



# **Clean Energy Technology Diffusion in Developing Countries for the Green Economy**

**Interdisciplinary research project supported by SNIS**

## **Final Report**

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### **Abstract** (8 to 15 lines long)

Innovation and diffusion of clean energy technology is essential for moving toward a green economy in a carbon-constrained world. While the developed world is trying to transition to a more carbon-neutral energy mix, developing countries are struggling to secure sufficient energy to meet basic human needs. The objective of this research project was to provide an in-depth investigation of the determinants of the diffusion of clean energy technologies to developing countries. The project relied on conceptual methods from both the economic (e.g international technology diffusion and trade literature) and political science literature (e.g studies on energy governance, regime complexity, effectiveness and social learning) and contributed to new empirical insights. Although the research project investigated different barriers to clean energy diffusion and different kinds of technologies (efficient lightings, clean cookstoves, renewable energy among which geothermal in particular), the collective contribution of the project highlights the critical importance of domestic policies and policy learning enabled by clean energy governance, openness to trade and imports of new technologies, and social diffusion and peer-group effects to diffuse information among consumers.

## **Executive Summary**

### **1. Research plan**

Innovation and diffusion of low-cost clean energy technology is essential for the transition to a green economy in a carbon-constrained world. While the developed world is trying to transition to a more carbon-neutral energy mix, developing countries are struggling to secure sufficient energy to meet basic human needs. The International Energy Agency (IEA 2012) estimates that: “Over 1.3 billion people are without access to electricity and 2.7 billion people are without clean cooking facilities. More than 95% of these people are either in sub-Saharan African or developing Asia and 84% are in rural areas.” For developing countries, adopting and adapting existing affordable clean technologies from the developed world or across developing contexts remains a challenge.

The aim of this research project was to provide an in-depth investigation of the barriers to the diffusion of low-cost clean energy technologies to developing countries, as well as the governance mechanisms (policies and international cooperation) that can help to unlock diffusion and improve clean energy access. Studying technological diffusion, defined as the processes by which existing technologies spread and are adopted by potential users, is highly relevant. While there is a wide recognition that innovation is essential element of the transition toward green economies and sustainability, there is considerably less understanding on what processes and institutions can facilitate wider and more equitable access to innovative clean technologies.

Our focus during the project was specifically targeted at *low-cost* clean energy technologies, which in theory hold the greatest potential for alleviating energy poverty and the environmental and health externalities to energy use in both the short- and medium-term. We referred to low-cost technologies as those with substantial cost-saving elements for end users (e.g energy-efficient lightbulbs or clean cookstoves) or technologies with potential to provide cost-effective solutions to societal objectives (e.g cost-competitive distributed solar or geothermal energy).

The study aimed to address research questions such as: what are the most important barriers and instruments to low-cost green technology diffusion across developing countries? What is the impact of domestic policies and transnational collaboration on the diffusion patterns of low-cost clean energy technologies across states? How can the transnational clean energy regime facilitate the international diffusion of clean energy technologies and thereby help to address energy poverty, green growth and climate change in developing country contexts?

To address these questions, the study has drawn on conceptual analysis based on both the economic (e.g international technology diffusion and trade literature) and political science literature (e.g studies on energy governance, regime complexity, effectiveness and social learning). Theoretical methods in economics allowed constructing models of information diffusion among economic actors, while conceptual methods from political sciences were used to theorize on the formation of a transnational regime complex for clean energy using social network analysis.

Next to conceptual analysis, the research project relied on a combination of both quantitative and qualitative empirical analysis.

The quantitative analysis included econometric estimations of the factors thought to affect the diffusion of specific energy technologies within developing countries: namely energy-efficient lighting and clean cookstoves. These technologies have been chosen to operationalize the dependent variable because of their relevance to greening the economy of developing countries and the availability of data. An initial cross-country dataset on energy-efficient lightings provided by the UNEP EN.Lighten programme was completed by detailed panel data on cross-country trade on lightbulbs. For the analysis of the diffusion of clean cookstoves, the research project used a rich household survey data conducted over the 1987-2010 period in India, which made it possible to analyze both temporal and spatial aspects of clean cookstoves diffusion. Cross-country panel data econometric estimations have investigated both the economic (e.g. trade) and governance (both at the national and international level) mechanisms that constitute barriers to or enablers of clean technology diffusion in developing country contexts. In relation to economic barriers and trade openness, the project also investigated the role of trade institutions and ongoing trade liberalizations of environmental goods and services for clean energy products as embodied in international trade rules.

As such, the quantitative analysis relied extensively on new data, specifically collected for this project. This resulted in the construction of several new databases on:

- 1) Domestic policies, such as implementation of information provision programmes, subsidies and regulations for the promotion of energy-efficient lightings for 72 low and middle income countries over the 1993-2013 period. These data were manually coded using information from the UNEP EN.LIGHTEN Global Policy Map.

- 2) Domestic policies in renewable energy for a set of 165 countries over 1978-2011. The dataset informs whether countries have adopted a feed-in tariff scheme for renewable energy over the period and cover both OECD and non-OECD countries.

