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Local Content Requirements and the Renewable Energy Industry - A Good Match?

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ICTSD
International Centre for Trade and Sustainable Development

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Global Green Growth Institute

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ICTSD welcomes feedback on this document. These can be forwarded to Joachim Monkelbaan, jmonkelbaan@ictsd.ch

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The Global Green Growth Institute (GGGI) is a new kind of international organisation that has been established to accelerate "bottom up" (country- and business-led) progress on climate change and other environmental challenges within core economic policy and business strategies. The Institute provides an international platform for evidence based learning and policy innovation that helps to illuminate practical opportunities for progress on the twin imperatives of economic development and environmental sustainability, while deepening cooperation among developed and developing countries, the public and private sectors, and practitioners and scholars. Founded in June 2010 and established in Seoul, GGGI is committed to help developing and emerging countries pioneer a new "green growth" paradigm, and is scheduled to be converted into an international organisation in October 2012.

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Foreword

Climate change and the sustainable supply of energy are unique challenges. A massive scale up and deployment of renewable energy sources could significantly reduce the emissions responsible for climate change and contribute to a more secure supply of energy for all.

On the one hand, efforts to scale up sustainable energy require generation costs to be as low as possible. On the other hand, governments are increasingly using green industrial policies to achieve other policy objectives such as sustainable economic growth and domestic employment. Governments for example try to gain local benefits from increased renewable energy deployment by mandating that renewable energy goods and services are produced domestically. Such policy choices for 'local content requirements' are rather based on political motivations than on economic analyses and consideration of trade law.

The purpose of this paper is to assess the use, potential usefulness and legality of local content requirements (LCRs) in renewable energy policy. Based on a rigorous review of existing literature, the paper finds a number of conditions which determine the economic feasibility of local content requirements. Then the paper explores some real world LCR schemes in terms of value creation, innovation, trade-distorting impacts and the efficiency of allocation of resources. The authors observe that while it is understandable that governments wish to promote domestic sustainable energy capacities and industries, their imposition of local content requirements may also mean that countries are not always able to choose the highest quality equipment and services globally available at the most competitive price.

Finally, the paper assesses the legality of LCRs in terms of WTO law. This should be seen against the backdrop of a rapid increase in the number of trade disputes related to LCRs in the renewable energy sector, up to the point where some observers call it a 'clean energy trade war'. The legality of LCRs is a crucial factor as it could potentially guard against sustainable energy policies designed with discriminatory and protectionist intent. LCRs run clearly counter to WTO rules, and this has been confirmed in the 'Ontario case' in which Japan and the EU complained about LCRs for renewable energy equipment in this Canadian province.

Based on this multi-dimensional analysis, the paper draws some lessons for both domestic policy and for international cooperation. Moving forward, the urgency of addressing climate change and the provision of clean energy to all will require, among other policy responses, a clear and coherent governance regime for sustainable energy goods and services supported by trade rules and robust markets. The current stalemate in the WTO's Doha negotiations, particularly in efforts to liberalise environmental goods and services, has prevented action to address barriers to trade in sustainable energy goods and services. Even a successful conclusion of the round would leave a number of trade-related rules pertaining to sustainable energy – including LCRs – unclarified, given the Doha mandate's lack of a holistic perspective on energy.

With such a scenario, sustainable energy trade initiatives (SETIs) may present worthwhile alternatives. These possibilities include a Sustainable Energy Trade Agreement (SETA), a stand-alone initiative designed to address barriers to trade and enable a trade policy-supported energy governance regime. A SETA might be pursued initially as a plurilateral option – either within or outside the WTO framework – and eventually be "multilateralised." A SETA could also help clarify existing ambiguities in various trade rules and agreements as they pertain to sustainable energy and provide focalised governance through effective, operational provisions.

One such policy tool where greater clarity in trade rules will be required is the use of LCRs as a means to create domestic economic growth, employment and political support for renewable energy.

The paper discusses the feasibility of approaches for a SETA. In addition to ensuring non-discriminatory treatment for the same SEGS as far as parties to a SETA are concerned, the authors acknowledge that this may be challenging given the stance of various WTO Members on deriving wider benefits from scaling up renewable energy.

This paper was written by Tom Moerenhout, Researcher at the Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development (IISD) , and Jan-Christoph Kuntze, Energy Advisor at the Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ). The content of this paper is developed in full by the authors and is not attributable to either of these organizations.

The paper is produced as part of an initiative of ICTSD's Global Platform on Climate Change, Trade and Sustainable Energy. As a valuable piece of research, it has the potential of informing innovative policy responses on sustainable energy trade initiatives and will be a valuable reference tool for policymakers involved with LCRs as well as trade negotiators. We hope that you will find the paper to be a thought-provoking, stimulating, and informative piece of reading material and that it proves useful for your work.

Ricardo Meléndez-Ortiz
Chief Executive, ICTSD

Executive Summary

This paper offers an initial assessment of the use, potential usefulness and legality of local content requirements (LCRs) in RE policy. It can be seen that LCRs for RE are used frequently, either as a precondition to the receipt of financial support or as part of eligibility requirements in public tenders. They are often attached to expensive public financial support programs to gain additional local benefits from increased RE deployment. It is observed that most countries using them base their policy choices on political motivations, rather than on economic and empirical analyses, which remain largely absent in the case of LCRs.

From the scarce empirical literature on LCRs, it is found that there are a number of initial basic conditions that determine the feasibility of creating domestic industries and, perhaps, subsequent innovators. In addition to a stable and sizeable market, the financial support (to which LCRs are often linked) for the RE sector needs to be sufficiently large to avoid alienating potential investors. The local content rate must also not be too restrictive and must be associated with learning benefits, as knowledge of the current technology increases effectiveness. Finally, when technologies are still in their infancy, the potential of LCRs to reduce costs through learning-by-doing is higher. Many countries using LCRs, however, do not explicitly target the creation of global innovators. The given basic conditions are broad and necessary to create domestic producers, though not necessarily sufficient to guarantee welfare creation.

In addition to national welfare creation, the paper poses the question whether, under certain conditions, content requirements can be used in conjunction with the development of a global innovator that can compete on the international market and push down technology costs in the medium-term. Aside from the basic conditions for national welfare creation, the analysis puts forward that conditions for potential medium-term benefits are country and technology-specific, and complex. While it is found that LCRs will create short-term costs for the industry and will likely inflate retail power prices alike, a medium-term benefit of increasing competition and innovation on the international market may offset these costs. It is of great importance to note that this is a theoretical possibility. To date, these potential positive spillover effects have not been modelled or demonstrated.

From an analysis of LCRs used in national RE policies, it appears that they are often poorly designed for national value creation and fail to score well against the identified basic conditions. In many countries, LCR rates are observed to be very high, which increases their trade-distorting impact and the inefficient allocation of resources. This may drive up costs excessively and hamper international competition in the short-term. In some countries, LCRs focus on components that have low learning-by-doing potential, or on non-infant industries. This reduces the possibility that the protectionist measure will lead to innovation in the medium-term. One particular problem is that inefficient LCRs often seem to focus on upstream manufacturing and neglect the value in the downstream services sector.

On the legal side, it is concluded that support schemes with LCRs for RE are generally prohibited under WTO law as they violate several WTO provisions, namely the national treatment principle in Article III:4 of the General Agreement on Tariffs and Trade (GATT) and Article 2.1 of the WTO's Trade-Related Investment Measures (TRIMs) Agreement. In addition, they might constitute "prohibited subsidies" under Article 3.1(b) of the Subsidies and Countervailing Measures (SCM) Agreement. Guidance on the legality of feed-in tariffs for RE development can be drawn from the recent decision of a WTO Appellate Body in the Canada – Renewable Energy case. Contrary to support schemes with LCRs, procurement tenders that contain LCRs, however, will hardly be disciplined by WTO law and may therefore be permissible.

Because of the financial crisis, public financing for RE policies is more limited, especially in austerity-driven jurisdictions. At the same time, in order to achieve global green growth, policies and investments such as this are needed to increase RE development and deployment – even more so when fossil fuels remain heavily subsidized. It is not surprising that countries wish to attach local benefits to expensive public financing programmes, in particular because many of the first-movers in RE technology development were wealthy countries.

Our assumption is that achieving local economic or employment benefits on the one hand and RE innovation on the other should not necessarily be seen as a contradiction. In this regard, we support international cooperation in streamlining green industrial policies. Whether LCRs are an appropriate policy tool to achieve both is a question that remains unanswered for now. Our initial assessment concludes that it may be a theoretical possibility, but it has not yet been demonstrated in reality. In addition, a technology-specific LCR cannot be used by all countries together, as this would only result in global protectionism for that specific technology.

The importance of analyzing opportunity costs, performing rigorous scientific research and discussing the use of LCRs is thus self-evident, and we strongly encourage further research. This paper first sets forward the arguments in favour of and against the use of LCRs. This is followed by a description of empirical analysis of the conditions needed to generate additional welfare with the use of LCRs. It will then analyze the wind LCR in China, and give descriptive analyses for LCRs in Ontario, Quebec, Spain, Italy, France, Greece, Croatia, the US, India, Brazil, South Africa and Turkey. Finally, it will assess the legality of LCRs under WTO law.

Call for further research

This paper offers an initial assessment of the use, usefulness and legality of LCRs in RE policy, mainly aimed at communicating that, despite free trade rules, many countries employ LCRs in this sector. The principal outcome objective is to set the agenda for debate and encourage further scientific research. In this regard, it is not an in-depth study of the specific role of LCRs for RE as an integral part of green industrial policy. This particular topic would be a useful contribution for future research and allow the application of a well-developed framework for a green industrial sector with significant environmental potential to be tested. A contribution like this would have two distinct advantages: it could test whether well-developed industrial policy (IP) research and its conclusions can be applied to RE (RE) and would provide a conceptual and theoretical framework to evaluate the effectiveness of industrial policy measures such as LCRs in the field of RE.

In addition to testing LCRs for RE with a well-established IP framework, more detailed research would also prove valuable. In this regard, the authors are mainly thinking about technology-specific analysis and market-specific analysis. In the case of the former, LCRs obviously carry different potentials for different technologies, depending not only on the state of technology but also on issues such as size and weight that can affect transport and substitution costs. In case of the latter, the usefulness and effectiveness of LCRs in smaller and more fragmented markets is a necessary research subject to determine potential regional initiatives. While this contribution limitedly sets out the use of LCRs in smaller markets, the bulk of the analysis is skewed toward larger countries. Since their entry in the market and their use of LCRs, the playing field of RE has logically changed. Therefore, a study of the impact of this change on the potential of LCRs for certain regions with smaller markets would be well appreciated.

Chapter 1

Introduction

Governments are increasingly focusing on green industrial policies to achieve sustainable economic growth. The interconnectedness and urgency of these adaptive challenges require a rapid, global shift to green industrial growth. The shift towards green economy is high on the international agenda, having been one of the major items for negotiation at the Rio +20 summit in June of 2012. Contemporary challenges call for innovative thinking along with increased cooperation and coordination across regimes such as the WTO (trade), ILO (labour), UNEP (environment) and UNFCCC (climate change). However, the enduring stalemate in international climate negotiations and the Doha development round is threatening the successful and urgent transition to green growth. Because of a lack of international policymaking, many countries have turned towards uncoordinated national-level solutions to climate change. Due to the cost of such policies, they often seek to include components of green industrial policies capable of creating new green jobs and prosperity. Such policies eventually aim at gaining higher shares in the global green economy through sustainable industry creation.

The use of LCRs in green IP should be put in context. On the one hand, the international economy and the financial system remain distressed. Global recovery is expected to slow down and halt or even reverse in some parts of the world, mainly because of the European sovereign debt crisis.[1] Financial uncertainty is also felt in job markets around the world, with an increase of twenty-seven million unemployed since 2009, a total of 200 million. Labour markets are showing little improvement, with insufficient corporate investments being an important cause.[2] On the other hand, and at the same time, climate change and environmental degradation pose a great threat to the sustainability of the international environment and economy in general and to sustainable growth in developing countries in particular.

LCRs are an example of a national policy tool that is increasingly being used to achieve green growth. By its very nature, it has considerable repercussions on employment and international trade. It is also controversial due to its protectionist nature, as can be seen in multiple cases that have been brought to the WTO recently. In these cases and within the wider debate, it was not the support mechanisms for renewable electricity generation as such that were challenged, but rather the LCRs that were attached to them (*vide infra*). This paper attempts to refocus the LCR debate around the ultimate question of whether this measure can play a role in achieving green industrial growth in general, and RE deployment and innovation in particular. After defining LCRs and setting out theoretical and empirical considerations, the current use of LCRs in RE policies will be analyzed. An in-depth analysis of LCRs used in China to promote the wind energy industry will be used first to shed light on the objectives, difficulties and effectiveness of LCR legislation. This will be complemented by examples from other countries to indicate different ways of applying LCRs. Finally, a legal analysis will explore whether support schemes and procurement tenders with LCRs are in compliance with WTO law.

Chapter 2

Defining LCRs

Local content requirements are policy measures that require foreign or domestic investors to source a certain percentage of intermediate goods from local manufacturers or producers. These local producers can be either domestic firms or localized foreign-owned enterprises. The policy measure is by definition a performance requirement that can be enacted at the state, sub-state or regional level.[3] Often, the legislation foresees a gradual increase of the percentage of inputs that needs to be sourced locally. The overall objective of content requirements is seldom spelled out explicitly, but may be either developing local competitive industries or increasing employment.[4]

Local content requirements are often linked to other, positive policy measures. In the case of RE development, the eligibility for state support is sometimes conditioned upon an LCR.[5] Some countries use LCRs as a precondition for RE projects in their procurement tenders. In other cases, content requirements are used as a condition for receiving a tariff rebate on other inputs,[6] preferential electricity tariffs or tax treatment. LCRs are often used to complement such incentive schemes to benefit the local economy. Incentive schemes alone are difficult for policy makers to sell, especially in times of fiscal restraint, without at least some arguments that the environmental benefits will also be accompanied by economic benefits.

Chapter 3

Debate on the empirical evidence of the effectiveness of LCRs

3.1 Arguments in favour of LCRs

Proponents of using LCRs in industrial policies in general, and RE policy specifically, often refer to two main reasons. On the one hand, they claim that LCRs can foster economic benefits such as net employment gains and the creation of a domestic industry. Developing countries use them as an argument to protect infant industries. On the other hand, they look at LCRs to generate environmental benefits in the medium-term.

3.1.1. Economic benefits

First, economic objectives include short-term aims such as job creation. The alleged capability of LCRs to create 'green jobs' is often something that helps governments gain political support for green industrial programs. By requiring enterprises to use a certain proportion of inputs from local industries, proponents argue that employment will certainly increase.[7]

Second, economic goals often include longer-term aspirations for sectoral growth in fast-growing sectors with increasing demand (such as RE for example). Support is aimed at fostering infant industries by protecting them from foreign competition until they can realize their latent comparative advantage. The long-term goal of many countries is to be able to export RE technology and equipment to a promising international market in which related demand is rapidly growing. However, since it is difficult to compete with first-movers and other countries that are using LCRs first to supply their domestic market and then to export, it is often claimed that ambitious countries should also use LCRs if they are seeking to capture their 'part of the pie'.[8] This relates back to the political economy of subsidies, in which it could be argued that LCRs may offset the subsidies or other governmental support in the home base of the now affected investor.[9] Whereas developing and emerging economies often claim that they have a more legitimate reason to use LCRs due to their lower GDP per capita (the infant industries argument), industrialized states using LCRs eventually want the same outcome: a long-term, export-ready industry with local jobs attached.

Third, it is sometimes claimed that LCRs will lead to an increased tax base for governments because of a larger local manufacturing industry. This would allow countries to have more income in a time of financial need, while developing a new industry.[10] This argument is commonly used in developing countries, but becomes increasingly relevant for developed countries in times of austerity. However, as the increased tax base has to be offset against the financial incentives typically offered, it is not clear ex ante what the net balance will turn out to be.

