¹

It is important to consider the biological, sociological, economic, climatic, and hydrological environment unique to the area while discussing the relationship between water and energy. Water supply and sanitation systems are not "one-size-fits-all." The acceptability of various water supply and sanitation solutions is determined by the local socioeconomic and environmental factors, despite the fact that novel technologies are still in the process of evolving.³²

In view of the facts described above, the following problems might be highlighted:³³

1. Growth in the population (and migration patterns to mega-cities)

By 2050, the projected growth in global population from 7.1 billion to 9.2 billion people, substantially reducing the amount of water available per person. Additionally, when large populations move to megacities, the demand is concentrated, and local water resources are stressed, thus lowering the amount of water per person.

A growing number of people are also relocating to coastal communities where the saltwater is too salty to drink, and desalination is too expensive. Salinity from the sea can contaminate groundwater resources when we vigorously pump the water from groundwater sources to serve the expanding urban population and growing urbanisation.³⁴

³⁰. Ken Conca and Erika Weinthal, "The Water–Energy–Food Nexus in Arid Regions: The Politics of Problemsheds", in Ken Conca and Erika Weinthal (eds.), *The Oxford Handbook of Water Politics and Policy* 167–196 (Oxford University Press, Oxford, 2016).

³¹.S. Bieker, P. Cornel and M. Wagner, "Semicentralised Supply and Treatment Systems: Integrated Infrastructure Solutions for Fast Growing Urban Areas" 61(11) *Water Science & Technology* 2905–2913 (2010).

³². T.A. Larsen and W. Gujer, "Separate Management of Anthropogenic Nutrient Solutions (Human Urine)" 34(3–4) *Water Science and Technology* 87–94 (1996).

³³. *Supra* note 14.

³⁴. Franklin W. Schwartz and Hubao Zhang, *Fundamentals of Ground Water* (John Wiley & Sons, New York, 2003).

2. Changes in climate (dryness and shifting patterns of precipitation).

Over time, rainy regions frequently become wetter and dry parts frequently become dryer as a result of our changing climate. Arid regions experience more frequent and severe droughts because the comparatively little soil moisture evaporatively evaporates more quickly in hotter circumstances. On the other hand, humid regions are getting wetter and experiencing more high rainfall occurrences and flooding as a result of a warmer ocean draining more water and a warmer atmosphere being able to hold more moisture, causing clouds to rise and increasing global rainfall rates. The dual forces of climate change—too little and too much water—lead to an unsustainable use of water resources.³⁵

3. Energy options electricity generation, biofuels, and unconventional oil and gas exploitation.

We make energy decisions that have significant water consequences to meet the demands of expanding populations and development. For instance, more water is used globally to produce electricity than is ever used for anything else outside irrigation. Thankfully, there are fewer evaporative losses when the receiving stream is replenished with cooling water from power generation plants than when it is used for irrigation. However, it might have a negative impact on fisheries and habitats downstream of the returned water is excessively hot or includes anti-corrosion agents or chlorine disinfectants.

This conflict between expanding energy and water resources is known as the "energy-water nexus." It is evident that water cannot exist without significant energy inputs or without energy having significant water consequences. The quality of the local surface and groundwater may be impacted by the production of new fossil fuels (coal, oil, and natural gas). Some methods for energy development remove a lot more water than others.³⁶

4. Scarcity of water due to physical and economic poverty.

The effects of water shortage are more severe for the impoverished than for those who can respond or adapt. Destitute individuals cannot afford to move to a better site, import clean drinking water, cleanse tainted water to meet safe drinking standards, rebuild a dry well, or pump water over considerable distances. This critical need is recognized by volunteer organizations and nongovernmental organizations (NGOs), who are collaborating to discover

³⁵ Jerald L. Schnoor, "Living with a Changing Water Environment" 38(3) *The Bridge* 46–54 (2008).

³⁶ Antoine Rabatel, *et al.*, "Current State of Glaciers in the Tropical Andes: A Multi-Century Perspective on Glacier Evolution and Climate Change" 7(1) *The Cryosphere Discussions* 81–102 (2013).

solutions. Between the years 2000 and 2015, the number of people without access to clean drinking water is to be cut in half, according to Goal 7 of the United Nations Millennium Development Goals, Ensuring Environmental Sustainability.³⁷

The UN initiative has had significant success in achieving its aim of providing clean drinking water. However, there are still millions of people in the globe without access to sufficient water supplies; therefore, much work has to be done.³⁸ In addition, the associated development objective of providing more than a billion people with basic sanitary facilities (toilets and sewage transportation) has not been accomplished. A post-2015 development agenda has been established by the UN, containing "Water and Sanitation for All" as a stand-alone objective. For water sustainability, such a broad international effort is necessary.

CONCLUSION

Since the advent of contemporary statehood, energy, water, and climate have been governed independently in "sectors" in the majority of nations. This type of "silo" governance is something that the Water Energy Climate Nexus aims to alter. Due to these new energy sources' minimal water requirements, there is minimal correlation between the relationship of water and energy, leading to the rising production of renewable energy. However, in order to prevent negative effects and spillovers on the agricultural sector and farmer livelihoods, increased generation of renewable energy must coexist with initiatives for ensuring food security.

There is limited policy cooperation on water, food, and energy concerns because of the nations' sharp governance contrasts. To encourage inter-sectoral governance of water, food, and energy, the state must take the initiative to build and harmonize strong policy institutions. To do this, the ministries and agencies in charge of overseeing these resources must work well together.

Because of this, collaborations between governments and national and international business sector organizations to invest in cutting-edge renewable energy technologies might be a key change agent. Although there is a lot of room for development in these PPPs, strong governance is also necessary. Due of the necessity for businesses to use "nexus thinking" in

³⁷. *Ibid.*

³⁸. World Health Organization (WHO) and UNICEF, "1 in 3 People Globally Do Not Have Access to Safe Drinking Water", available at: <https://www.who.int/news/item/18-06-2019-1-in-3-people-globally-do-not-have-access-to-safe-drinking-water-unicef-who> (last visited on June 2, 2024).

order to prevent supply chain issues, the private sector is the best setting for systems thinking. In most of the important emerging economies, PPPs are still in their infancy.

It is important to keep in mind while implementing the PPP model that businesses must quickly adjust and better understand their vulnerability to future water shortages in order to reduce water-related risks. Water-intensive thermal production plants might be replaced with renewable energy sources that use less water to generate electricity as one option for utilities.³⁹

Finally, it may be claimed that we cannot stop climate change until we make the required energy choices to put the era of fossil fuels behind. To foster growth in the economy, we need to manage land and energy responsibly and aid in rescuing people from poverty. Without controlling migration to mega-cities and population growth, we cannot address the water problems brought on by urban development. Furthermore, if we want to supply clean water for a growing population, we seek a universal socialist agenda that empowers societies provides them with the resources & tools they need to tackle new issues.

³⁹. Christina Copeland, Sara Law, Maurice R. Greenberg, *et al.*, “Water-Related Risks and Impacts on the U.S. Energy System”, in *Impact of Climate Risk on the Energy System: Examining the Financial, Security, and Technology Dimensions* (Council on Foreign Relations, New York, 2019).