- 3) Diffusion and access to clean cooking fuels across regions and households in India. The dataset was constructed by combining a series of national sample households surveys in India, and provides data on households' expenditures on types of fuel used for cooking purposes, next to a large set of individual characteristics. The dataset covers the 1987-2010 period for about 100,000 Indian households per year.

- 4) Dataset on the international and transnational institutions working on clean energy and level of cross referencing across institution for relevance and epistemic authority in the regime complex for clean energy.

The qualitative empirical analysis relied on case studies to examine in greater detail the role of specific policies and transnational cooperation initiatives to shed light on pathways of impact and best practices. Field research has been carried out in collaboration with UNEP's Green Economy Advisory Service. The specific case study of geothermal energy in Indonesia was selected as it demonstrated relevant variation in the adoption of policies and involvement in transnational clean energy programmes. Qualitative research was also conducted to provide new insights on the structure of clean energy governance internationally and the relative role and authority of different institutions in the clean energy governance regime complex.

## **2. Results:**

The analysis and combination of both theoretical and empirical insights brought forward during the project provided a picture of some of the key determinants and enablers of clean energy diffusion, in particular in the context of developing countries. Although researchers have examined different barriers to clean energy diffusion and different kinds of technologies (efficient lightings, clean cookstoves, renewable energy among which geothermal in particular), the collective contribution of the project highlights the critical importance of the following factors:

### **1. Clean energy governance**

Liliana Andonova and Kathryn Chelminsky developed a new research agenda to examine the emergent structure of clean energy governance internationally. The project research is a contribution to the literature on global governance by elaborating more explicitly a theory of regime complex formation. It questions the implicit assumption of many existing studies that institutions that overlap in mandates or activities necessarily make a loosely coupled system of governance with recognized authority. Our theory stipulates first that three distinct political dynamics can contribute to institutional proliferation in the governance of any issue area: i) discord of interests and dissatisfaction with the status quo on the part of powerful actors; ii) the organizational practices and mission expansion of existing institutions; iii) the rise of transnational actors and their capacity to establish new forms of governance. While different strands of existing literature examine how each of these streams have changed the nature of global governance, we argue that their *interplay* provides the ‘raw material’ of governance complexification. However, platform proliferation, overlap and even friction are not sufficient conditions to discern the emergence or structure of a regime complex. Our main argument is that a fourth dynamic, which entails inter-organizational recognition and legitimation of authority, is a necessary condition for a set of institutions to work as a purposeful system of governance with recognized authority. Drawing on sociological and normative perspectives on legitimacy, we specify how processes of legitimation influence the structuring of a regime complex and ultimately the articulation of its normative purpose. The research also presents for the first time systematic data on the range of international organizations and initiatives engaged in clean energy governance and the relative recognition of their authority and centrality in the emergent regime complex. The resulting paper entitled “*Emergence of a Regime Complex for Clean Energy: The Critical Role of Legitimacy*” has been presented at several inter-disciplinary conferences and has been submitted for a journal review.

The PhD dissertation research of Kathryn Chelminski (“*Harnessing the Ring of Fire: Assessing the Effectiveness of the Clean Energy Regime Complex in Addressing Barriers to Geothermal Development in Indonesia and the Philippines*”) in turn examines the causal mechanisms through which the clean energy regime complex has influenced policy development and technology deployment of clean energy in Indonesia. The research involved extensive field work in addition to interviewing and data collection at the international level.

### **2. Trade openness**

Several contributions of our research project emphasize the role of trade openness and of lowering trade barriers to facilitate the international diffusion of clean energy technologies.

First, two studies emphasize the role of the trade for the specific case of energy-efficient lightbulbs. One of the research paper of the project entitled “*Shedding light on policy diffusion: The ban on incandescent light bulbs*” written by Eirik Lindebjerg (Graduate Institute and UNEP) and Joelle Noailly shows that lower trade barriers in energy-efficient lightbulbs largely contributed to developing countries’ decisions to adopt a ban on incandescent light bulbs. Cuba, for instance, was one of the first country to adopt a ban on incandescent lightbulbs, which subsequently led to a large diffusion of compact fluorescent lightbulbs (CFL) lamps through the country. Yet, this policy decision was preceded and triggered by large cheap imports of CFL lamps from China. The study uses econometric duration models to investigate the impact of trade openness and trade tariffs on the international diffusion of the ban on incandescent lightbulbs for 111 countries over the 1995-2015 period. The results confirm the strong effect of trade - as a factor easing access to the alternative CFL technology – on the decision to adopt a ban on incandescent lightbulbs. Other factors next to trade are regional learning, environmental awareness and political rights.

The second contribution on lightbulbs entitled “*The light at the end of the tunnel: Impact of policy on the global diffusion of fluorescent lamps*” and written by Suchita Srinivisan looks more specifically at factors affecting imports of CFL lightbulbs in a given country – a measure of access and diffusion of these new energy-efficient lamps – and finds that next to domestic policies (see next section), trade agreements with top exporters of technologies (such as China in the case of CFL) are also an effective means of facilitating the transfer of these technologies. The importance of trade for the case of lightbulbs could lead to conclude that trade especially matters for this type of simple homogeneous products that have relatively low costs of adoption.