3.1.2. Environmental benefits

LCR proponents also refer to the alleged benefits that would mostly follow from spillover effects in the medium-term. First, it is put forward that LCRs will eventually bring more, new mature players to the global market, which, in the medium-term, will increase competition and innovation and thereby lower green technology costs. This accelerates the schedule on which RE reaches grid parity and is able to compete with fossil fuel and nuclear energy without subsidization. Eventually, this should lead to more deployment than would have been the case without the policies. This environmental argument does not offset the counter-argument that points to short-term cost increases (vide infra), but rather claims that this initial disadvantage will be compensated by gains in the longer-term. It should be noted that this environmental argument is still clearly linked to national IP, as the cheapest medium-term deployment strategy would be to have other countries incur the cost of innovation first.

Second, it has also been claimed that imposing LCRs can benefit a certain transfer of technology and knowledge. Because of LCRs, businesses are forced to transfer technology so the end-quality of their product – which is now using local inputs – is sustained.[11] Technology transfer as a result of LCRs comes from learning-by-doing and capacity building in domestic supply. Although it is not patent-related, this knowledge of technology and how to operate it is an important component in reaching global green industrial growth.

3.2. Arguments against LCRs

Opponents of using LCRs in RE policies mainly use economic arguments. Generally, they refer to four areas: inefficient allocation of resources, trade impacts, retail power price inflation and employment concerns. When assessing these arguments, they also question the capability of generating environmental benefits in the medium-term.

3.2.1. Inefficient allocation of resources

Opponents of domestic content requirements rely on the economic, neo-liberal theory that mainly shaped the WTO. It is clear that LCRs are indeed unjustifiable in a simple competitive equilibrium model with constant returns to scale and perfect information. Such a model assumes allocative efficiency, while LCRs specifically move away from a Pareto-optimal situation. However, by also using a model with increasing returns to scale, Tomsik and Kibucek (2006)[12] find that LCRs lead to higher prices for locally produced intermediate goods and an inefficient, suboptimal allocation of resources. Opponents believe that LCRs distort Ricardo's principle of comparative advantage. LCRs will force or incentivize businesses and countries to invest their resources inefficiently and in the wrong sectors, as they will artificially improve the competitiveness of local products, while making foreign products less attractive. Even if subsidies and LCRs are intended to be temporary, the sectors might not even reach the necessary efficiency to survive without governmental support. However, subsidies and other support schemes might end up being politically difficult to withdraw when interests become cemented in politics and policies.[13]

3.2.2. Impact on trade

This allocative inefficiency has a negative impact on free trade. LCRs are by definition protectionist measures. They are implemented because domestic material is more expensive than foreign material, which producers would favour in their absence. Therefore, the effect of LCRs is to hinder imports and reduce competition between domestic manufacturers and their foreign competitors, at least in the short-term.[14] Depending on the level of local content required in the regulations, LCRs are more or less import-restrictive. If a high share of local content is required in a domestic market with inefficient manufacturers, the LCRs will represent a high non-tariff import barrier and potentially nullify competition, which will hinder innovation through liberalized trade.

3.2.3. Inflation of power prices

Both opponents and proponents question the possibility of achieving the desired outcomes by using LCRs for RE . It is relatively uncontested that, in the short-term, LCRs inflate power costs.[15] Even Industry Canada (2011),[16] while accepting the role of LCRs in creating a wind and solar manufacturing industry, admits that LCRs could initially drive up manufacturing costs and hence electricity retail prices. This is because LCRs force the producer to purchase local inputs, which are usually more costly than those produced abroad (otherwise, there would be no need for LCRs). Eventually, the local producer will pass this burden partially or fully to the domestic consumer.[17]

3.2.4. Employment concerns

There are also concerns that LCRs do not generate additional green jobs. For example, in the RE sector, there are two potentially opposing effects from LCRs. On the one hand, there is the output effect: energy costs more to produce because input prices are higher. Hence, there is less RE production, which means less employment in the electricity generation sector. This, however, is not necessarily the case, as there may be more employment but lower returns for other factors. Of course, employment will increase in the component-manufacturing industry

because generators are required to source components locally. The balance between job losses as a result of higher input prices and job gains from financial incentives and in the component-manufacturing industry is very difficult to estimate and depends on sectoral and policy specifics. Furthermore, the more expensive domestic equipment can drive a substitution effect in which generators may increase their demand for labour if it can serve as a substitute to such costly equipment. The net effect of a potential job-losing output effect and the substitution effect is difficult to estimate *ex ante*.[18]

Theoretical analysis by Rivers and Wigle (2011)[20] concludes that the overall potential of LCRs to create jobs is ambiguous. If local content proportions are too high or successively increased, the output effect is likely to dominate the substitution effect. In their numerical simulations, LCRs would then reduce the amount of green jobs created instead of increasing them. Their analysis does seem to ignore the learning-by-doing potential and related medium-term spillover effects, which also include job creation and are one of the most frequently cited rationales for IP.

For the relatively young debate on green job creation and LCRs, empirical claims are often based on "anecdotal evidence". A good example is the 2011 study by the Institute for Local Self-Reliance.iii This study evaluates Ontario's "Buy Local" policy and how it maximizes jobs from clean energy. The study concludes that the domestic content requirement has been successful in creating green jobs. It emphasizes the promise of 43,000 new jobs and dozens of new manufacturing plants. However, the study fails at distinguishing between the job creation effect of the Ontarian feed-in tariff and the job creation effect of the LCR attached to it. Therefore, it cannot be concluded that it is the LCR that is creating jobs. In addition, the study calls for American states to draw lessons from Ontario's program. However, it does not assess specific market conditions or compare Ontario's market (in which LCRs have allegedly been successful) with the US market. The study does examine the important factor of cost per job, which it finds to be lower in Ontario than in many American states. However, it is again unsuccessful in linking this back to LCRs.

Box 1: Call for a rigorous debate on green job creation strategies

In spite of the legal reality described in section 6, a healthy debate concerning the usefulness or disadvantages of LCRs should include welfare effects such as increased employment – even if a certain level of protectionism would be necessary to reach such a goal. Since it is found in the mission statements of the WTO, World Bank, IMF and ILO, employment can arguably be considered a global public good. It also took a central role in the final declaration of the G20 organized in 2011 in Cannes. Simply put, free trade is not an end goal in itself, but a means to reach global progress on issues such as economic growth and employment, while preserving sustainability – again a notion referred to in the WTO preamble. Therefore, it is in the regime's own interest to safeguard political support for free trade by acknowledging and debating the potential of some trade-restrictive policies such as LCRs for employment benefits (if indeed they were able to do so under present conditions). From the WTO's perspective, the employment focus needs to be global in scope, even though national policy makers tend to be preoccupied with national-level benefits. If LCRs could increase deployment in the host state while reducing it elsewhere, the employment argument would lose its value and legitimacy from a multilateral perspective.

3.2.5. Impact of economic deficiencies on quality and innovation

First, there are fears that LCRs do not seize opportunities in non-tangible and service sectors in the medium-term because they overemphasize the manufacturing portions of the value chain. If this were the case, LCRs would only drive up short-term costs without ultimately reaping large opportunities, especially the employment associated with the non-manufacturing elements of the RE sector such as engineering, installation and maintenance. However, services are particularly important in RE development and technology development and are certainly an element that should be included in the equation.[21]

Second, high LCRs that are very trade restrictive may end up harming the transfer of technology. Such LCRs lead to high prices and reduced consumption, which may scare off investors and counter the objective of strengthening the local economy.[22] When investors do comply with high LCRs, the quality of RE units may decrease – at least in the short-term. High LCRs means that the market is more shielded from the competitive international market. If there are no plans to eventually reduce the LCR or the financial benefits to which it is attached, or if there is no quality assurance programme, then such LCRs can lead to a reduction in quality.

3.3. Empirical evidence on factors of LCR effectiveness

Veloso concluded in 2001 that empirical studies on LCRs were sparse and poor, with often-conflicting conclusions.[23] Ten years later, sound empirical analyses of the effects of LCRs in general, and those related to RE in particular, are still severely limited. In addition, many of the existing studies lack transparency when describing assumptions and methodologies, which inevitably weakens their scientific reliability. The following section will assess a limited number of effectiveness factors upon which empirical analyses generally agree. Five factors that are considered to be basic conditions, necessary (albeit possibly insufficient) for LCRs to create value in the host economy, will be studied.

3.3.1. Market size and stability

Lewis and Wiser (2005)[24] only see a role for LCRs if they are gradually introduced in stable markets with sufficient potential. Otherwise, businesses will not be keen on investing in domestic manufacturing. In addition to market stability, they see a sufficient market size as an important precondition for generating welfare effects from the use of LCRs. This eventually comes down to the ability to offer a stable demand. If there is no such demand, the higher costs as a result of LCRs may discourage investors from entering this market. Similarly, a large and stable market offers more possibilities for learning-by-doing (vide infra) (Lewis & Wiser, 2005). Veloso (2001),[25] who performed an extensive economic analysis of the effects of LCRs in the automotive supply chain, also finds that, if the industry and market are relatively small-scale, the possibility of achieving stated benefits by using LCRs is low. If the demand and therefore the production volume are higher, the effect will be increasingly large.

3.3.2. Restrictiveness of LCRs

There seems to be a consensus in the literature that LCR percentages cannot be too high at first. Lewis and Wiser (2005)[26] suggest that LCRs can work, but only when the proportion of required domestic content is not too high and is gradually phased in. Their empirical base for these conclusions seems, however, rather limited, and the authors decline to provide insights on what appropriate rates could be. In his empirical analysis, Veloso (2001)[27] also finds that LCRs work best when the government does not set the required domestic proportion too high. Appropriate rates are a function of production volume and opportunity cost of capital. Up to a certain level, the cost penalty as a result of LCRs is offset by the value for the local economy (for example, additional domestic manufacturing). When this happens, the LCRs can create a net benefit. This net benefit reaches its maximum level at a certain percentage, after which the

difference between the penalty and the benefit to the local economy decreases. This means the opportunity cost of capital rises again and it becomes more attractive to invest limited resources in another industry.

When this happens, the RE industry will produce less in comparison with the maximum net benefit, and the value of their production will also decrease. As fixed costs (for example buildings and machines) are often a large share of total sourcing cost in the local economy, the opportunity cost of capital thus plays a crucial role in determining the optimal LCR rate. Production volumes are related to market size and demand. If demand is small, the production volume will be small and the penalty curve becomes steeper. This drastically reduces the local content rate at which the maximum net benefit is achieved. In the RE sector, for example, the production volumes of components can only supply the domestic market until they reach a price for quality level that allows for exportation. Therefore, once again, a stable and sizeable demand is necessary to increase the potential welfare effect of the LCRs. If the government sets the rate too high, the economy will most likely be harmed. The weight of these different variables, however, varies from technology to technology.

To date, economic modelling to determine the appropriate LCR rate seems largely absent. There are few examples of countries that have based their LCRs on volumes of production, potential for technology learning and opportunity costs of capital. Rather, most countries start off with rather high LCRs that may reduce net social benefits. Lewis and Wiser, for example, express concerns about the negative impact of a high local content rate in Canada and China. Ontario's LCR for solar PV was 50% in 2009-2010, and was increased to 60% in 2011. Its requirement for wind projects rose from 25% in 2010 to 50% in 2012.[28] In China, all wind turbine generator manufacturers were required to use respectively 40% (before 2003), 50% (2003) and 70% (until 2009) of domestic components in the manufacturing of wind turbines.[29] This was mandated for project developers competing in the Chinese wind tendering system, as well as for projects that were authorized at a state level. This LCR was introduced to gain benefits for the local economy in exchange for the higher electricity tariffs that wind energy producers were granted. However, it is less widely known that the Chinese LCR actually started off lower (20%) and earlier (1997) than its better-known 40%-70% scheme (*vide infra*).

3.3.3. Cooperation and financial incentives

Supply chains are complex. Often an intermediate goods-producing sector involves multiple companies supplying different components of the intermediate good to which an LCR may apply. Cooperation in the intermediate manufacturing sector may include, among others, the integration of certain activities or services or the conclusion of stable contracts. This is relevant in the RE industry. While turbine towers have a straightforward link to the steel industry, solar PV cells are composed mainly of silicon and thin film, with many more components underlying their production. Veloso finds that, when governments prepare the introduction of an LCR beforehand with local businesses and when it is coupled with some form of subsidy, they are more likely to generate positive welfare effects.[30]

Preparing LCRs with local businesses is meant to increase certainty and information on both sides. Governments can learn how to determine the appropriate rate of LCRs, while local businesses can prepare cooperation to prevent an influx of new foreign intermediate good-manufacturing companies that could threaten their growth. The literature on LCRs does not set out what type of subsidy or financial support is most adequate, and at which step of the value chain the support should be targeted. This is a serious deficiency of studies so far. Subsidies are complex and costly, and mentioning that there "needs to be some form of financial support" is too general. This paper, however, is aimed at introducing the LCR issue to a general audience and will not examine the subsidy question in-depth.

3.3.4. Learning-by-doing potential and technology knowledge

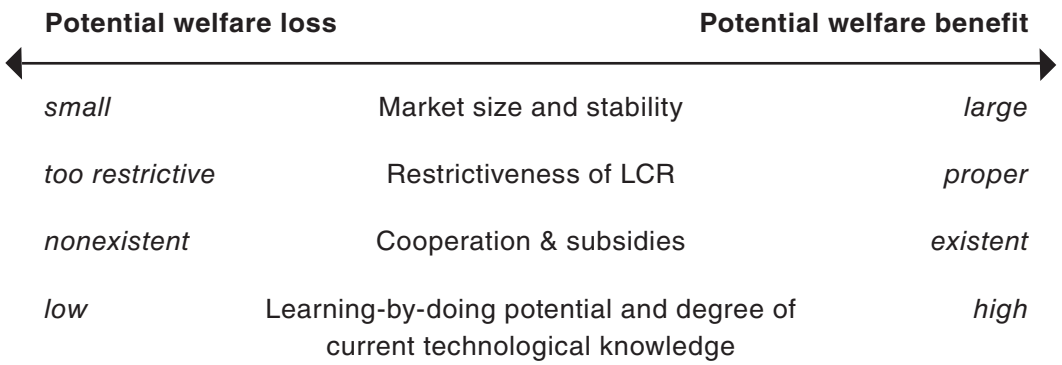
"Learning-by-doing" is a key argument for proponents of LCRs for RE . This means that producers can lower the costs of installed capacity simply by means of the learned efficiency that comes from experience. This is a so-called "spillover effect" of policies, such as LCRs, that increase RE deployment.

The key question is whether the cost reductions that come from learning-by-doing are sufficient to offset the increased production costs that Rivers and Wigle (2011)[31] note are inherent in any LCR scheme. If they are, then this is a powerful argument. However, there has been relatively little analysis of the spillover effects that LCRs might have on green technology costs and innovation. Tomsik and Kubicek (2006) note that it is still unclear whether the technology learning effect can outweigh the costs of LCRs.[32] By analyzing the automotive sector, Veloso (2001)[33] shows that LCRs are more effective when there is already some modicum of local knowledge about the technology for which components now need to be purchased domestically. Where the knowledge gap between local and foreign firms is too wide, however, LCRs are ineffective at convincing local firms to jump that gap. There are thus two different technology-related effectiveness factors: one that is technology-specific – "How much and at what rate can the technology still surf down the learning curve?" – and one that is specific to the firms in the host state enacting the LCR – "Do those firms have adequate base knowledge of the current state of technology?" As the second factor is a precondition for the first one, they will both be treated as part of the "learning-by-doing potential" in what follows.