Another contribution of the project written by our academic partners from the World Trade Institute: Manfred Elsig and Jenny Surbeck (University of Bern) entitled “*Who is really serious about the green economy? An empirical assessment of green goods liberalization in developing countries*” looks at the role of trade liberalization for a broader set of environmental goods and technologies in the context of clean technology diffusion. The study compares liberalization patterns (both through preferential trade agreements and through the WTO) for environmental goods (EGs) from the 1990s onwards and investigates differences in ambitions in green products’ liberalization. Tariff liberalization data is drawn from DESTA and WITS online and three main sources of classification systems for EGs are used: 1) the Asia-Pacific Economic Community (APEC), 2) the Organisation for Economic Co-operation and Development (OECD) and 3) the so-called “Friends of environmental goods” group in the context of ongoing WTO negotiations. The results show that Friends and OECD members have a similar and fast liberalization for their defined EGs whereas APEC members show an incremental liberalization for their classification of EGs. The data also indicates that average tariffs are substantially higher and tariff liberalization is distinctly slower for Southern than for Northern importing countries, despite the fact the Southern countries could benefit from faster liberalization through higher imports of environmental goods from Northern countries.

### **3. Domestic policies and policy diffusion**

Another key insight that has emerged from the research project is the critical importance of public policy, mainly at home but also in neighboring countries, since policies tend to diffuse geographically through space. The critical role of public policy is highlighted in both our quantitative and qualitative empirical findings.

A qualitative assessment of Indonesia's energy policies showed that moving towards clean energy for developing countries will require not only the implementation of clean energy policy but also appropriate reforms of fossil-fuel subsidies. Using field research and interviews, the research project contributed to the analysis of the success and failures of Indonesia's attempt to remove fossil-fuel subsidies. This led to a working paper entitled "*Redefining 'success' in Indonesia's Fossil Fuel Subsidy Reforms*," written by Kathryn Chelminski which was presented at various conferences, workshops and symposiums. The results of this work show that completing the reforms successfully require two key elements: increased transparency and fiscal buffers to better manage volatility in the oil and currency exchange markets. Getting fossil fuel subsidy reform right requires political determination, strong communication campaigns and sound macroeconomic policy-making to ensure that the reform is socially accepted and fully implemented.

Another contribution looked at the role of specific clean technology policies on the international diffusion of energy-efficient lightbulbs. The working paper "*The light at the end of the tunnel: Impact of policy on the global diffusion of fluorescent lamps*", written by Suchita Srinivisan evaluates the effectiveness of a broad range of domestic policies implemented in a sample of 72 low and middle income countries from 1993 to 2013 in order to facilitate the diffusion of compact fluorescent lamps (CFLs). A major contribution of this work is the collection of an original dataset on implementation of information provision programmes, subsidies and regulations on energy-efficient lightbulbs using data, which was manually coded directly from the UNEP EN.LIGHTEN Global Policy Map. The paper also builds on economic theory to formalize a model of technological diffusion via social learning amongst consumers of new technologies that finds that policy-makers are more likely to implement policies if they can implement them more effectively, and if the scale of implementation is large. The empirical part of the paper uses an instrumental variable econometric estimation to evaluate the effectiveness of these policies and finds that all the policies mentioned above are effective in encouraging the transfer (via imports) of CFL in this sample of countries: subsidies are found to be the most effective policy, followed by the ban, and information policies, suggesting that cost-based barriers are most significant for this sample of countries. The results also show that countries are more likely to learn from the experiences of "policy-leaders", or countries in each geographical region that are at the forefront of implementing clean energy policies. This result was also found in the other contribution on lightbulbs "*Shedding light on policy diffusion: The ban on incandescent light bulbs*" written by Eirik Lindebjerg and Joelle Noailly which looked at how a specific and important policy in this sector, namely the ban on incandescent lightbulbs, diffused internationally. Here again regional learning was found to be an important driver of the international diffusion of the ban.

Policy support for clean energy technologies is fundamental, given the market externalities in this sector, but is often lacking in developing countries contexts due to weak institutions. This is why the research project puts a particular focus on understanding the determinants of international policy diffusion. Besides the case of energy-efficient lightbulbs, an additional contribution aimed to investigate the determinants of feed-in tariffs policy adoption for renewable energy. This work initiated by Joelle Noailly and our SNIS partner Lena Schaffer (University of Konstanz) resulted in a Master's thesis entitled "*National and international*

*determinants of feed-in tariff policy adoption and subsequent tariff levels*” written by Corinne Graessle. The results of survival analysis econometric estimation show that the worldwide diffusion of feed-in tariff policies over the last decades has been mainly driven by higher development levels, lower fossil-fuel rents, energy security aspects and strong institutions. The main added value of this work is the construction of an extensive dataset on feed-in tariff policies for 165 countries worldwide over the 1978-2011 period. Data from the OECD were completed by using information from various sources (REN21, REEP, IEA, IRENA) to collect additional information on policies in developing countries.

#### **4. Social diffusion**

The last result emerging from the research project is the critical importance of social diffusion and peer-group effects to diffuse information among consumer groups. This is particularly important in developing countries, where national policies may still be lacking or be difficult to implement due to high costs of enforcements and low compliance levels.

The project contribution on “*Adding Fuel to Fire? Spatial Disparities and Peer Effects in the Adoption of Clean Cooking Fuels in India*”, written by Suchita Srinivisan and Stefano Carattini (London School of Economics and HES-SO Geneva) evaluate whether households exhibit social learning in the adoption of clean cooking fuels in India. In addition, the paper also seeks to identify the nature of these “peer-effects”, i.e. whether they are merely information spillovers, whether they are driven by learning-by-doing behaviour, or a desire to imitate other consumers. The cooking fuel studied in this paper is liquefied petroleum gas (or LPG), whose use is more prevalent in the richer, urban areas of the country. The study uses National Sample Survey Household Consumer Expenditure data, along with Indian Human Development Survey data for these purposes, both of which provide ample information on the socio-economic characteristics of sample households for about 100,000 households per year over the 1987-2010 period. The results provide some evidence to suggest the presence of spillovers across households at the level of the village or urban block, i.e. a household is more likely to use LPG if other households in the same village or urban block do so, controlling for several factors found to be important in the literature such as income, education, whether the household is rural or urban, and other socio-economic characteristics. These effects seem to strengthen over time for rural households, while they deteriorate over time of urban ones. Moreover, the results also show that these effects are stronger in states which were better supplied and received more LPG subsidies.

#### **3. Match between research results and initial expectations**

The purpose of this project was to provide novel qualitative and quantitative evidence on the factors affecting low-cost clean energy technology diffusion in developing countries. So far, an examination of data on developing countries was still lacking as most of the current literature on clean energy innovation and diffusion mainly relied on empirical evidence for developed countries. The research project was successful in creating new original datasets for specific technologies for which data were available (lightbulbs, cookstoves, renewable energy and geothermal energy in particular). We faced limitations with respect to data collection during the course of the research that we initially did not expect. At the beginning of our project, we aimed to write a comparative study on clean cookstove adoption in a sample of low and middle-income countries, but we were unable to pursue this idea because of a lack of

comparable data, which is why we turned to country-level studies. Also, the technologies studied are rather heterogeneous (lightbulbs and cookstoves having relatively low costs of adoption, while geothermal energy is more complex and expensive) and the lack of large cross-countries cross-technologies datasets did not allow for a more in-depth comparative analysis.

Along our analysis, many of our hypotheses regarding the determinants of international diffusion originally formulated for the project have been confirmed. Our empirical results confirmed in particular that the diffusion of low-cost energy technology to developing countries does not take place automatically and faces instead specific barriers, in particular market failures (e.g. lack of environmental regulation, information inefficiencies), institutional factors (e.g. weak institutions), and economic barriers (trade, tariff barriers). Also, our expectations regarding the important impact of climate and clean energy policies on the greater diffusion of clean energy technologies, all else equal, have been confirmed. Finally, our results corroborate the expected impact of the clean energy regime, namely the greater the interactions between transnational clean energy initiatives and national policies, the more likely the diffusion of clean energy technologies.

Our results on the importance of the role of “learning”, whether at the level of institutions (international or regional policy learning) or at the level of consumers (social learning) were initially under-emphasized at the stage of the proposal writing, as we did not anticipate that they would form an important contribution of our research project. When institution building is particularly weak as is the case in developing countries contexts, the role of learning, either from international governance institutions with recognized authority, from regional policy leaders or from informed consumers appears as a key enabler of clean energy technology diffusion.

#### **4. Practical applications of results**

The policy relevance of the research is evident through collaboration with UNEP and the development of a joint working paper series. During the course of the project, we had the opportunity to inform the policy-making bodies on the results of our project at several occasions. Joy Kim, our contact at UNEP, participated at all our annual SNIS partner meetings to discuss progress of on-going research and implications for policymakers.

A main opportunity to present our key results to policymakers was provided during the UNEP-CIES side-event “Technology innovation for a green economy in developing countries” organized within the framework of the OECD Green Growth and Sustainable Development Forum in Paris on December 15, 2015. The event provided country case studies to examine the issues of accessing clean energy technology and how to contribute to the evolution of eco-innovation for small and medium enterprises in developing countries and was attended by about 100 participants.

In addition, SNIS team members also presented their work at the Annual Conference of the Green Growth Knowledge Platform (GGKP), held in Venice in January 2015. The GGKP, founded by GGGI, the OECD, UNEP, and the World Bank, is the world’s largest global partnership of organizations and experts committed to collaboratively generating, managing, and sharing green growth knowledge and data to mobilize a sustainable future. The global meeting in Venice drew together leading researchers, practitioners and policy makers in a



number of plenary and parallel sessions. Our main key messages presented during these policy-oriented fora related to the need for sound environmental regulations in developing countries, the effectiveness of international development assistance in removing barriers to diffusion and the role of trade liberalisation.