The final result depends, inter alia, on the context – the sectoral characteristics both domestic and global. As such, conclusions on the actual potential of LCRs should be made on a case-by-case basis. The argumentation for or against LCRs, however, is likely to be more robust when external effects such as learning-by-doing are included in the analysis.[34]

3.4. Basic conditions for potential LCR effectiveness in the RE sector

These basic conditions found throughout empirical analyses result in the following continuum. Note the amount of uncertainty associated with this framework, and hence its inherent weakness to make inferences about potentially effective or ineffective LCRs. In particular, the "proper" restrictiveness of LCRs begs the question of which rate is ideal. As mentioned, this is often country, market, and technology-specific. Similarly, "existing subsidies" provide no information about the type of subsidy and its target, amount and duration. These are crucial questions, as subsidies may well add to the costs of LCRs without increasing their potential welfare benefit.



The terms 'welfare loss' and 'welfare benefit' are crucial in the analysis of LCRs for the RE industry. In terms of employment or economic benefits, it is likely that welfare benefits for one state or jurisdiction harm the growth prospects of others. That is why this framework mainly deals with national welfare creation, rather than with achieving "global goods". It is, however, useful since the first step towards creating a mature player in the RE industry while using LCRs would likely be the creation of a strong domestic industry. Only in a second step (the medium-term spillover effects), might LCRs for RE policy differ from LCRs for IP by creating global benefits such as technology development.

As mentioned, to date, there is no empirical research to support such a claim. This innovation potential of LCRs is very difficult to estimate, as innovation is a dynamic process that occurs over the medium-term and often in sudden bursts or inconsistent timeframes. There are two methods by which LCRs could lead to innovation. First, they can help establish companies that learn by doing. This element is covered in the framework above and can be initiated while the LCR is in place. Second, they can help foster infant industries until they become mature players that subsequently invest in R&D or further learn by doing. It must be noted that it is also possible that LCRs could fracture the industry. If – and not when– mature players are created as an effect of LCRs, the financial incentives to which the LCR is attached will at one point be abandoned to release the established companies to global competition, which is necessary to foster innovation. This adds an additional element to the framework: the end of the LCR in general or the financial incentives to which the LCR is attached in particular. These conditions include an emphasis on quality versus quantity and investment into R&D, rather than over-emphasis on learning-by-doing via increased deployment.

In what follows, elements of existing LCRs will be explained, in a qualitative manner, using the slight empirical evidence concerning the basic conditions for potential welfare effects from LCRs. In addition to this jurisdiction-specific assessment, the analysis of global benefits created by the use of LCRs will mainly focus on innovation and technology development. Whenever possible, we will assess the two arguments put forward for using LCRs in RE policy to achieve "global goods":

(1) LCRs as valuable policy measures when technologies are still learning how to develop a mature industry that can compete on the international market after the end of the LCR or financial support (medium-term benefits outweighing short-term costs);

(2) LCRs as political tools to garnish support for costly RE policies (such as feed-in tariffs) by offering additional public benefits.

While the first argument focuses on a positive effect of LCRs, the second argument concentrates on the negative consequences that can be caused by its absence.

Chapter 4

Analysis of China's apparent LCR success

Many sources have described China's success in creating a domestic wind industry that subsequently led it to become a global player in wind energy. Most recently, much attention has gone to the downward pressure the Chinese boom has put on established companies such as Vestas. There is much interest in the policy measures that China took to go from being a small-scale turbine manufacturer to having three of the global top ten manufacturers in only six years' time. There seems to be a consensus about the effectiveness of the Chinese mix of financial incentives, LCRs and CDM-funding.[35] The picture, however, is more complex than this, and sustained Chinese success in the turbine-manufacturing sector is not yet guaranteed (*vide infra*).

Here, we will investigate the presence of the basic conditions for potential welfare effects for China's LCR programme in a qualitative manner. This LCR programme is a combination of different wind energy incentive policies to which LCRs were attached. It first includes the Ride the Wind Program of 1997, which carried a 20% content requirement for two joint ventures. The main Chinese boom period, however, was between 2003 and 2009. During this time, two types of policies determined wind power development. On the one hand, there was the tendering system for nationally approved projects over 100 MW.[36] This system included LCRs as an element for reaching a high bidding score. In the tendering projects, the score of complying with the LCR in the total bid gradually increased as well, from 0.20 out of a total of 1.0 in 2005 to 0.35 in 2007.[37] This means that LCRs in tendering projects were not obligatory, but, as they counted for 20% or 35% of the final evaluation of the bid, it was nearly impossible not to comply with them. On the other hand, there were wind farm projects approved by the National Development and Reform Commission (NDRC). When a project involved the installation of 50 MW or more, it came within the purview of the NDRC.[38] These projects also ran until 2009 and required the same local content to obtain the score representative of compliance with these LCRs as in tendering projects. In this case, the LCR were a formal requirement. The LCR was abolished with the introduction of countrywide feed-in tariffs (FITs) in 2009. While these two national programmes may seem – and are indeed – different in nature, they will be treated together because they formed the Chinese policy framework to foster infant industries until they become mature, global competitors.

4.1. Basic conditions for potential LCR welfare effects

When benchmarking China's success against the five aforementioned effectiveness indicators, it can be concluded that China was in an extraordinary position to gain welfare benefits from its LCR. First, China has an enormous domestic wind energy resource, which is estimated at between 700 and 1,200 GW of exploitable capacity on land and sea.[39] Because of its large population and area, China also has a large and growing domestic market for electricity. This means that it was in a position to take advantage of economies of scale in relation to wind turbine manufacturing and the stable demand for wind turbines in the domestic market.

Second, the restrictiveness of the Chinese LCR seems to have been stringent. The well known Chinese tendering system started with an LCR of 50% in 2003, which was increased to 70% in 2004.[40] The last tenders were issued in 2007 and the content requirement was abolished in 2009. This seems to be a high jump of 20% over a period in which learning-by-doing was hardly possible. However, it is less known that this LCR was not new, but had some predecessors that might have allowed for technology learning before 2003 (though this learning is not proven). In the "Ride the Wind Program" of 1997, China had already included a 20% LCR for two joint ventures to domestically manufacture wind turbines. The program itself foresaw a gradual increase to

80%, dependent on China's learning about the current state of wind energy technology. In the five-year plan of 1996 to 2000, the NDRC also included a 40% LCR for NDRC-approved wind farm projects.[41]

Third, in every programme, the LCRs were combined with substantial financial support to retain market attractiveness for foreign and domestic investors. The government provided financial support from its technology funds for the aforementioned joint venture projects of 1997.[42] In the tendering program that started in 2003 and for state-approved wind tariffs, the government only provided the beneficial tariffs if the LCR was met. Otherwise, the much lower conventional energy tariffs were applied.[43] The difference between conventional on-grid power prices and the de facto FITs varied depending on the province and was related to wind speed, market access and grid conditions.

Table 1: Difference in electricity tariffs in Chinese tendering projects

Province	Average conventional power price[1]	Tendering-approved wind tariff[2]
Jiang Su	0.4092 Yuan/kWh	0.4877 Yuan/kWh
Guang Dong	0.4072	0.5013
Western Inner Mongolia	0.2859	0.4656
Eastern Inner Mongolia	0.3596	0.5216
Jilin	0.376	0.509
Hebei	0.37	0.551
Gansu	0.2758	0.5206

Notes: The average conventional power price is the 2009 average; the tendering-approved wind tariff is the last tariff approved in the period 2003-2007 for the first 30,000 full load hours (FLH). In 2009, 1 Yuan was on average equal to US$ 0.146.

Sources: 1. (Pengfei, 2010) 2. (Junfeng, Pengfei, & Hu, 2010)

In parallel with preferential electricity tariffs, the Clean Development Mechanism offered an additional incentive to investors, in this case conditional on Chinese ownership but not on the use of local content. The legislation states that, to be eligible for approval as CDM projects, investments had to be Chinese-owned or Chinese joint ventures with foreign partners.[44] As CDM was an important source of additional revenue – close to 0.07 to 0.10 Yuan/kWh or approximately 0.010 to 0.014 US$/kWh – this legislation encouraged technology transfer and technology learning through joint operations.[45]

In summary, in contrast to stringent LCRs, financial incentives available to wind energy developers were still high. Bradsher (2010)[46] rightly cites the presence of Gamesa (the main Spanish wind turbine manufacturer) in China during the wind energy boom as an indication of the remaining attractiveness of the Chinese market. Rather than pushing Spain – and the EU – to take action under the WTO in opposition to China's LCR under the tendering mechanism or NDRC-approved tariffs, Gamesa chose to train Chinese companies and transfer technology, thus losing relative market share but also gaining profits by increasing the absolute volume of its production. Thus, it seems that, for technology transfer, the policy was rather successful and did not remove foreign players from the market too soon.

Fourth, China had relatively little know-how before the LCR was put in place. In 1996, it had only 56.6 MW of wind power in place, most of it built by non-Chinese companies. This went up to 166.6 MW in 1997 and 468 MW in 2002.[47] While China's knowledge of the state of wind energy technology was rather

low in 1997, the Ride the Wind programme foresaw the gradual increase of the LCR as a function of technology learning through the joint ventures, which was the eventual result. In a very short period of time, China learned by interacting. As mentioned, the Clean Development Mechanism was one of the main drivers of cooperation and technology transfer. Similarly, to be eligible for an R&D grant (further discussed under section 4.4) of up to 45 million Yuan per 1.5 MW turbine, companies had to be state-owned or majority Chinese-controlled (51% of the stocks), and the developed intellectual property was required to have a Chinese patent. However, this R&D legislation was dropped during WTO consultations with the United States.

The learning-by-doing potential of wind turbine manufacturing was present, although relatively low compared to other RE technologies such as solar PV. Wind learning rates have differed significantly among various studies. A literature review conducted by the International Energy Agency (IEA) shows that technology-learning rates for wind have varied from 8% to 32%. The review concludes that learning rates based on electricity production costs are more appropriate than those based on investment costs, as the former takes into account efficiency improvements and lower costs for operation and maintenance.[48] It seems that, based on production costs, China did in fact rapidly master the learning curve and learned by doing in the last five years. However, while Chinese companies decreased component prices substantially, it is unclear what share of this decrease was due to technological development and what share was due to an initial race to the bottom after the suspension of the LCR. This race to the bottom is characterized by companies lowering quality to push down component prices once the LCR is abandoned. The stage during which they are opened up to competition is often linked with consolidations and is important to a company's survival. Even when the Chinese LCR was suspended, the IEA estimated that onshore wind turbine prices could still decrease from 10 to 20%.[49] Chinese companies thus have the potential to compete with other international players.

In terms of technology learning, it could be concluded that, despite strict content requirements, China still succeeded in transferring technology. The value of its immense domestic market and financial incentives did not deter foreign companies, who decided to comply with the joint venture and LCRs in order to become players in the Chinese market. However, as described more extensively below, the gradual increase of the LCR and the maturing of Chinese companies did eventually repel most foreign players, and with them, up-to-date technological know-how.

4.2. LCR effectiveness in domestic industry and job creation?

China's LCR for wind energy scored well in terms of fostering the infant wind energy industry and technology transfer. In terms of deployment, China experienced a boom in wind turbine manufacturing from a total installed capacity of 1,260 MW in 2005 to 25,805 MW at the end of 2009, when the national FITs were introduced without any LCRs.[50] At the end of 2009, it had the second-largest cumulative installed capacity in the world and the single largest newly installed capacity (13.8 GW), which represented one-third of the global newly installed capacity. Along with installed capacity, it also produced one-third of the global wind turbine output for that year (10,129 turbines).[51]

Arguably more important in terms of economic development than the rise of deployment is the rise of domestic production levels. The combination of a steep rise in deployment and LCR led to the development of a Chinese manufacturing industry. Before 2000, Chinese companies held only 10% of the domestic market share. In line with the rapid expansion of Chinese wind power developers, the Chinese wind turbine equipment manufacturing industry boomed, which it has continued to do since the LCR ended in 2009. The top three, five and ten Chinese companies accounted for respectively 55.5%, 70.7% and 85.3% of newly installed capacity in 2009 and for 59.7%, 70.4% and 84.8% of total cumulative installed capacity

in China. Six out of ten top manufacturers in China were Chinese. The five largest companies had growth rates of more than 113%. Most foreign-owned and private enterprises retreated from the Chinese wind market in 2009.[52]

Table 2: Newly installed and cumulative market share of the top ten equipment manufacturers in China (2009)

Market share distribution of newly installed capacity			Market share distribution of cumulative installed capacity		
Name of enterprise	Installed capacity (MW)	Market share	Name of enterprise	Installed capacity (MW)	Market share
Sinovel	3496	25.32%	Sinovel	5,652	21.90%
Goldwind	2722	19.72%	Goldwind	5,343.85	20.70%
Dongtang	2035.5	14.75%	Dongtang	3,328.5	12.90%
United Power	768	5.56%	Veetas	2,011.5	7.80%
Mingyang	748.5	5.42%	Gamesa	1,828.75	7.10%
Veetas	608.75	4.41%	GE	967	3.70%
XEMC Wind Power	454	3.29%	Mingyang	896.5	3.50%
GE	322.5	2.34%	United Power	792	3.10%
Suzton	293	2.12%	Suzton	606.25	2.30%
Gamesa	276.25	2.00%	Windey	594	2.30%
Others	2079.71	15.07%	Others	3,814.45	14.80%
Total	13803.21	100.00%	Total	25,806.3	100.00%

Source: (Junfeng, Pengfei, & Hu, 2010)

This is in stark contrast with what the playing field looked like only a few years ago. In 2009, the market share of the four major foreign companies in China only accounted for 10.8% of the newly installed capacity and 11.4% of the total cumulative installed capacity. Most of the twenty-four remaining foreign companies exited the market in 2009, leaving only about ten foreign companies actually active on the Chinese domestic market. In 2005, foreign companies still dominated with a market share of around 70%. This Chinese green industrial growth in the wind industry created a considerable amount of jobs. It is estimated that the industry generated between 150,000 jobs directly related to wind power and about 200,000 in total.[53] It is unclear how many jobs could have been created had Chinese capital been invested elsewhere.

In terms of technology learning, the local content requirement led to a transfer of know-how related to current wind energy technology. In the last two decades, onshore and offshore wind energy development has been characterized by an expansion of tower height and rotor diameter. This both increased the maximum output capacity – now up to 6 MW – and decreased the prices per installed production capacity. Output capacity is thus a useful proxy for manufacturing performance. Before 2005, there were hardly any 1-MW units installed in China (MW units are often seen as an indicator of technology development in the wind industry). Through technology transfer and learning, domestic companies rapidly started manufacturing and the share of MW-scale turbines grew from 51% in 2007 to 87% in 2009, which is mainly attributable to domestic

producers. From 2005 onwards, the Chinese government focused on the development of 1-GW scale wind power parks. These are mainly based on MW-scale units.[54]

This type of domestic industry creation was advantageous for China, but less so for foreign companies. Because of the domestic growth, first-movers like Germany experienced more competition on the international market and saw their market share drop. Even though the sales of the largest foreign wind companies kept rising throughout 2010 due to high demand, their position in the global and Chinese market was reduced because of the rise of Chinese companies.[55] Similarly, Bradsher points out that, in 2010, Gamesa, like other foreign companies, sold twice as many turbines as it did when it was market leader in China in 2005. However, its market share was considerably reduced.[56] Nevertheless, due to a slump in demand and Chinese competition, foreign companies now face the challenge of competing harshly with cheap exports from the Chinese giants. For example, Vestas cut 4,900 jobs in 2009 and 2010 alone, and even more in 2012.[57] In June 2012, the company also had to sell a wind turbine tower factory in Denmark, which was bought by Suzhou, the largest Chinese tower manufacturer.[58] As a reaction to Chinese tower export, the Obama administration imposed tariffs of 14% to 26% after estimating that Chinese producers and exports had received production subsidies up to this level.[59] The fact that China is scoring well in the global wind energy market, however, does not mean it is advantageous for long-term international wind energy growth and innovation per se. Moreover, if it is, it has not yet been established whether this is the result of the use of LCRs.