## **5. Questions that merit further exploration**

While our project has provided a first analysis of studies on clean energy innovation and diffusion in developing countries contexts, there is a need for future research in this area. In particular, the construction and availability of new datasets is crucial to future studies on this question. Such broader datasets could allow for more refined comparisons of how the various factors identified during the project effectively affect different types of technologies.

Finally future work should also investigate how the adoption of low-cost clean energy technologies contribute to reduce carbon emissions in developing countries. The question of a possible “rebound” effect, i.e. a potential increase in energy consumption due to behavioural responses as an increasing number of consumers adopt the clean technology, remains open and has not been much studied in developing countries contexts.

## **6. Publications and activities**

### **Partnerships**

Several forms of collaboration and partnerships have been established during the time frame of the research project.

First, the academic network of SNIS researchers met at several occasions to exchange ideas and comment on the work of other team members through the organization of two internal workshops organized by Liliana Andonova and Joelle Noailly at the Graduate Institute in June 2014 and June 2015. Each team member was also invited to present his work during a research seminar at the Centre for International Environmental Studies along the course of the project. These meetings provided the opportunities to develop further the academic collaboration among SNIS researchers.

Second, the SNIS project fostered a close collaborative partnership with the Sustainability Science Program (SSP) of the Harvard Kennedy School of Government. Members of our team (Liliana Andonova and Kathryn Chelminski) have collaborated closely with the interdisciplinary team at the KSG including with Professor Laura Anadon, William Clark and Henry Lee. Andonova presented results of the SNIS project at the University College London workshop of the Harvard team and at the SSP symposium at Harvard; Professor Laura Anadon gave one of the bi-annual public lectures of the CIES Geneva Environmental Dialogues on the deployment and diffusion of clean energy technologies in China and India. Importantly, Kathryn Chelminski had an opportunity to spend the last year of her PhD with the Energy Program of the Kennedy School, directed by Henry Lee, where she expanded her

research to focus on policy reforms as essential conduit to more effective clean technology diffusion and adaptation in developing countries.

Third, the SNIS research team benefited from collaboration with the INOGO COST network, which resulted in the organization of the final SNIS workshop on “Climate Policy Innovation and the Access to Clean Energy Technology in Developing Countries” on May 26-27 in Geneva (see next section). This workshop brought together about 20 interdisciplinary scholars, including both junior and senior researchers, to discuss climate policy innovation and access to clean energy technology in developing countries.

Finally, policy partners were also actively involved in the project in particular regarding dissemination activities and the sharing of knowledge. Our main policy partner UNEP (Joy Kim) collaborated on the provision of data (EN.LIGHTEN Global Policy Map) and on the organization of the side-event and policy workshop during the OECD Green Growth Forum which involved selecting country studies and working papers. Feedback from policymakers attending the event was highly positive and UNEP showed appreciation for the collaboration on the event (see UNEP’s letter of appreciation in Annex).

The Geneva Dialogue lecture of Professor Laura Diaz Anadon was also the results of a collaboration between the SNIS project and the Green Growth Knowledge Platform. Ben Simmons, founding head of the GGKP, acted as a moderator of the discussion

### **Academic activities and Policy events**

The following academic and policy events were organized to share and disseminate research findings:

#### **Academic Workshops:**

- SNIS Partner Meeting, 17 June 2014, Graduate Institute, Geneva. Discussing of aims of SNIS project and networking opportunity among partners to discuss project outcomes, research collaborations and timelines, with Manfred Elsig, Joy Kim, Jeremy Lucchetti, Lena Schaffer, Alain Patrice Schaub, Suchita Srinivasan, Jenny Surbeck, Liliana Andonova, Joëlle Noailly, Kathryn Chelminski.
- SNIS Partner Meeting, 5 June 2015, Graduate Institute, Geneva. SNIS Workshop of working papers with all SNIS partners. Discussion of on-going progress, with Manfred Elsig, Joy Kim, Lena Schaffer, Suchita Srinivasan, Jenny Surbeck, Liliana Andonova, Joëlle Noailly, Kathryn Chelminski.
- SNIS-INOGO workshop on “Climate Policy Innovation and the Access to Clean Energy Technology in Developing Countries”, 26-27 May 2016, Graduate Institute, Geneva. Final academic workshop of the SNIS project.