4.3. Are LCRs useful for green innovation?

However, the fact that Chinese companies have been responsible for the largest share of global wind energy deployment in recent years does not relate to their quality and green innovation potential. The growth of Chinese manufacturers and their excellent performance in recent global statistics is largely due to the combination of the LCR with a large domestic resource and demand. In 2009, the three largest Chinese companies in the global top ten manufacturers were Sinovel at number three, Goldwind at number five and Dongfang at number seven. By 2011, China had four companies in the global top ten (Sinovel, Goldwind, United Power and Mingyang).[60] In 2009, Chinese companies started the export of complete wind turbines. They exported to four different countries for a total of 28.75 MW, which is a small amount compared to the global market potential. At the same time, plans were announced to open Chinese manufacturing plants in other countries.[61] In the years thereafter, Chinese wind turbine export only grew. In 2011, China exported a total of 220 MW. The largest exporter was Goldwind, exporting 189 MW or 124 wind turbines to the US, Ecuador and Ethiopia.[62]

Wind energy innovation first required catching up with global standards for technology development and wind turbine quality. Both steps required heavy investments in R&D. The top Chinese wind turbine manufacturers started to enter the multi-MW market by producing wind turbines with a capacity of more than 2 MW. Goldwind, Sinovel and the Shenyang University of Technology, for example, had already connected 3 MW turbines to the grid in 2009. Goldwind and Sinovel have also started to research and develop 5-MW units, just like Dongfang Steam Turbine, Haizhuang and XEMC.[63] However, there are quality concerns among technology experts. First, many foreign players left the market because of the high LCR before 2009 and because of fierce competition from Chinese suppliers. As Chinese companies mainly “learned by interacting” initially, the exit of foreign players was a serious blow to continued technology transfer. Second, because the addition of Chinese wind energy projects for CDM purposes is being scrutinized more heavily, some fear a decrease in project finance, which reduces the available funding for deployment and R&D. If Chinese companies do not pass the quality test in the upcoming years, the potential argument for LCRs as creators of global, innovative competitors will strongly lose ground.

However, the top Chinese manufacturers realized the challenge of the global market relatively early on and all opened their own R&D centres to develop entire wind turbines. This move towards independent industries has marked the growth of industry associations, consulting organizations and R&D support services in China. However, a joint report from the Chinese Renewable Energy Industries Associations, the Global Wind Energy Council and Greenpeace concludes that, in general, there is still a large difference between China's R&D industry (in terms of employment, institutions and quality) and the international standard.[64] For example, as domestic component manufacturers have mainly focused on glass fibre production for wind turbine blades, electronic control systems still need to be imported.[65] It will thus more appropriate to answer whether the LCR was effective in achieving green innovation in a few years' time, as this is a decisive period for Chinese companies to catch up with global quality standards and appear as mature wind energy innovators. Indeed, if the focus of Chinese growth remains overly manufacturing-focused, the potential for innovation will decrease.

4.4. Government support for wind energy R&D

The Chinese government seems determined to meet the challenge of quality improvement. In 2008, it established the "Special Fund" in support of domestic research and the development of MW-scale wind turbine systems. Wind power equipment manufacturers were eligible for a 600 Yuan/kW (€72/kW) grant for the first fifty wind turbines produced. The grant was divided between the wind turbine manufacturer (50%) and critical component manufacturers (50%) and was only meant to cover the costs of R&D into new wind power equipment. The grant for component manufacturers would particularly favour converter and bearing manufacturers, two critical components that were still mostly imported. To be eligible for the R&D grant, a few requirements had to be satisfied. Among others, the company had to be state-owned or Chinese-controlled, the developed intellectual property right had to belong to a Chinese company and the rated capacity of the turbine had to be 1.5 MW or greater. For R&D on a 1.5 MW wind turbine model, the grant could have been worth up to 45 million Yuan (€ 4.83 million).[66]

Because of its reliance on joint ventures and technology sharing, China spent very little on R&D in its LCR years. Not until 2008 was the aforementioned R&D "Special Fund" established. However, the willingness of China to actually make a decisive step from the funding of capacity increase to R&D is not entirely clear. For example, China's new FIT does not have a degression rate – that is the rate by which a tariff would be reduced every year – which would give companies the incentive to deploy and learn by doing more quickly. As the financial benefit decreases, it also pushes companies to invest in R&D to tackle bottlenecks and lower production costs. In addition, while encouraging R&D for critical – so far imported – components such as converters and bearings, China also offers an import tariff rebate for these components to large companies (producing more than fifty turbines per year). This could give an incentive for import rather than investment in R&D for the local production of these components if the rebate of import tariffs and the net revenue of the subsequent sales of wind turbines are larger than the net benefit from R&D funding for these specific components.

The import tariff rebate is specifically designed to keep up production in response to the high demand for wind energy turbines. However, it runs contrary to the view that growth rates will have to be moderated if the Chinese wind industry is to switch to building higher quality turbines. If deployment rates keep on growing, firms will have an incentive to keep forging a price war that finds its origin in the cheap manufacturing of lower-quality turbines.[67] Finally, the "Special Fund's" LCR itself attempted to veil Chinese companies from competition in an area where they do not yet have a competitive advantage. This was one of the main reasons why the US started consultations with China at the WTO. During these consultations, China withdrew the Special Fund.[68]

4.5. How to make LCRs work for green innovation

One of the main arguments against infant industry protection through LCRs is that such a policy could become an indefinite protectionist subsidy. Indeed, when local content policies do not want to prohibit global green tech innovation, the financial incentives to which the LCRs are attached need to be abandoned in time so that companies like the large Chinese manufacturers are exposed to competition in the international and domestic market. Otherwise, there will be insufficient incentives to invest in R&D and innovation. In the case of China, the country abandoned its main LCR in 2009. As Bradsher rightly points out, the US played a significant role in pushing China to leave behind its main local content policy. It already did so in 2009 concerning the local content condition for receiving beneficial tariffs, and again at the WTO when the United States contested the LCR in the "Special Fund".

This turns out to be a crucial point for the LCR debate. If they want to be a potential catalyst for green innovation, LCRs can actually benefit from the WTO regime. As an effective forum for discussing and settling trade disputes, it can be a helpful venue for preventing and repairing the abusive use of LCRs (if they are proven to be useful, which is not yet the case). As they lose a comfortable market position, abandoning LCRs will always result in a setback for domestic suppliers. This is why many governments will be lobbied not to phase out LCRs. Since LCRs are clearly prohibited under WTO law (vide infra), the WTO can serve as a strawman that jurisdictions may use as an incentive for phasing out LCRs to allow the 'adolescent' industry to enter the international market.

4.6. Current steps towards quality improvement

At the time of writing, Chinese wind manufacturers appear to be in the post-LCR adjustment period, when growth pains occur the most. Yuanyuan (2011) points out that, because of the incentives (including local content) and high demand, an excessive amount of players entered the Chinese wind market, some of them too small to guarantee quality. The market responded to this excessive supply by waging price wars over component prices. For example, the prices of wind turbine blades decreased from $1,000/kW in 2008 to $550/kW in 2011. This type of market behaviour may reduce quality and could threaten the Chinese wind industry all together.[69] On the one hand, these price reductions may be caused by governmental financial support. In this case, companies are shielded from competition, which threatens the prospects of innovation, as the subsidization of Chinese companies may impede other established innovators like Vestas. On the other hand, these reductions may be due to a reduction in quality, which threatens sustained Chinese growth. Finally – although this is largely disagreed upon by most international and Chinese experts –China could have achieved remarkable efficiency gains. As it stands right now, it seems that low turbine quality in connection with state subsidization harms innovation concerns in the sector. When cheap, lower-quality turbines reach the world market and impede established producers, global innovation can in fact be harmed.

Consequently, turbine quality is one of the main concerns of companies and policy makers. In September 2011, China's National Energy Administration (NEA) approved technical standards that covered grid access, the monitoring of operations, the quality of wind energy output and the manufacturing requirements of key equipment, among others. The standards, which took effect in November 2011, are expected to accelerate the consolidation of the large companies and do away with smaller, inefficient, low-quality producers.[70] The NEA also started encouraging the installation of wind farms in regions that have lower wind speeds but are closer to load centres. Up until now, large wind farm projects were often located in remote regions with high wind speeds. This was one of the causes of transmission problems. The new policy gives the NEA and State Grid more time to solve transmission bottlenecks, while encouraging manufacturers to invest in R&D

for longer blades and taller towers.[71] This allows established companies that boomed as a result of LCRs to invest in turbine innovation in the medium-term. Again, it is clear that if LCRs are to be useful for innovation, other policies during and especially after the LCRs need to help domestic companies that grew as a result of the LCRs move towards an environment in which they can learn by doing and invest in turbine innovation.

These policies are complemented by more quality initiatives such as, for example, the wind power evaluation system jointly proposed by the Chinese Wind Energy Association and Vestas.[72] Furthermore, the IEA recommends heavy investments in public R&D platforms, the strengthening of supply chains and the development of specialist wind power training courses and university curricula in its wind energy development roadmap through 2050.[73] In the case of China, it appears that, if the LCR was meant to serve as a tool toward medium-term green innovation, deployment growth rates should be lowered in the near future, consolidation should take place and quality should gradually increase to global standards.

Chapter 5

Analysis of the current use of LCRs in Renewable Energy policies

Despite being explicitly prohibited under the WTO, LCRs are still used for infant industry development around the world. Both developed and emerging economies frequently use them – or have suggested using them – for RE policy. This puts the current debate in an interesting light. For example, the EU joined Japan in the WTO complaint against Ontario's FIT scheme, mainly because the Ontarian scheme is coupled with a restrictive LCR as a condition for the receipt of subsidies or other governmental support. The Ontario FIT requires that a certain share of components for wind and solar energy projects come from local manufacturing or service providers. The WTO Appellate Body concluded that the Ontarian scheme violated legal provisions in the GATT and in the WTO's TRIMs Agreement. The Appellate Body left undecided whether the scheme constituted a "prohibited subsidy" under the SCM Agreement (vide infra). In November 2012, China filed a dispute against the EU and certain Member states, targeting domestic content restrictions for RE policies in, among others, Italy and Greece.[74]

In what follows, emphasis is on content requirements used specifically for RE policies. The most well known schemes with attached LCRs are set out. The objective is to demonstrate that, despite the pending and past WTO cases, LCRs in green industrial policies are used in many countries. Besides the Japan-Canada and EU-Canada case, the WTO has already dealt with the aforementioned disputes between the US and China over China's Special Fund and now has to handle the recent Chinese complaint against six US state-level RE policies that are allegedly using LCRs.

5.1. Ontario

Ontario (Canada) has had an LCR in place since 2009. In its Green Energy and Green Economy Act, the province aims at increasing RE deployment and creating green jobs. Ontario's market for RE is significant, which is important since, as noted above, there is a need to serve a sizable domestic market if the LCR is to be effective in creating competitive domestic players. In 2004, Ontario's total wind energy potential was estimated at 14,000 TWh/year. Another study thoroughly examined the land available and concluded there was sufficient space to produce 24 GW of wind energy. Concerning solar energy, Ontario is one of Canada's regions with the best annual horizontal solar radiation. Its technical potential is estimated between 7,000 to 8,000 GWh per year for residential PV alone.[75] Other studies estimate that solar potential reaches 90 GW on barren land alone.[76] However, the market could give additional incentives. For example, the Green Energy and Green Economy Act does not set out specific installation ("X GW in 2020") or generation ("Y GWh in 2020") targets. Were there such ambitious targets, investors would likely perceive an even more secure demand.

Ontario's LCR is coupled with a FIT. If the required share of local content is not respected, RE developers are not eligible to receive the higher FIT. While some other jurisdictions with LCRs allow project developers to replace the percentage they are not able to source locally by selling locally produced components outside of the LCR jurisdiction (export credits), Ontario does not grant such flexibility. The LCR was also not phased in previously; 2009 was the first time a content requirement was used. The restrictiveness of the LCR points toward Ontario's intention to tap into growing markets. The solar industry is especially subordinate to LCRs that are more stringent.

The LCR sets out, for various types of RE , the percentages of total project value that have to be sourced in Ontario to be eligible for the FIT (see table below). The legislation further spells out the percentages that can be claimed for a number of designated activities to meet those overall targets. For example, turbine towers made in Ontario earn a credit of 4% and the steel used to manufacture those towers from the Ontario steel mill

earns a credit of 9%. This way, the policy-maker can prioritize certain policy targets like employment or green innovation. For example, in Ontario, construction costs and on-site labour along with consulting services by Ontarian residents are credited at 20%. This is indicative of Ontario's green jobs objective.[77] According to the government of Ontario, the Green Energy and Green Economy Act has lead to the creation of 20,000 new jobs. It is unclear how many of these jobs were due to the use of LCRs and how many were due to Ontario's strong FIT support policy.[78]

Table 3: Selected content requirements for RE projects in Ontario, Canada

	2009	2010	2011	2012
Wind > 10 kW	25%	25%	25%	50%
Solar > 10 kW	50%	50%	60%	60%
RE projects < 10 kW	40%	40%	60%	60%

In terms of technology knowledge prior to the LCR, Marion Fraser, Fraser & company argues that Ontario was suffering from a techno-institutional lock in which established companies and policies hindered the development of RE . While the installed wind capacity reached about 704.3 MW in 2008,[79] the installed solar capacity had only reached 2 MW.[80] Knowledge of and experience with RE was thus rather limited, as were training opportunities in the field of RE. The Green Energy and Green Economy Act did not address this specific problem.[81] It seems the province left it to the LCR to reach its technology learning objectives. While it is too early to estimate the results of the LCR, it is clear that, in spite of the LCR, the market interest of RE producers has not faded. On the contrary, due to the market potential and high FITs (for example 13.5 cents/kWh when the average electricity tariff is 4.02 cents/kWh), project applications quickly arrived at 8 GW, of which 2.5 GW will be able to connect to the grid immediately.[82] The exact share of foreign companies remains unclear. However, while some established foreign companies like Vestas and General Electric heavily oppose the LCR[83], they have still signed deals to meet it.[84]

An expected result of the RE program is that retail electricity prices increased by over 17% in less than one year in 2010, and are expected to increase gradually during the years to come.[85] While this is also observed in countries that use FITs without LCRs (like Germany), it is likely that LCRs were responsible for an additional part of the retail price surge. The restrictiveness of the content requirement and the FIT policy, together with a 2 GW wind energy development deal between Ontario and Samsung (which was never formally mentioned in Japan's complaint), led Japan to file its complaint against the Ontarian FIT.

5.2. Quebec

Quebec has been using LCRs in its wind energy tenders since 2003. The main motivation for their use was to create a local supply chain as well as new economic opportunities in regions that are experiencing difficulties. Quebec has a relatively small market potential of 4 GW, which it aims to harness by 2015.[86] Before the LCR in 2003, Quebec only had 99.75 MW installed.[87] Apart from its aggressive local content policy, Quebec has a stable and clear policy environment. In total, there have been three wind energy tenders. The initial one, issued in 2003, mandated that the first 200 MW should have 40% local content, the next 100 MW 50% and the remaining 700 MW 60%. The second tender, 2 GW in total and issued in 2005, mandated a 60% regional LCR, of which at least 50% had to be sourced from the Gaspésie region. The third tender, issued in

2010, largely maintained the structure of the second. While some companies complained about the LCR, none of the major players turned their back on the Quebec market. In fact, GE, Enercon and REpower all opened manufacturing facilities.[88]

5.3. Spain

While the Chinese operations of the Spanish firm Gamesa have been affected by the LCRs in China, the growth of the company itself can be traced back to the initial LCR for the RE promotion scheme in Spain. Compared with European first-movers such as Denmark and Germany, Spain was a latecomer in wind turbine manufacturing. It entered the market in 1994 with an installed capacity of only 73 MW for that year.[89] This is the main reason why many Spanish provinces included an informal, noninstitutionalized LCR as a condition for project developers to be allowed market entry. Indeed, there is no national LCR policy.[90] In addition to its provincial LCRs (which are often not formalized in legislation, but rather used when governments decide to grant development concessions), Spain uses FITs to encourage investments. Although FITs are not coupled with the provincial LCRs, it is an important policy tool for preserving Spain's attractive solar and wind market. However, Spain's support for its RE policy had created a €16 billion debt by 2010.[91]

Gamesa's growth is an important case study for analyzing the potential effects of LCRs. The company was initially part of a joint venture with Vestas, the Danish wind energy market leader. With the provincial LCRs, Gamesa grew to become the second-largest wind turbine manufacturer in the world in 2002.[92] Because Spanish provinces used LCRs as early as 1994, the main wind technology developments occurred when Spanish companies like Gamesa were already established players in the global market. Therefore, Spain is still considered as an early-mover compared to other jurisdictions such as China. Provinces that have used LCRs are Galicia, Navarra, Castile and Leon, and Valencia. The first two currently have regulations mandating 70% local content. It is estimated that the LCR in Navarra has created 4,000 jobs.[93] However, it must be noted that there is a general lack of clarity concerning the amount of net jobs created by RE development, which is also the case for LCRs.