This workshop brought together 18 interdisciplinary scholars under the flag of the COST Action INOGO (Innovations in Climate Governance) to discuss climate policy innovation and access to clean energy technology in particular in developing countries. Researchers from Europe, the United States, Nigeria and Hong Kong responded to the call for papers initiated early 2016. Papers were presented into five

sessions on the themes of low-cost clean technologies, fossil-fuel subsidies, cross-country studies, investment and governance. Prof. Kathryn Hochstetler held a keynote session on “Green Industrial Policy and the Renewable Energy Transition: Can Industrial Policy be Green?” From the SNIS research team, the following papers were presented:

- Presentation by Liliana Andonova of paper “Emergence of a Regime Complex for Clean Energy: The Critical Role of Legitimation”
- Presentation by Suchita Srinivasan of paper “Adding Fuel to Fire? Spatial Disparities and Peer Effects in the Adoption of Clean Cooking Fuels in India”
- Presentation by Kathryn Chelminiski of paper “Redefining Success in the Politics of Fossil Fuel Subsidy Reform in Indonesia”

### **Seminars**

- CIES Brown Bag Lunch Seminar, 5 March 2013, Graduate Institute, Geneva. Presentation by Lena Schaffer of "Explaining government choices for promoting renewable energy".
- CIES Brown Bag Lunch Seminar, 22 October 2014, Graduate Institute, Geneva. Presentation by Eirik Lindebjerg "Shedding light on policy diffusion: The case of incandescent lightbulbs".
- CIES Brown Bag Lunch Seminar, 18 November 2014, Graduate Institute, Geneva. Presentation by Kathryn Chelminski "Overcoming barriers to clean energy technology diffusion: The case of geothermal energy in Indonesia,".
- CIES Brown Bag Lunch Seminar, 5 November 2015, Graduate Institute, Geneva. Presentation by Manfred Elsig of paper entitled “Who is really serious about the green economy?”

### **Policy Events**

- Geneva Dialogue Lecture, November 24, 2015, CIES, Graduate Institute. Public lecture by Professor Laura Diaz Anadon, Harvard Kennedy School of Government, on “Energy technology innovation: the role of domestic and international actors”, co-organized by CIES and the Green Growth Knowledge Platform (GGKP). The lecture was opened by Liliana Andonova and the discussion was moderated by Ben Simmons, founding head of the GGKP.
- OECD Green Economy and Green Growth Forum, UNEP side-event, 15 December 2015, OECD, Paris, co-organised by CIES and UNEP. Over 100 participants from the OECD, academic and private sector, gathered in Paris at this side-event “Technology innovation for a green economy in developing countries” within the framework of the Green Growth and Sustainable Development Forum on December 15, 2015. The event provided country case studies to examine the issues of accessing clean energy

technology and how to contribute to the evolution of eco-innovation for small and medium enterprises (SMEs) in developing countries. The side- event was opened by Joy Kim, Senior Economic Affairs Officer at UNEP’s Economics and Trade Branch (ETB) and Liliana Andonova, Professor and Co-Director of the CIES, who emphasized that exploring these barriers is important in light of the advancement of consensus on the need for clean technologies following the COP21 and the Sustainable Development Goals. Elisa Tonda (UNEP) and Joelle Noailly (CIES) also acted as discussants on the presented research results.

- Presentation by Kathryn Chelminski of paper “Political economy of energy access and sustainable energy transitions in Indonesia” .
- Presentation by Suchita Srinivasan of paper entitled “The light at the end of the tunnel: Impact of policy on the global diffusion of fluorescent lamps”.
- Presentation by Jenny Surbeck of paper entitled “Who is really serious about the green economy?”

The project research findings were presented and discussed in the following international conferences and global meetings:

#### **Presentations at international meetings**

- 4th Edition of the series of thematic seminars of UNOG seminar, “Sustainable energy for all”, 29 October 2013, Palais Nations, Geneva. Presentation by Kathryn Chelminski of "Greening of global energy governance: Interconnections Between Energy and Climate Change" at the Energy and Environment Panel at 4th edition of the series of thematic seminars of UNOG seminar, “Sustainable energy for all”, organized by UNOG.
- SPSA Conference, 30-31 January 2014, University of Bern, Bern. Joint presentation by Liliana Andonova and Kathryn Chelminski of paper "Is there a clean energy regime complex?", organized by SPSA/ASSPEnvironment and Development Panel by Liliana Andonova, Katharina Michaelowa.
- International Studies Association Conference 2014, 26 March 2014, Toronto, Canada. Presentation by Liliana Andonova of “IOs and Institutional Innovation: The Case of Climate Finance”, organized by ISA.
- International Studies Association Conference 2014, 26 March 2014, Toronto, Canada. Joint presentation by Liliana Andonova and Kathryn Chelminski of paper "Is there a clean energy regime complex?", organized by ISA.
- Penser la gouvernance de l’environnement à l’international Séance 1 : Séminaire Organisations internationales, 11 September 2014, CERI, Sciences Po, Paris. Presentation by Liliana Andonova of “IOs and Institutional Innovation: The Case of Climate Finance”, organized by Sciences Po, Paris.
- SINERGIA Workshop, 26 September 2014, Graduate Institute, Geneva. Presentation by Suchita Srinivasan of paper entitled “The light at the end of the tunnel: Impact of policy on the global diffusion of fluorescent lamps”, organized by CIES.

- Interdisciplinary PhD Seminar, 5 November 2014, Graduate Institute, Geneva. Presentation by Kathryn Chelminski of “Divergences in the ‘sustainable energy trinity’: The case of Indonesia”, organized by IHEID.
- Energie et cohésion : gouvernance, régulations et négociations -- Groupe de recherche à CERI, 12 November 2014, Sciences Po, Paris. CERI presentation of "Ambitions and realities of 'energy for all' in Indonesia" by Kathryn Chelminski, Participants from Energy group - CERI/CRNS, EDF, CERI/CRNS, Sciences Po Paris:
- Swiss Program in Environmental and Energy Economics (SPEE) 2014, 1st-5th December 2014, University of Basel, Basel. Presentation by Suchita Srinivasan of "The Light at the End of the Tunnel: The Impact of Policy on the Global Diffusion of Fluorescent Lamps", organized by the University of Basel.
- Third Annual Conference of the Green Growth Knowledge Platform 2015, 29th-30th January 2015, Ca' Foscari University of Venice, Venice, Italy. Presentation by Suchita Srinivasan of "The Light at the End of the Tunnel: The Impact of Policy on the Global Diffusion of Fluorescent Lamps", organized by the University Ca Foscari Venezia, Global Green Growth Institute, OECD, UNEP, The World Bank, TERI.
- ISA Conference 2015, 18-21 February 2015, New Orleans, LA USA. Presentation by Kathryn Chelminski of paper “Impacts of the clean energy regime complex on Indonesia’s geothermal energy evolution”, organized by ISA.
- International Association for Energy Economics (IAEE) Annual Meeting, May 2015, Antalya, Turkey. Presentation by Suchita Srinivasan of paper entitled “The light at the end of the tunnel: Impact of policy on the global diffusion of fluorescent lamps”, organized by IAEE.
- European Association of Environmental and Resource Economics (EAERE) Annual Meeting, June 2015, Helsinki, Finland. Presentation by Suchita Srinivasan of paper entitled “The light at the end of the tunnel: Impact of policy on the global diffusion of fluorescent lamps”, organized by EAERE.
- European Association of Environmental and Resource Economics (EAERE) Annual Meeting, June 2015, Helsinki, Finland. Presentation by Eirik Lindebjerg of paper entitled “Shedding light on policy diffusion: The ban on incandescent light bulbs”, organized by EAERE.
- Sinergia Project Workshop on Innovation, Diffusion and Green Growth Workshop, September 2015, London School of Economics, London. Presentation by Suchita Srinivasan of paper entitled “The light at the end of the tunnel: Impact of policy on the global diffusion of fluorescent lamps”, co-organised by CIES and LSE.
- Energy and justice in the EU and Asia conference, 14-15 October 2015, Sciences Po, Paris. Presentation by Kathryn Chelminski of paper “Political economy of energy access and sustainable energy transitions in Indonesia”, organised by CERI/Sciences Po.
- Conference on Taxes and Subsidies in Dynamic Models, October 2015, University of Brescia, Italy. Presentation by Suchita Srinivasan of paper entitled “The light at the end of the tunnel: Impact of policy on the global diffusion of fluorescent lamps”, organized by the University of Brescia.

- ETIP Fellows Research Seminar, 9 December 2015, Harvard Kennedy School, Cambridge. Presentation by Kathryn Chelminski of paper “Impacts of the clean energy regime complex on geothermal energy development in Indonesia”, organised by Harvard Kennedy School.
- International Workshop on Enhancing Legitimacy in Polycentric Climate Governance, 19-20 May 2016, EUI, Florence. Presentation by Liliana Andonova and Kathryn Chelminski of paper “Emergence of a Regime Complex for Clean Energy: The Critical Role of Legitimation”, organised by the European University Institute.
- SEI/Lund Workshop “Politics of Fossil fuel subsidy reform in Indonesia”, 16-17 June 2016, SEI, Stockholm. Presentation by Kathryn Chelminski of paper “Redefining ‘success’ in Indonesia’s Fossil Fuel Subsidy Reforms”, organised by SEI/Lund.
- Environmental Politics & Governance Conference, 16-17 June 2016, Gerzensee, Switzerland. Presentation by Liliana Andonova of paper “Is There a Clean Energy Regime Complex? Rethinking the Politics, Legitimation and Structure of Complex Governance”.
- World Congress of the Spatial Econometrics Association, June 2016, Rome, Italy. Presentation by Suchita Srinivasan of paper “Adding Fuel to Fire? Spatial Disparities and Peer Effects in the Adoption of Clean Cooking Fuels in India”, organised by the Spatial Econometrics Association.
- International Association for Energy Economics (IAEE) Annual Meeting, June 2016, Bergen, Norway. Presentation by Suchita Srinivasan of paper “Adding Fuel to Fire? Spatial Disparities and Peer Effects in the Adoption of Clean Cooking Fuels in India”, organised by IAEE.
- Atlantic Workshop of Environmental and Energy Economics, June 2016, A Toxa Spain. Presentation by Suchita Srinivasan of paper “Adding Fuel to Fire? Spatial Disparities and Peer Effects in the Adoption of Clean Cooking Fuels in India”, organised by CEPE (ETH), University of Munster.
- IPAG International Research Meeting in Business and Management, July 2016, Nice, France. Presentation by Suchita Srinivasan of paper “Adding Fuel to Fire? Spatial Disparities and Peer Effects in the Adoption of Clean Cooking Fuels in India”, organised by IPAG.