At the same time, the provincial LCRs that were catalysts in the creation and development of Gamesa also created a wind energy innovator, especially since, when the policies were first implemented, there was still a lot of learning-by-doing potential. Up until 2001, Gamesa was part of a joint venture with Vestas, which held 40% of its shares. The years between 1994 and 2001 were important for wind energy development, with average turbine diameters growing from around 50 m to around 110 m. Turbine height, diameter size and related output capacity were and still are key indicators of technology development and related cost reductions. During this important period, Vestas transferred up-to-date technology to its joint venture with Gamesa – who held a majority of the shares. Over a seven-year period in which demand increased strongly as a result of Spanish financial support, Gamesa grew within the joint venture. When Gamesa went public in 2000, it did not have any proprietary technology, but only licensed technology from Vestas that was limited to the Spanish market. However, the company had definitely learned by doing and its technological knowledge had developed enough to allow it to continue growing alone. Eventually, in 2001, due to increasing strategic differences, Gamesa bought out Vestas' 40% and soon became a competitor of the firm.[94] Gamesa itself received the JEC innovation award for wind energy twice, most recently in 2011.[95] Although it seems LCRs successfully helped create a strong, innovative player (Gamesa) at a time when learning-by-doing was still high, the financial support linked to this type of policy put a lot of pressure on Spain's public budget.

5.4. Italy, France, Greece and Croatia

Within the EU, a few Member states use FITs with LCRs to encourage the development of domestic industries. This lead China to file a dispute before the WTO against the EU and certain Member states on 5 November

2012. The complaint targets the domestic content restrictions of, among others, Italy and Greece.[96] In 2011, Italy enacted LCRs for the subsidization of solar energy in its legislation (Conto Energia). This law foresees an additional 5% to 10% incentive for project developers who source components in the European Union. Because of the internal market of the European Union, it is impossible for national legislators to discriminate against other European countries. This results in a situation where the LCR mainly benefits Spanish and German solar energy leaders.[97]

In itself, Italy has a tremendous solar PV market. At the end of 2011, more solar PV was connected to the grid in Italy (9 GW) than in Germany (7.5 GW) or China (2 GW). Even though this number is disputed, it is established that Italy installed the most PV capacity in the world in 2011. In 2010, Italy had a cumulative installed capacity of 3.5 GW, so the 9 GW installed at the end of 2011 represents almost a tripling of its cumulative installed capacity.[98] Most of this capacity was thus installed prior to the region-wide LCR. However, because of its subsidies and the open European market, the Italian government has now decided to slow down PV instalment since the gains to Italian manufacturers are relatively low, while the subsidization scheme comes at a high cost. One year after the "Made in EU" LCR instalment, critical voices stated that the scheme did not favour Italian manufacturing, as most module assemblers tend to source their components abroad. At the same time, it is believed that the Italian market will remain favourable to investors, as it is likely to be one of the first markets in the world where solar PV reaches grid parity. Therefore, vast amounts of government subsidies no longer seem as necessary.[99] This shows the importance of the jurisdiction in which the LCRs are enacted. In the EU, for example, it is technically forbidden to favour Italian manufacturers over German ones. Therefore, an EU-wide LCR in Italy could successfully help boost EU companies that are already established, but not foster an Italian solar PV manufacturing industry.

As in Italy, France recently introduced a local content bonus for solar energy project developers. Under this scheme, which came into force in 2012, the government offers a 10% bonus on the price that EDF (Electricité de France) pays to solar energy installers when it purchases the energy generated from their installations. This bonus is only valid when 60% of the added value of the installed solar panels is generated within the European Union.[100] While indicating the desire to develop a French solar energy supply chain, the scheme faces the same difficulty as the Italian scheme: solar panel manufacturers can still source their components from first-mover countries like Germany or Spain. Because of the high costs of the FIT scheme, France decreased the support by 30% in one year.[101] Conventional electricity tariffs range between 4 and 5 €c/kWh, while, for example, PV plants now receive 10.76 €c/kWh and roof-integrated residential installations between 32.42 €c/kWh and 37.06 €c/kWh. It is likely that the bonus is an attempt to mitigate the negative outcome of the decline in financial support. In 2011, France connected 1.5 GW to the grid, of which about 10% was built during that year. This brought their total to about 2.5 GW.[102]

Croatia also introduced an LCR that is linked to its FIT. The Croatian scheme operates with a correction factor that increases the FIT received by a renewable electricity producer based on the percentage of local content it achieves. If producers fail to meet the 60% LCR, they are not eligible for the full FIT but will receive between 99% and 93% of the FIT, depending on the precise percentage of the project. The scheme applies to all RE technologies. The Croatian scheme has not yet been used in practice, precisely because the term "domestic component" has yet to be defined in decrees. Currently, all producers receive the full FIT, regardless of the amount of local content they use. The Croatian government has announced modifications of this law in the near future. It is not yet clear how the LCR will be structured and whether it will be "Croatian" or, in anticipation of accession to the European Union in 2013, "EU wide".[103]

The case of EU Member states shows the political difficulties that a regional LCR might encounter. To date, most jurisdictions that have the capacity to enact LCRs are also competent to provide financial support measures to their RE industries. As mentioned, such financial support is necessary to retain market attractiveness for foreign players who then transfer technology and know-how as a result of the LCR. The European Union does not have the fiscal strength and legal competence to support RE development with policy measures such as EU-wide FITs. This fiscal competence remains at the Member state level. However, the European Union's internal market legislation prohibits trade-restrictive discriminatory policies such as LCRs. Therefore, EU Member states that wish to formally enact LCRs can only do so by installing a "made in the EU" requirement. This means that, while paying for the financial support necessary to increase the potential effectiveness of LCRs (directly or indirectly via a cost pass-through to ratepayers), Member states or their citizens might be financing manufacturing industries in other European Member states.

Clearly, this can cause political tensions as some Member states with a large market potential and low fiscal health (for example Spain, Italy and Greece for solar energy) end up paying for the manufacturing industries of countries that have more fiscal strength and an industry that is already established (for example Germany or Denmark). However, the enormous potential of the EU market and the technological knowledge that is already available are also two very important factors for increasing the potential effectiveness of LCRs. Therefore, European coordination of green industrial policies would be necessary to reap the benefits of the internal market. When it comes to the solar and wind industry, however, the EU has the most advanced technology in the world. This means it is very unlikely that the "LCR for green innovation" argument can be considered legitimate for "made in the EU" content requirements. Even though it is true that the wind and especially the solar industries still have a large potential of learning-by-doing, it is likely that global innovation will benefit if the current technology leader is exposed to competition.

5.5. United States

Generally speaking, the United States follows WTO law with regards to LCRs for its RE industries at the federal level. The US government has repeatedly called for the phasing out of LCRs, which was instrumental in pushing China to abandon its LCR. The government has also repeatedly criticized the current Indian scheme. In terms of RE , the US has proven the crucial importance of a large, stable market. Tawney (2012) argues that, ever since the United States introduced stability into its wind energy support schemes, the domestic content of wind projects grew from 25% in 2006 to more than 60% in 2011, without LCRs.[104]

However, some US states have been interested in using LCRs for certain green industrial policies. For example, Montana and Louisiana have an LCR included in their blending mandates for biofuels (ethanol).[105] In Louisiana, 2% of the ethanol that is being sold must be produced from local non-corn feedstock.[106] Certain states have also used LCRs for RE policies, which led to a public complaint by China's Ministry of Commerce.[107] While this conflict had not yet resulted in a formal WTO dispute at the time of writing, China did mention it on several occasions. This case is another example of the rising trade tensions between the US and China over RE subsidies. In May 2012, the US started applying anti-dumping tariffs of 31% on solar cells manufactured by 61 Chinese companies. They also applied countervailing duties of up to 250% on other Chinese solar companies. This measure followed months of US investigations that concluded that China was dumping products below production costs. In the meantime, the US Commerce Department is also investigating potential dumping by Chinese wind turbine manufacturers. One week after the anti-dumping measures were enacted, China filed a complaint against them at the WTO.[108] Less than a month later, it also made a public complaint regarding a number of US state subsidies, including LCRs.

This as yet informal WTO complaint targets five states and six measures, of which five seem to include LCRs. First, California's Self-Generation Incentive Program provides for

an additional 20% financial support "for the installation of eligible distributed generation or advanced energy storage technologies from a California supplier."[109] Second, Massachusetts' Commonwealth Solar II rebates provides for rebates for homeowners and businesses that install solar PV. "In addition to a base incentive, further incentives ("adders") are available for installations using components manufactured in Massachusetts."[110] The base incentive was set at 0.40 USD/watt and the local content bonus reaches 0.05 USD/watt.[111] Third, New Jersey's Renewable Energy Manufacturer's Incentive Program has provided rebates for purchasers and installers of solar panels, investors and ranking systems manufactured in New Jersey in the past. This program, however, ceased at the end of 2011.[112] Fourth, under the Ohio Wind Production and Manufacturing Incentive Program, generators received a production incentive of 0.01 USD/kWh for up to five years (or until the entire amount of the grant approved had been earned by the wind energy project). However, projects that used Ohio-manufactured turbines received an incentive rate of 0.012 USD/kWh. This incentive was only valid in the 2007 solicitation round, for which applications closed in July of the same year. "Ohio-manufactured" was defined as follows: (1) 30% of the total turbine cost was manufactured in Ohio; (2) one of the main turbine components (nacelle, blades, tower) was entirely manufactured in Ohio; (3) the turbine was completely assembled in Ohio with at least fifty employees dedicated to this task.[113] Finally, Washington's Renewable Energy Cost Recovery Incentive Program grants higher support when domestic manufacturing is used.

Table 4: Incentive payment rates in Washington

For Noncommunity projects		Incentive payment rate (USD/kWh)
	Solar modules manufactured in Washington state	0.36
	Solar or wind generating equipment with an inverter manufactured in Washington state	0.18
	Anaerobic digester or other solar equipment or wind generators equipped with blades manufactured in Washington state	0.15
	All other electricity produced by wind	0.12
	Both solar modules and inverters manufactured in Washington state	0.54
	Wind generator equipment with both blades and inverters manufactured in Washington state	
For Community solar projects		
	Solar modules manufactured in Washington state	0.72
	Solar equipment with an inverter manufactured in Washington state	0.36
	Other solar equipment	0.30
	Both solar modules and inverters manufactured in Washington state	1.08

Source: (Washington State Legislature, 2010)

5.6. India

Until recently, India did not have an LCR as such, but an IP environment that mandated a 51% domestic equity ownership for the leading industries. This obligation was meant to encourage technology transfer by global players and to force multinationals to use locally sourced components and labour. Since 2009, India has accepted 100% FDI in the RE sector. It has a large market potential and labour force and has developed a modest manufacturing base, which makes it interesting for foreign investors to invest in RE projects.[114] In 2010, India had a total installed solar PV capacity of 22 MW.[115] That year, the Indian government launched its most ambitious RE programme – the Indian Jawaharlal Nehru National Solar Mission (JNNSM). One of the requirements to be selected in the first round (2010-11) was that projects based on crystalline

silicon technology had to use modules manufactured in India. This requirement was strengthened in the second round (2011-12) in which all eligible silicon PV projects were required to use cells and modules manufactured in India.[116] According to the Secretary of the Indian Ministry of New and Renewable Energy, a requirement to source solar inverters from local production could soon be added to the existing regulation.[117] This proposal remained throughout 2012, but has not yet been implemented.[118] The JNNSM further requires that 30% of a project's value in solar thermal projects be sourced locally. The scheme is administered by NTPC Vidyut Vyapar Nigam Ltd (NVVN), a subsidiary of the public power producer National Thermal Power Corporation (NTPC).

Although the scheme has not been challenged under WTO law, several foreign companies have issued complaints to their governments that could be renewed in the future. For example, the Office of the US Trade Representative has already formally expressed concerns about the LCR to the government of India. This can be seen as a first step in a diplomatic process that may be brought to the WTO. US Trade Representative Ron Kirk has already mentioned that India might be breaching WTO rules.[119] Both the EU and the US have referred to the GATT and TRIMs agreements (as discussed below). India, however, argues that the policy amounts to government procurement, as NTPC purchases all the solar power that is generated. Anticipating a possible WTO dispute, the Indian commerce department is already preparing its defence together with the Ministry of New and Renewable Energy.[120]

Aside from legal issues, the Indian LCR has been challenged on its effectiveness in achieving economic and employment objectives. This is mainly because of the unintended and unanticipated rise of thin film deployment. It is expected that 50% of the first batch (140 MW) will be thin film, which is colossal compared to the position of thin film in the global solar market (about 14%). CEEW and NRDC (2012) argue that two main factors lead to this rise of thin film in India. First, while silicon PV cells and modules fell under the LCR legislation, thin film technologies were exempted. Because of the cost increases for silicon-based modules and cells as a result of the LCR, cheaper thin film imports achieved a competitive advantage. Second, solar project developers had better access to international financing for projects to which the LCR did not apply (i.e. thin film). In particular, the Export-Import Bank of the United States (Ex-Im) and the Overseas Private Investment Corporation (OPIC) have granted low-interest loans for Indian solar projects provided they use thin film equipment from US companies – which can be seen as a foreign content requirement. This type of loan has skewed the market in favour of US thin film.[121] The thin film boom has lead to the overproduction of local silicon PV, which has been unable to benefit from the large market demand for solar PV.

Besides being ineffective in gathering economic benefits from the growth of a domestic industry, the Indian LCR has also been challenged on its capacity to create jobs. While the LCR is focused on the module-manufacturing sector, about half of the value and jobs are created downstream. Currently, however, Indian policy and the LCR are not focusing on services, but are exclusively manufacturing-focused. Concentrating on downstream development would also make it easier for mature companies to vertically integrate or venture between upstream and downstream Indian companies, which could generate additional local benefits.[122]

5.7. Brazil

Brazil has a lot of experience using LCRs in the oil and gas sectors. It also has an LCR of 60% for wind energy. Its main rationale for the LCR in the wind industry is to encourage the domestic manufacturing of 1.5 MW turbines or larger.[123] Complying with LCRs is a condition to access subsidized loans from Brazil's National Development Bank (BNDES), which is the most important lender for almost all wind energy projects. Most of the loan rates offered by BNDES are half as high as the best rate commercial banks can offer. Because of the LCRs attached to these attractive loans,

foreign manufacturers like Gamesa, General Electric and Kenersys are keen on building local factories. The Chinese market leader Sinovel has also announced that it will open one.[124] Before BNDES' LCRs, Brazil already used LCRs for the Programme of Incentives for Alternative Electricity Sources (PROINFA). This programme gave tariff incentives based on the wind capacity factor (which is linked to wind speed). When the capacity factor was as high as 44% (good wind speed), the tariff reached about $62/MWh, which is a viable tariff as $70/MWh was seen as a good price by the private sector.[125] This program started in 2002 and aimed at installing 3,300 MW of renewables (biomass, wind and small hydro power plants) in a first phase and 1,429 MW in a second phase. PROINFA set so-called "nationalization indices" at 60% for equipment and 90% for services.[126] In 2002, Brazil only had 22 MW of installed wind energy capacity. This increased to 931 MW in 2010.[127] Compared to other countries with a huge wind resource, this is only a very modest increase.

BNDES' LCRs are coupled with the weight of the different components, which means that wind turbine towers must be de facto produced within Brazil (they often account for around 80% of a turbine's total weight). However, Brazilian steel is about 70% more expensive than imported steel. Accordingly, the turbine costs will also increase, which is likely to be supported by subsidies and an increase in power prices.[128] In 2009 and 2010, Brazil issued tenders to encourage wind energy development. However, the winning bid prices were much lower than expected – about 50% lower than the tariffs attributed under the PROINFA programme. This reduces profit margins across the entire value chain along with market attractiveness. This is why BNDES loans are rather important, even though they come with a stringent LCR. Not all developers have decided to abide by the LCRs. Of the 4,316 MW contracted in the 2009 and 2010 tenders (including pending PROINFA projects) and the 928 MW already under construction, BNDES only financed 1,342 MW.[129] Still, Backwell (2011)[130] reports that wind energy project developers have blamed the Brazilian LCRs for their difficulties in scaling up the wind market in Brazil. In 2010, BNDES considered offering an exception for LCRs on imported steel. However, the steel industry in Brazil is also aiming at market growth and has blocked this proposal. In response, some wind energy turbine developers have started experimenting with concrete towers. Despite their drawbacks and expensiveness (they need to be manufactured on location), some project developers believe concrete towers will be cheaper in the long run than using high-priced domestically sourced steel for their towers and losing access to cheap BNDES loans.

The case of Brazil shows the immediate costs of LCRs. Despite its sizeable market with a large wind energy potential (especially in the North Western region), the LCRs attached to cheap BNDES loans might well be discouraging companies from drawing upon this potential. First, the 60% LCR was rather stringent from the beginning. Nevertheless, foreign companies seem to have entered the market and transferred technology. Second, and more importantly, the LCRs are linked to weight, which means they are de facto linked to steel. This means that the technology innovation potential of the LCRs is rather limited. By focusing on steel, the LCRs are overly manufacturing-focused and provide no stimulus for innovation. The cheap BNDES loans might serve as a pull factor for now, but high steel prices have undisputedly been affected, which will hamper the delivery of the full wind energy potential in Brazil.

5.8. South Africa

After a first round in November 2011, South Africa concluded its second bidding round for RE projects in March 2012. The South African government attached special importance to local content in the first round, but even more so in the second.[131] Initially set at 35%, the government aims at raising the requirement to 75% over time. However, a specific timeline has not been set. The LCR agreement before the first round was made through a "Green Economy Accord", which was supported by business, government and labour community groups. In this way, the government tried

to include an element that raises the potential effectiveness of the LCR – vertical cooperation. The accord included plans for skills development, basic education and the rise of local production. At the same time, the government was well aware that there needed to be additional funding for energy producers in order to make sure the burden was not overly shifted onto consumers. It was the Industrial Development Corporation that eventually extended green economy funding to R25 billion (about USD 3 billion) over five years, along with the South African Renewables Initiative, which set up low-cost loans with the support of European partner countries.[132] In mid 2010, South Africa only had 10 MW of installed capacity.[133]

After the first bidding round, however, local producers started opposing the LCR rate because they found the 35% requirement to be too low. It is claimed that 400 industry jobs were lost and several businesses closed after the first bidding round. As a result, the Conference of South African Trade Unions (Cosatu) recently called for an increase in the LCR to 50% or 65%.[134] This shows the political dilemmas that LCRs can bring. On the one hand, local manufacturing industries and stakeholders will push for higher LCRs in order to reap more employment benefits. On the other hand, the government needs foreign companies for technology transfer, and it also needs to take into account the risk of high short-term power price escalation as a result of high LCRs. The government of South Africa decided to increase the LCR in the second round, and is planning to do so even more in the future.[135]

5.9. Turkey

The FIT scheme for renewable electricity production in Turkey consists of two different components, a fixed and a variable one. Depending on the RE technology used, the Turkish Renewable Energy Law sets certain amounts of FIT payments. This law first came into effect in 2005 but, because it yielded little results, it was revised in 2010. Since the start of 2011, renewable electricity producers can receive additional payments under the FIT scheme if they use local components in their projects. This applies to all renewable energies.[136] For PV solar projects, for instance, bonus payments are given for the use of local modules, cells, invertors and tracking systems. While the initial tariff is USD 0.13/kWh – very low compared with many other countries; in Germany, support is about three times as high – using local content can add an additional USD 0.07/kWh.[137] In the middle of 2010, only 3 MW of PV capacity had been installed.[138]

The FIT therefore varies among electricity producers using the same technology, depending on how much local content they use. Hydro-electricity has a baseline tariff of USD 0.073/kWh, but can gain an additional USD 0.023/kWh when using local content. Geothermal plants have an FIT of USD 0.105/kWh, which can be increased by a maximum of USD 0.153/kWh. Electricity generated by biomass and landfill gas has an initial tariff of USD 0.133/kWh, which can go up by USD 0.056/kWh when local content is used. The exact amount of local content that is needed and the calculation methods are set out by ministerial regulation.[139] Average electricity prices in Turkey fall between USD 0.15/kWh (residential) and USD 0.10/kWh (industrial).[140]

The wind energy market in particular has significant potential in Turkey. In 2010, 1.3 GW of wind energy had already been installed in Turkey.[141] The technical potential is estimated at 150 GW, and the market is set to grow by 30% annually until 2014 and to reach 20 GW by 2023. While the level of the FIT for wind is relatively low (USD 0.073/kWh), the large amount of resources and the additional LCR bonuses make the market attractive for a long-term presence. By using locally produced components, the FIT for wind can go as high as USD 0.11/kWh. As the legislation and wind energy market are relatively new, it is yet to be seen whether LCRs can encourage companies to settle in Turkey for the long run.[142]

5.10. Other countries

Many other countries use LCRs as a policy measure for certain areas of green industrial development. For example, Ukraine introduced an LCR together with a FIT system in 2009. The legislation stipulates that project developers are not eligible to receive the FIT unless they source a certain percentage of their components locally. The LCR is valid for power plants commissioned after 1 January 2012, when the legislation entered into force. It was set at 15% in 2012, which increased to 30% in 2013 and will increase to 50% in 2014. In addition, solar power plants commissioned after 1 January 2013 and 1 January 2014 must respectively source 30% and 50% of the raw and other materials used in solar modules in Ukraine.[143]

In Chubut (Argentina), the wind energy law of 2005 stipulated that FIT support be conditioned upon LCR compliance. The LCR for wind energy started at 10% in 1999 and increased to 30% in 2001, 60% in 2003, 80% in 2005 and 100% in 2007. In spite of the large wind resource and the early start of the LCR (when there was still learning-by-doing potential), the low financial incentives and the rigid timeline of LCR increases (not linked to technology learning) are quoted as being a serious hindrance to wind power development in Chubut and Argentina.[144] In 2010, only 30 MW had been installed in Argentina, which has a potential of over two million MW.[145] That year, the government wrote out a new tender in which LCRs were very importantiv and[146] accepted 754 MW of wind power projects.[147] Other Latin American countries also use LCRs. For example, in its 2010 wind energy tender, Uruguay required a 20% equity participation and that 80% of maintenance work be sourced locally.[148]

The Malaysian Renewable Energy Bill 2010 foresees a variable FIT linked to LCRs. The scheme grants the payment of a basic FIT rate. In addition, biogas, biomass, and solar PV producers receive a bonus FIT payment when locally manufactured or assembled components are used. For example, the use of locally manufactured solar photovoltaic modules and solar inverters give a FIT bonus of respectively 0.01 USD/kWh and 0.003 USD/kWh. These are rather modest compared with the initial FITs for Solar PV (which range from USD 0.27/kWh for installations of more than 10 MW to USD 0.39/kWh for installations producing no more than 4 kW). The local content bonus for biogas and biomass is equally small (0.003 USD/kWh).[149]

Table 5: Examples of LCRs in the wind and solar industry

Country (technology)	Market potential	LCR % (start year), % (2012)	Vertical cooperation & financial support	Technology Installation prior to LCRs[3]
China (wind)	Very large	20% (1997), 70% (2009)	Joint venture, CDM, state tariffs, national tender requirement	56.5 MW (1997), 468 MW (2002)
Ontario (wind)	Large	25% (2009), 50% (2012)	Feed-in tariff conditionality	704 MW (2008)
Quebec (wind)	Small	40% (2003), 60% (2012)1	Tender requirement	100 MW (2002)
Spain (wind)	Large	70% (2012)[2]	Market entry requirement (provincial), non-coupled FIT (national)	73 MW (1994)
Turkey (wind)	Large	Variable (2011)	Additional FIT / local content used	1.3 GW (2010)

Country (technology)	Market potential	LCR % (start year), % (2012)	Vertical cooperation & financial support	Technology Installation prior to LCRs[3]
Brazil (wind)	Large	60% (2002), 60% (2012)	Condition for subsidized BNDES loans	22 MW (2002)
South Africa (wind)	Large	35% (2011), >35% (2012)	Tender requirement	< 10 MW (2010)
Ontario (solar)	Large	50% (2009), 60% (2012)	Feed-in tariff conditionality	2 MW (2008)
Italy (solar)	Large	Variable (2011)	5 to 10% bonus / local content used	3.5 GW (2010)
France (solar)	Medium	60% (2012)	10% bonus on EDF repurchasing price	2.5 GW (2011)
Turkey (solar)	Very large	Variable (2011)	Additional FIT / local content used	3 MW (2010) mostly off-grid
India (solar)	Very large	30% (2011), 30% (2011)	Feed-in tariff conditionality	22 MW (2010)

1. Of which 50% in the Gaspésie region; 2. In the provinces of Galicia and Navarra. Spanish provincial demands started in 1994; 3. Learning rates were highest for wind between 1984 and 2003. Turbine prices (excl. China) rose since 2004, partially as a result of rising commodity prices. The technology is already relatively mature, compared to solar PV. Solar PV learning rates remain significant in 2011. On average, there is an estimated 22% cost reduction for each doubling of cumulative installed capacity. (Gielen, 2012)

5.11. Discussion on the use of LCRs in RE policies

5.11.1. Objectives

Local content requirements for RE are used frequently and in a large number of countries. Both developed and emerging countries use them to encourage local industries. When looking back at the two objectives that could justify the use of LCRs, it is observed that most governments use them to spur the manufacturing of RE technologies and thereby to increase employment opportunities. In none of the reported case examples did governments explicitly quote the desire to become a global innovator as a primary objective. They do often mention the desire to become a global leader in the sector, which would imply being open to global competition eventually. This element is important as – let us not forget – creating an export industry can be solely based on local subsidies. This is exactly what the US says is happening in the Chinese solar – and potentially also wind turbine – industry. Thus, to become an innovator, the adolescent industry needs to be opened up to international competition once it is able to compete. The fact that governments do not address this at the beginning of LCRs is worrying, as it may indicate that the content requirement is set to stay indefinitely. Governments that have LCRs are reluctant to abandon them. Growth pains and consolidations following LCR suspension are, logically, politically far more unattractive than the concerns raised at their initial introduction.

5.11.2. Presence of basic conditions

The framework of basic conditions for potential effectiveness has proven a valuable tool to assess whether countries follow the conditions for creating national welfare. It was added that, to be useful in creating innovative capacity, the policy environment around LCRs needed to foresee (1) that attention is paid to the quality of technology, in addition to learning-by-doing; and (2) that LCRs are phased out when the former infant industries are mature enough to compete internationally. It must be noted, however, that the beneficiaries are not

always infant industries (e.g. Brazil, where the beneficiary was the steel sector).

It can be observed that countries often fail to combine proper incentives and policies. When it comes to market potential and stability, some countries with a small potential still use LCRs (Quebec). Others with a large market potential sometimes fail to establish ambitious targets that could help attract more investors (Ontario). In addition, not setting limits may become a problem for the taxpayer, as there is no limit on how much investors can take advantage of the scheme. LCRs often start off too high or are increased too rapidly. For example, in Argentina, the LCR grew from 10% to 100% in 8 years. Since the proper financial incentives had not been put in place, this severely damaged the development of the wind market. Countries could enhance LCR effectiveness by encouraging more vertical cooperation and less subsidization, governments could prepare LCRs together with the industry, and intermediate component suppliers could cooperate with their supply chain to become more efficient and thereby partially mitigate the higher prices investors would have to pay for these intermediate components. When it comes to subsidization, however, it is interesting to note that financial support with LCR conditionality is attacked the most (China, Ontario, India). Even though the result is similar, countries that use local content bonuses or LCRs within tendering systems have been less severely scrutinized.

Learning-by-doing potentially plays an important role. In the solar industry, a high learning-by-doing and market potential has coincided with a booming market. In wind energy, there is less learning-by-doing potential, with fears that LCRs could be too manufacturing-based, adding little to innovation (e.g. Brazil). Technology knowledge is often low before LCRs are put in place. This is why it is crucial that they be increased incrementally. For example, Chubut decided up front that, by 2007, 100% of wind turbines would be sourced locally, regardless of their learning evolution. Governments that use LCRs could help by publicly revealing the type of components that foreign and domestic companies source locally. This way, it would be possible to determine whether the LCRs are overly manufacturing-focused and to verify changes over time, including how this relates to technology development. While this could increase the legitimacy of research on LCRs for green innovation, the absence of this information could arguably point to their lack of effectiveness in technology development.

The case of Gamesa – and potentially of Chinese market leaders in the future – shows that it may be possible to create innovative capacity together with LCRs, under strict conditions. Both Gamesa and the Chinese wind industry mostly complied with the generic, broad conditions above: (1) space for learning-by-doing in the technology; (2) cooperation with global leaders in the technology to which the LCR applies (for example through joint ventures); (3) appropriate financial support to attract these global leaders to the market; (4) a large and stable market that gives additional incentives for investors to enter the market; (5) an LCR that is not overly stringent or coupled to technology learning. The fact that Gamesa and parts of the Chinese industry met these basic conditions seems to have been an important element in their domestic growth.

5.11.3. Supplementary measures

In addition to direct financial support for RE production in the form of increased electricity tariffs, more research should be conducted on supplementary measures that aid local content development. For example, in the German and Danish wind industries (the two first-movers and market leaders), the government provided more and better loans to projects that were sourcing more of their components locally. Like India and others, the EU also favours the importation of components over fully assembled RE systems by applying higher customs duties to the latter. This is again aimed at supporting the development of a local supply chain. For example, the US, Denmark and Germany also have export credit assistance and development aid loans to help their companies export to foreign markets.[150]

It is possible to increase local content by developing a proper stable market policy, among others by encouraging cooperation in local supply chains. However, this takes time, effort and coordination. LCRs are an easy way out for many governments. For example in Ontario, the Green Energy and Green Economy Act made no mention of training and education, which are arguably two crucial components for building technological know-how to increase the pace of learning-by-doing and innovation. In the end, if proponents of LCRs argue for their use to achieve global objectives such as technology development, it should be proven that LCRs give way to increased innovative capacity. While such a conclusion would follow from country and technology-specific research, it can be generally observed that, today, most LCRs are primarily used for industrial development purposes.

5.11.4. Innovation potential and political reality

Some argue that the most sustainable approach is to establish a system of innovation that encourages domestic companies to bring innovation to the value chain segments in which the country has a comparative advantage.[151] While this is certainly the ideal situation and should be encouraged within national and international policies, it might not be compatible with the difficult disbalance between first-movers and latecomers, as well as that between developed, emerging and developing economies. It is also unlikely that such a system would lead to very fast deployment in countries that are rich in resources but have less know-how, especially if additional incentives are needed to encourage industrial growth. This could lead to a perverse situation in which developing countries (or those that are financially distressed, like Greece) finance richer companies from industrialized nations.