### **Publications:**

Andonova, L. and K. Chelminski (2015) “UNEP,” chapter in *Edward Elgar Encyclopedia of Global Environmental Politics and Governance*, P. Pattberg and F. Zelli (eds), Edward Elgar: UK.

Chelminski, K. (2016) The Political Economy of Energy Access and Sustainable Energy Transitions in Indonesia. *L'Europe en formation*, Spring 2016 (387): 146-165.

Chelminski, K. (2016) "Lessons from Indonesia's Fuel Subsidy Bonfire." Op-ed in Climate Home, June 14. <http://www.climatechangenews.com/2016/06/14/lessons-from-indonesias-fuel-subsidy-bonfire/>

Chelminski, K. (2016) “Redefining Success in the Fossil Fuel Subsidy Reform in Indonesia”, CIES Research Paper No 44, July.

Chelminski K. (2016) “Harnessing the Ring of Fire: Assessing the Effectiveness of the Clean Energy Regime Complex in Addressing Barriers to Geothermal Development in Indonesia and the Philippines”, IHEID PhD thesis (under the supervision of Liliana Andonova).

Grassle, C. (2016) “National and international determinants of feed-in tariff policy adoption and subsequent tariff levels”, IHEID Master’s thesis (under the supervision of Joelle Noailly, with Lena Schaffer and Liliana Andonova).

Lindebjerg E. and J. Noailly (2015) “Shedding light on policy diffusion: The ban on incandescent light bulbs”, Paper prepared for presentation at the Annual Meeting of the European Association of Environmental and Resource Economists, Helsinki, June 2015.

Lindebjerg E. (2015) “Shedding light on policy diffusion: The ban on incandescent light bulbs”, IHEID Master’s thesis (under the supervision of Tim Swanson and Joelle Noailly).

Srinivisan, S. (2016) “The light at the end of the tunnel: Impact of policy on the global diffusion of fluorescent lamps”, CIES Research Paper No 45, July.

The following publications are foreseen:

Andonova, L. and K. Chelminski. “Emergence of a Regime Complex for Clean Energy: The Critical Role of Legitimacy.” Under review

Chelminski, K. (2016) “Redefining Success in the Fossil Fuel Subsidy Reform in Indonesia”, UNEP Working Paper.

Elsig, M. and J. Surbeck, F. (2016) “Who is really serious about the green economy? An empirical assessment of green goods liberalization in developing countries” to appear as World Trade Institute Working Paper and as UNEP working paper.

Srinivisan, S. (2016) “The light at the end of the tunnel: Impact of policy on the global diffusion of fluorescent lamps”, UNEP Working Paper.

Srinivisan, S. and S. Carattini (2016) “Adding Fuel to Fire? Spatial Disparities and Peer Effects in the Adoption of Clean Cooking Fuels in India” to be published as CIES Research Paper and Grantham Research Institute on Climate Change, London School of Economics, Working Papers Series.



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## Acknowledgement of the cooperation for the UNEP-CIES joint GE innovation project

1 message

Joy KIM <Joy.KIM@unep.org>

7 janvier 2016 à 15:58

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Cc : Joëlle Noailly <joelle.noailly@graduateinstitute.ch>, Liliana Andonova <liliana.andonova@graduateinstitute.ch>, Fulai SHENG <Fulai.SHENG@unep.org>, Steven STONE <Steven.STONE@unep.org>, Ligia Noronha <Ligia.Noronha@unep.org>

Dear colleagues,

First of all, best wishes for the new year.

I would like to acknowledge your kind cooperation and data provision for the joint UNEP-CIES research project on 'the role of clean energy technology for innovation in developing countries' GE transition' which was funded by SNIS (Swiss Network for International Studies).

UNEP colleagues who have provided data and support for the studies include:

- Gustavo Manez
- Javier Otero
- Mark Radka
- Laura Williamson (REN21)
- Hanh Le, Southeast Asian Network of Climate Change Offices, Energy Branch/DTIE, UNEP,
- Amr M. Abdelhai, (GSWH) Energy Branch, Programme Officer, DTIE.

Thanks to your cooperation, three country studies and working papers have been presented at the joint UNEP-CIES side event at the OECD Green Growth and Sustainable Forum on 15 December 2015. More than 100 OECD and non-OECD delegates, academics and business representatives attended the event (pls. see the weblink below).

<http://www.unep.org/greeneconomy/News/TechnologyInnovationforaGreenEconomyinDevel/tabid/1060962/Default.aspx>

I would also like to thank Elisa Tonda and Liazzat Rabbiosi for their cooperation and participation in the event where UNEP's recent publication on 'eco-innovation and technology' was presented as well.

Once the working papers are finalized (expected in May 2016), I would share them with you FYI. Hope you find the studies also useful for your respective work stream.

Best wishes,  
Joy