The empirical research question surrounding LCRs and their potential to increase innovative capacity in the medium-term should not be whether it is the most ideal green IP conducive to technology development, but rather whether certain formulations of LCRs could lead to innovation in certain contexts. A first qualitative analysis shows that, under certain conditions, LCRs have been successful in increasing domestic output. However, this conclusion implies an additional innovation potential in the medium-term, which would be a leap of faith and is not currently founded by empirical analysis. It is true that the Spanish wind giant Gamesa may serve as an example of a protected infant industry that became a global innovator. However, it cannot be concluded with certainty that the LCR facilitated the creation of this innovator. Furthermore, it is impossible to ascertain what the net added innovative capacity could have been in a policy environment without any LCRs. In addition, the Chinese wind industry is showing promising signals of quality improvement. However, it is still too early to rule whether the Chinese wind sector will fully develop and become innovative without state support. These two examples are therefore by no means a conclusion that LCRs lead to innovation. For this, in-depth research would also need to offer a specific set of indicators, whereas this analysis has only looked at sales and output. Together with an introductory qualitative assessment, this is largely insufficient in making any statistical inferences on the innovative capacity of LCRs or the remaining innovative capacity regardless of LCRs.

In the end, together with innovation potential, political motivations and realities have to be included in the LCR equation and protectionist and inefficiency concerns must remain a predominant and important factor. Counterfactual reasoning can reveal the potential for certain benefits that may have not occurred in the imperfect world market determined by individual state politics. As green tech is often not competitive vis-à-vis conventional technologies that are often subsidized (cars, electricity generation, transport fuel, etc.), state support remains necessary. It is questionable whether China would have invested as heavily in wind energy deployment if it had not been able to reap local benefits. Similarly, political considerations such as industry creation and employment were necessary to invest in renewables in countries

like South Africa, Canada and Greece. At the same time, the French and Italian solar markets grew so strongly that maintaining financial support was impossible. In all these cases, the absence of local benefits posed a serious political barrier, which, by diminishing political support, ultimately threatened to undermine the objectives of the policy.

Political realities and subsidies for conventional technologies might thus add to arguments in favour of a coordinated local content strategy that, under certain conditions, could foster innovation in the medium-term. However, the main question is not whether there would be more deployment in the absence of LCRs. If financial support was given without an LCR, it is quite probable that more investors would enter the market and that more RE capacity would be installed sooner. However, a realistic assessment of policies should include the political reality that high financial support for RE programmes might not be publicly supported if there were no local benefits attached to it. Indeed, if there was no financial support for technology deployment that is not yet competitive with conventional energy generation, it is equally probable that fewer investors would enter the market. If this is the argument, then innovation and unsubsidized export competitiveness should at least be an explicit objective of countries using LCRs; however this is not the case as yet. This also places an important spotlight on fossil fuel subsidies that artificially keep electricity retail prices low. If such environmentally harmful and financially wasteful subsidies were to be phased out, RE would become more competitive and part of the raison d'être of LCRs would disappear.

Chapter 6

WTO scrutiny

This section assesses how current WTO rules discipline the use of LCRs in RE support policies. As seen in the examples above, two types of policies containing LCRs appear frequently. First, financial support schemes such as FITs have LCRs attached to them. Second, procurement tenders make the eligibility of RE project developers contingent upon the use of local content. The legality of both types of policies under WTO law will be assessed, one after the other.

6.1. WTO scrutiny of support schemes with attached LCRs

WTO law consists of different agreements that discipline, among others, internal regulations and taxation, the use of subsidies and the application of TRIMs. Specific agreements that need to be analyzed to evaluate the consistency of support schemes that contain LCRs with WTO law are the GATT, the TRIMs Agreement, and the SCM Agreement.

6.1.1. Assessment of Article III of the GATT

GATT Article III demands the same national treatment for similar domestic and foreign products when it comes to internal taxation and regulation. When analyzing a potential violation of GATT Article III:4, one will need to consider whether a support scheme with LCRs constitutes a "law, regulation and requirement affecting the [...] internal sale, offering for sale, purchase, transportation, distribution or use [of imported products]," whether domestically and foreign-manufactured RE components constitute "like products", and whether foreign RE components are accorded "less favourable treatment" than domestic ones.

Support instruments for RE development, such as FITs or renewable portfolio standards, would likely qualify as "laws, regulations and requirements".[152] They would further "affect" the "internal sale" of imported components, as they contain incentives for developers to use domestic instead of imported RE components.[153] The question of "likeness" of domestic and foreign RE components would presumably be answered in the affirmative. The WTO's Appellate Body defined "(i) the physical properties of the products; (ii) the extent to which the products are capable of serving the same or similar end-uses; (iii) the extent to which consumers perceive and treat the products as alternative means of performing particular functions in order to satisfy a particular want or demand; and (iv) the international classification of the products for tariff purposes" as the characteristics that "like" products must share. In addition, it considered the "competitive relationship of the products" as a decisive criterion.[154]

The question concerning Article III:4 GATT is whether foreign component manufacturers are "less favorably treated" than domestic manufacturers because of LCRs. As defined above, LCRs force foreign or domestic RE investors to source a certain percentage of their components from local manufacture or production. Such an arrangement quite clearly treats foreign manufacturers less favourably than domestic manufacturers, as the incentives are conditioned on their products being purchased only up to a certain percentage. The WTO Panel in Canada-FIRA considered that a requirement to purchase goods of domestic origin was contrary to Article III:4.[155] Support schemes with LCRs would therefore likely be found inconsistent with Article III:4 GATT.

In addition, support schemes with LCRs might violate GATT Article III:5. Whenever WTO Panels found a violation of GATT Article III:4 in the past, they refrained from assessing a violation of Article III:5 for reasons of judicial economy.[156] Article III:5 GATT prohibits support schemes that "require, directly or indirectly, that any specified amount or proportion of any product which is the subject of the regulation must be supplied from domestic sources." A WTO Panel found

such a "requirement", for instance, in a US regulation that made tobacco producers that failed to source a fixed amount of local content in their production subject to penalties.[157] In the case of support schemes for RE that are contingent upon the use of local content, no direct penalties would be imposed by the state in case of non-compliance. Instead, one could argue that these schemes might involve an "indirect" penalty, as RE producers that do not fulfil the required local content quota would not receive support and would thereby have a competitive disadvantage towards other producers that fulfil the quota. However, since there is no precedent in WTO case law, it is uncertain whether such an argument would be considered by a Panel and whether a Panel would rule that support schemes containing LCRs are inconsistent with GATT Article III:5 on this basis.

Both Articles III:4 and III:5 GATT may only restrict support schemes with LCRs if Article III:8(a) GATT does not preclude them. GATT Article III:8(a) exclusively applies to "laws, regulations or requirements governing the procurement by governmental agencies of products purchased for governmental purposes and not with a view to commercial resale (…)." A Panel would assess this matter in three steps: (i) whether a support scheme with LCRs may qualify as 'laws, regulations or requirements *governing* procurement', (ii) whether it involves "*procurement* by governmental agencies", and (iii) whether any potential "procurement" is undertaken "*for governmental purposes*" and "not with a view to *commercial resale*" (emphases added).

The Panel in Canada-Renewable Energy found that the FIT scheme with LCRs in Ontario "governed procurement" as it controlled and regulated the procurement of electricity, the Appellate Body mooted the Panel's argument. It held that Ontario's FIT with LCR referred to generation equipment used in renewable energy projects, while the product potentially "procured" by the government was electricity. The Appellate Body concluded that Ontario's FIT did therefore not fall under "laws, regulations or requirements governing the procurement by governmental agencies" of electricity within the meaning of Article III:8(a) of the GATT 1994.[158] The ruling of the Panel in *Canada-Renewable* Energy was the first WTO decision on support schemes for RE and is the first reference for future rulings on other support schemes with LCRs. Most likely, support schemes do not fulfil the conditions of Article III:8(a) GATT and would therefore be subject to Article III:4 and/or Article III:5 GATT.

6.1.2. Assessment of the TRIMs Agreement

The WTO's TRIMs Agreement contains an "Illustrative List" that further clarifies which measures may be inconsistent with GATT Article III:4.[159] Based on Articles 2.1 and 2.2 TRIMs Agreement, the Illustrative List states that "trade-related investment measures" "which are mandatory or *enforceable under domestic law* or under administrative rulings, or *compliance with which is necessary to obtain an advantage*, and which require: (a) the *purchase or use by an enterprise of products of domestic origin* or from *any domestic source*, whether specified in terms of particular products, in terms of volume or value of products, or in terms of a proportion of volume or value of its local production […]"are inconsistent with GATT Article III:4 (emphases added). When assessing Articles 2.1 and 2.2 TRIMs Agreement, a Panel would determine: (i) whether support schemes with LCRs constitute "trade-related investment measures" (TRIMs) and (ii) whether they fall under the scope of the Illustrative List.[160]

First, a support scheme with LCRs may be considered an "investment measure" due to its "significant impact on investment" in the RE sector. Such a scheme would likely result in more investment into domestic manufacturing facilities for RE components, while disincentivizing investments into manufacturing facilities abroad that aim to import components.[161] The Panel in *Canada-Renewable* Energy argued, for instance, that the objective of the FIT with LCRs in Ontario was to "[e]nable new green industries through new investment and job creation" and to "[p]rovide incentives for investment in RE technologies."[162] It considered specific evidence of cases in which the scheme had

incited foreign manufacturers to move their production of RE components to Ontario.[163] A support scheme with LCRs would also likely be considered "related to trade" as it would generally favour the use of domestic over imported components.[164]

Second, as most support schemes with LCRs will constitute "trade-related investment measures", they may be subject to the Illustrative List of the TRIMs Agreement. These schemes would generally be considered "mandatory under domestic law", as they are spelled out in binding legal documents and require compliance with their provisions to "obtain an advantage", for instance in terms of FIT payments or green certificates. Most schemes with LCRs further require the "purchase or use" of products of domestic origin from renewable electricity generators in the form of a minimum share of local content in their projects.[165] They may therefore be inconsistent with the TRIMs Agreement.

A support scheme with LCRs that is found to violate GATT Article III:4, GATT Article III:5, or Articles 2.1 and 2.2 of the TRIMs Agreement would need to be brought into conformity with the requirements of said provision, provided that it is not justified by Article XX GATT (assessed below). However, before the concerned WTO member is asked to bring its measure into conformity, the WTO's Dispute Settlement Body – consisting of an ad-hoc Panel in a first instance and a permanent Appellate Body in a second instance – would need to rule on the legality of the support scheme. A final ruling could take a considerable period of time. If its support scheme with LCRs were to be found to violate WTO law, the defending member could find itself confronted with retaliation measures by another WTO member (Article XXIII:2 GATT).

6.1.3. Assessment of the SCM Agreement

In addition to their potential inconsistency with the GATT and TRIMs provisions, support schemes with LCRs may further constitute "prohibited subsidies" under the SCM Agreement. The first question to assess is whether such schemes meet the requirements for "subsidies" in the SCM Agreement. Only then could they potentially violate the provisions of the Agreement.

Article 1.1 SCM Agreement lists two requirements for a measure to qualify as a "subsidy". First, a "financial contribution by a government or any public body within the territory of a Member" must exist. Second, a "benefit" must be conferred. A support scheme with LCRs would, for instance, be considered a "financial contribution" if it involved "government purchases" of electricity.[166] One might reason that, by issuing a support scheme (such as a FIT), the government pays for the amount of electricity delivered to the grid, receives control of the electricity in the grid in return and can sell it to any customer. The Panel in Canada - Renewable Energy argued on this basis that the government of Ontario "purchased" electricity and that it therefore made a "financial contribution".[167] The Appellate Body in Canada - Renewable Energy reasoned that support schemes could also constitute a "financial contribution", as they potentially involved a "direct transfer of funds" or a "potential direct transfers of funds or liabilities".[168] In particular, capital investment subsidies or tax credits could fall under this line of argumentation as they are usually granted independently from the amount of renewable electricity that the supported project developer eventually feeds into the public grid.

If a support scheme with LCRs is administered by a private entity in the territory of a WTO member, it could equally qualify as a "financial contribution" under the SCM Agreement provisions, provided that the entity is "entrusted or directed" by the government and as long as the entrusted or directed task "would normally be vested in the government and [in case] the practice, in no real sense, differs from practices normally followed by governments."[169] In most cases, as the support schemes are set in public laws, private entities would be "entrusted or directed" by the government. With regard to whether support for RE diffusion is seen as a function that "would normally be vested in the government and in no real sense, differs from practices normally followed by

governments," the WTO's Appellate Body requires a case-by-case analysis "of the core features of the [private] entity concerned, and its relationship with government in the narrow sense".[170] In most cases, a support scheme for RE development would therefore constitute a "financial contribution" as per Article 1 SCM Agreement.

When it comes to the second requirement for the qualification as a "subsidy", the SCM Agreement requires a support scheme to "confer a benefit".[171] The essential question here is whether RE producers that are eligible for a support scheme with LCRs receive a financial contribution on "more favorable terms" than the "prevailing market conditions for the good or service in question in the country of provision or purchase".[172] Usually, a Panel would compare the FIT price that an electricity producer in Ontario receives with the regular price in Ontario's electricity market. However, in Canada - Renewable Energy, both the Panel and the Appellate Body argued that the wholesale electricity market in Ontario was not the right benchmark for the "benefit" analysis, as electricity from wind and solar energy had different "cost structures, operating costs and characteristics" than other sources of electricity and could not be viewed as openly competing with them.[173] The Panel reasoned that Ontario's electricity market was rather to be understood as an "electricity system" in which the Government of Ontario ensured a certain "supply-mix" of different energy technologies, among them PV and wind energy, in order "to ensure a safe, reliable, and long-term supply of electricity in Ontario".[174] The Appellate Body argued that the benchmark for the "benefit" analysis for wind- and solar PV-generated electricity therefore had to be a hypothetical market price only for wind- and solar PV-generated electricity.[175] The Appellate Body was, however, not able to complete the analysis whether the prices paid through the Ontario FIT corresponded to the electricity price in such a hypothetical market or whether they were "more favorable".[176] In passing, the Appellate Body stated that certificate schemes or competitive bidding schemes would likely not confer a benefit as these instruments aimed for the lowest possible price for electricity in the PV- or Wind-market.[177] For FIT schemes, the Appellate Body saw as relevant, whether its calculation was based on "reasonable" capital costs, operating and maintenance costs, and connection costs, or whether the government issued prices that were too high.[178] For clarity on whether support schemes with LCR confer a benefit or not, one will need to wait for future decisions in the WTO Dispute Settlement System.

The next step in the analysis of a Panel would be whether support schemes with LCRs constitute "prohibited subsidies" under the SCM Agreement if they are found to be "subsidies". Article 3.1(b) SCM Agreement defines subsidies as prohibited if they are "contingent (…) upon the use of domestic over imported goods." Support schemes that condition their eligibility upon the sourcing of a certain percentage of local content would be found to be "contingent upon the use of domestic over imported goods." If they meet this definition of "prohibited subsidies", they would need to be withdrawn by the concerned Member state "without delay."[179]

6.1.4. Justification of inconsistencies with WTO law under GATT Article XX?

A provision that might be invoked by WTO Members to justify financial support schemes with LCRs before a WTO Panel is GATT Article XX. This provision allows certain measures, otherwise inconsistent with WTO law, that are "necessary for" or "related to" the achievement of legitimate policy aims and that are applied in a non-discriminatory manner.

While GATT Article XX is eligible to justify violations of Article III GATT and Article 2.1 TRIMs Agreement, the recent decision of the WTO Appellate Body in China – Various Raw Materials suggests that it cannot be used to justify violations of provisions in the SCM Agreement. There are, however, various arguments to justify the eligibility of Article XX GATT for the SCM Agreement; a debate on these arguments is ongoing and it remains to be seen how the Appellate Body rules on this issue in future decisions.[180]

Two specific exception provisions of Article XX GATT – namely subparagraphs (b) or (g) – could potentially justify the inconsistencies of support schemes with LCRs. The application of subparagraph (b) depends on whether a defendant WTO Member can demonstrate that its measure protects (or aims to protect) "human, animal or plant life or health" and, if so, that it is "necessary" to achieve that objective. While it could defend its support scheme with LCRs as a preventive measure for "health risks" from fossil fuel production and climate change, the Member would likely fail to prove its scheme's "necessity". A Panel would argue that LCRs in a support scheme contribute little to health protection and that they might even constitute a barrier for RE development (see the examples of Brazil and Argentina above). Support schemes without LCRs would be considered a "less trade restrictive" alternative.[181]

For the application of subparagraph (g), the defendant must link the measure to the "conservation of exhaustible natural resources" and the measure must be found to "relate to" this topic. Furthermore, the measure must be "made effective in conjunction with restrictions on domestic production or consumption." In a first step, a WTO Member might successfully argue that support schemes with LCRs would "conserve exhaustible natural resources" as they aim at limiting CO2 emissions into the "clean air" from fossil fuel power plants. "Clean air" has been recognized to constitute an "exhaustible natural resource" by the Appellate Body.[182] In a second step, a WTO Member might also prove a "reasonable" relation between its support scheme with LCRs and the conservation of "clean air". It would, however, likely fail to prove that its support scheme with LCRs reserved equal treatment for foreign and domestic producers. For this requirement, a Member must show that a restriction on an imported product is imposed "in conjunction with restrictions on domestic production or consumption".[183] As most support schemes with LCRs explicitly demand that RE producers source domestic – rather than foreign – products, it would be difficult to defend. As a result, both subparagraphs (b) and (g) could not be used to justify the use of support schemes with LCRs.

A WTO Member trying to invoke GATT Article XX would also need to comply with the introductory paragraph of that provision, the so-called "chapeau". The chapeau requires that state measures not be "applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade (…)." The Appellate Body found that, "when a Member seeks to justify the discrimination resulting from the application of its measure by a rationale that bears no relationship to the accomplishment of the objective that falls within the purview of one of the paragraphs of GATT Article XX, or goes against this objective," it constituted arbitrary or unjustifiable discrimination.[184] As mentioned above, the two objectives that a state could use in order to justify its support scheme with LCRs are either (i) the "prevention of health effects" (under Article XX(b)) or (ii) "the conservation of clean air" (under Article XX(g)). However, a WTO Panel would likely argue that the discrimination of foreign component manufacturers through LCRs does not benefit the achievement of either of the two objectives. Instead, it could even find that LCRs impede the achievement of these two objectives, as they worsen investment conditions for foreign manufacturing firms (due to the restricted availability and choice of inputs for renewable electricity generation plants) and therefore potentially reduce their commitment to RE projects.[185] Even if certain support schemes with LCRs were to pass the previous criteria of GATT Article XX, they would likely be found to constitute "arbitrary or unjustifiable discrimination" and would therefore not be justifiable under GATT Article XX.

6.2. WTO scrutiny of procurement tenders with LCRs

While support mechanisms with LCRs may be prohibited under WTO law, it should be noted that procurement tenders for the construction of RE projects containing LCRs would hardly

be disciplined by WTO law. As shown above, the two preconditions for the application of GATT Article III:8(a) would likely not be fulfilled in the case of renewable electricity support, as government agencies do not purchase electricity "for [their] own use or benefit" and, since they "commercially resell" it to the end-customers, GATT Article III:8(a) would therefore not apply.

Aside from GATT Article III:8(a), the Government Procurement Agreement (GPA) is currently the only legal framework that could interfere with a tender that imposes a share of local content in its qualification conditions. The GPA is a plurilateral WTO agreement that only covers certain procurement measures and entities. It currently binds forty parties.[186] A support scheme with LCRs may be subject to the GPA if the host state of the scheme has ratified the agreement and if it has listed the entity that implements and administers the scheme in the Appendix to the GPA. As most entities that administer support schemes have not been integrated into Appendix I of the GPA, the impact of the agreement on tenders with LCRs is minor.

6.3. Summary of the WTO impermissibility of LCRs

Overall, support schemes for RE development that contain LCRs likely violate various different WTO provisions. They are inconsistent with the national treatment principle in GATT Article III:4 – and potentially GATT Article III:5 – as they promise to advantage the RE producers that source locally manufactured or assembled products over others that do not. They might equally violate Articles 2.1 and 2.2 of the TRIMs Agreement, as this agreement explicitly prohibits trade-related investment measures that require "the purchase or use of products of domestic origin or from any domestic source" in order to obtain an advantage. For the SCM Agreement, the principal question is whether a support scheme qualifies as a "subsidy" under its specific requirements. If it does, the scheme would constitute a prohibited subsidy under Article 3.1(b) SCM Agreement as long as it was found to be "contingent (…) upon the use of domestic over imported goods." GATT Article XX would likely not be available to justify support schemes with LCRs.

Contrary to support schemes with LCRs, procurement tenders containing LCRs would hardly be disciplined by WTO law. Public procurement is only subject to GATT Article III:8(a), which would most likely not apply to support schemes for renewable electricity (with LCRs), and the GPA, which relies on a positive list approach and therefore only binds the entities that were explicitly included into its scope of application by their host states.

Box 5: Opportunities of a Sustainable Energy Trade Agreement

How should one deal with the displayed impermissibility of support schemes with LCRs under WTO law if LCRs were proven useful for green innovation? Two factors suggest that WTO rules on support schemes with LCRs should become more specific and coherent. First, as has been discussed, support schemes with LCRs are much more severely disciplined than procurement tenders with LCRs, even though, in many cases, procurement tenders with LCRs constitute larger barriers to trade than support schemes. Second, many WTO Members have put in place support schemes with LCRs that violate provisions in WTO law. Often, these same members complain about other members' support schemes with LCRs. It is in the interest of the WTO and the WTO Members to avoid a flood of claims relating to these policies, such as those launched by Japan and the EU against the Ontarian FIT and by China against the EU.[187]

The International Center for Trade and Sustainable Development (ICTSD) and Cottier et al. have both proposed the creation of a new sectoral agreement on energy to achieve an integrated approach for the energy sector. An agreement on energy could address issues such as tariffs, non-tariff barriers, subsidies, procurement and services, specifically with

regard to trade in energy. It could also contain a coherent approach to support schemes and procurement tenders with LCRs.

Cottier et al. suggest modelling a new energy agreement on the WTO Agreement on Agriculture, which was negotiated during the Uruguay Round of the GATT.[188] The Agreement on Agriculture contains certain special provisions on policies in the agricultural sector, such as subsidies or tariffs, which can prevail over general provisions from other WTO agreements that would otherwise apply. The ICTSD proposes the establishment of a plurilateral agreement on energy – the Sustainable Energy Trade Agreement (SETA) – modelled on the GPA or the Information Technology Agreement (ITA). The GPA takes a positive list approach, only binding notified state bodies of its members (see above). The ITA stipulates that benefits could apply to all WTO Members if the signatories of the agreement collectively reach 90%of world trade. Alternatively, ICTSD suggests that the SETA could be established as a stand-alone agreement outside of the WTO framework, as either a plurilateral or a multilateral agreement.[189]

Regardless of the type of agreement chosen, the main question will be whether there is sufficient political support and acceptance for a more specific and coherent handling of energy issues among WTO Members. Any energy agreement would only apply to its signatories and would therefore only be relevant if both the plaintiff and the host state of the support scheme with LCRs had ratified the agreement. Further legal analysis and research is required to explore additional ways of establishing a sectoral energy agreement or another instrument in WTO law in order to make WTO rules on support schemes and procurement tenders with LCRs more specific and coherent.

Chapter 7

Lessons learned

Are LCRs and RE policy a good match? Our preliminary answer is ambiguous: experience teaches us that it may be possible to create innovative capacities in combination with LCRs. This, however, does not indicate whether it is the LCR that fosters medium-term innovation or whether this innovation happens in spite of LCR legislation. Any innovative effect would manifest itself in the medium-term, instead of in the short-term, and only under certain conditions. To date, it seems that most jurisdictions using LCRs in RE policies have not chosen the correct set of tools to formulate a comprehensive policy including LCRs that supports the creation of a viable innovator. This relates to one of the most important concerns: the creation of endless, costly and ineffective LCRs that are not intended to be phased out.

The argument that LCRs lead to an inefficient allocation of resources is a valid one. It seems to us that inefficiencies are even more guaranteed if there is a lack of positive results vis-à-vis the basic conditions for potential LCR value creation identified in this paper. In addition to the inefficient allocation of resources, it is also observed that LCRs are serious non-tariff barriers. Most LCRs that are currently being used appear to be very high, which means they are heavily trade-distortive. This drives up costs excessively and hampers international competition in the short-term. For example, in India, all silicon PV projects are required to use cells and modules manufactured in India if they want to be eligible for the FIT. This effectively bans foreign silicon PV from the Indian market. Similarly, Ontario has been criticized for having overly high content rates that are too trade-restrictive.

Five main conditions for potential national value creation have been identified. The presence or absence of these conditions allows for a better understanding of the objectives and potential results of LCRs. If we assume that LCRs are targeting infant industries, then the key question is simple: can LCRs be used to foster an infant industry in conjunction with creating a global innovator that is able to compete in global markets? If that can be achieved, then the benefits can be counted against the costs of short-term inefficiencies. If this is not the case, then LCRs are a failure both economically (wasted financial resources) and environmentally (with the money invested, more deployment could have been achieved through imports). While the basic conditions are necessary to successfully increase output and sales, they are not sufficient to guarantee the creation of an innovator. For each of them, the analysis of the current use of LCRs in green IP shows noteworthy shortcomings. The following conclusions can be drawn:

(1) *If LCRs are used, a stable and sizeable market is necessary.* Countries with low potential demand will not be able to foster infant industries, since not enough learning-by-doing can take place. Similarly, guaranteeing a stable demand is needed to complement the implementation of LCRs. A very stable and ambitious market will likely increase the amount of local content even without formal requirements, which is significant. For example, ambitious green technology targets, complementary education and know-how build-up policies generate local advantages. In their absence, it is possible that having the choice of using LCRs in green IP makes governments 'lazy'. For example, Ontario seems to pay insufficient attention to formulating ambitious targets or improving education possibilities to establish high-skilled experts in RE technologies.

(2) *If used, LCRs cannot be too restrictive and must be coupled with learning benefits.* If LCRs are too restrictive, foreign investors might not enter the market or the full market potential might not be tapped into. If LCRs are used,

the incremental increase of local content rates should be linked to capacity for green technology learning. A restrictive and ambitious program to increase technology transfer in just a few years' time is often detrimental. For example, Argentina harmed its own wind energy development by establishing a very ambitious timeline, which likely scared off investors and was too rapid to allow domestic producers to learn and become competitive.

(3) *If used, LCRs seem to allow for more technology transfer when it is attached to some form of adequate financial support to those incurring the costs.* The financial support to which LCRs are often attached is used to offset the increased costs imposed by the need to purchase locally. Policies that condition financial benefits upon LCR compliance can, under certain conditions (market potential, investor certainty, etc.), be effective in transferring technology from first-movers to local industries. For example, China, India and Ontario have attached similar conditions to their LCRs, which have successfully retained the attention of investors. However, because they serve as a condition for the entire financial support, rather than 'just' for a bonus, foreign investors generally tend to favour this type of conditionality less. This may lead them more easily to push their home countries to file a formal complaint at the WTO.

(4) *If used, LCRs work better when there is still a high learning-by-doing potential.* If creating global leaders with high innovative capacities is the objective, then it is logical that LCRs that target established and mature technologies will not contribute much. If deployment is the objective, LCRs in mature sectors will push up prices and might even be a barrier to deployment. For example, the LCR in Brazil was mainly meant to encourage the steel sector, and seems to have no medium-term value in wind energy technology development. An LCR can be overly manufacturing-focused, while neglecting the downstream sector. To avoid this, LCR legislation should carefully choose and set out detailed qualifying percentages associated with specific components or activities in which the jurisdiction realistically aims to create a global leader.

(5) *The use of LCRs is likely prohibited by WTO law.* Support schemes that have LCRs attached are especially likely be ruled illegal under WTO law. GATT Article XX is unlikely to be able to justify their use. Public procurement tenders, however, are hardly disciplined by WTO law. It might be permissible for WTO Members to include LCRs as a requirement in tenders, and even to give an important score to them.

These are only a few basic conditions for LCRs to potentially create value in national economies. Merging LCRs and innovative ambition is, logically, even more complex. A sixth condition that has been pointed to is the importance of abandoning LCRs and the financial incentives to which they are attached in time, so that the adolescent companies are pushed to compete on the international market. Without this, there will be little push to innovate. The WTO may be a particularly useful forum or strawman to this effect. At the same time, innovation policies need to pay particular attention to verifying product quality. We observed that some global innovators (like Vestas) have come under pressure because they are outcompeted by cheaper but lower-quality material from jurisdictions (like China) that are experiencing growth pains (e.g. consolidation) in the aftermath of phasing out LCRs.

In sum, there are many avenues for governments to "make bad policies". It should be noted that these basic conditions are built upon the assumption that LCRs only target infant industries, and do not protect mature industries. If this were the case and all states applied LCRs, then it is easy to see there would be no competition and hence no innovation.

Despite protectionist and inefficiency concerns, as well as legal impermissibility, many WTO Members use LCRs based on

political motivations. The world needs more RE and more innovation in RE technologies, but these require a lot of public support, which is costly to the taxpayer. To be able to implement such costly policies, governments seem to be trying to localize as many benefits as possible. This is certainly relevant when public financing is limited, as is now the case in many austerity-driven countries, which is why it is essential to integrate this argument into the debate on LCRs. While LCR policies have inefficiencies and can lead to reduced deployment, it is a valid concern whether governments would actually provide expensive financing programs that primarily benefit green businesses from other countries. This is what could be called the finance-content deadlock: no public finance without local content benefits.

The finance-content deadlock and the legitimate fear of highly inefficient open-ended LCRs show the need for international political coordination of national green industrial support strategies. This is especially so in light of the current stalemate in both the international climate negotiations and the Doha development round. In terms of the development-innovation capacity of content requirements, specific difficulties faced by resource-rich but economically poor nations should be included in the debate. In spite of many empty arguments concerning the availability of renewable resources and the potential developing countries to create renewable industries, poor countries simply do not have the financing capacity to make LCRs work or the potential to have FITs, the costs of which are covered by electricity ratepayers.

Regional strategies, therefore, may be able to increase the developmental and innovation potential if LCRs are used. Nevertheless, even without the use of LCRs, regional cooperation may be an alternative to reap local benefits from RE development. Regional initiatives may hold particular value when members are relatively small jurisdictions, the market size of which could have a negative impact on the local economy if LCRs were to be used. In this light, we support the work currently being undertaken on the potential of a Sustainable Energy Trade Agreement. Such an international agreement can only reduce costs for RE support in individual countries by coordinating policies and measures that take into account socio-economic ambitions and climate concerns. One example related to LCRs could be to require reporting, which could help further the economic analysis of LCR benefits and costs for specific technologies.

Finally, as already emphasized at the beginning of this paper, further research is required to support a meaningful debate on this pressing issue. As indicated, to date there has been relatively little empirical analysis of the potential of LCRs being used in conjuncture with the creation of globally competitive innovators. This is especially the case for LCRs in RE policy. Econometric modelling of LCRs for RE growth is particularly needed. It is certain that many countries use LCRs in RE policies and that these schemes are often contradictory to WTO law. However, it is in the interest of neither the trade community, nor the green tech community, to have the necessary debate before the WTO Dispute Settlement System. Instead, there should be informed debate about what is effective, and what is agreed as appropriate, in the support of critically necessary green technology development.

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