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Discussion Paper
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Green Energy and Low Carbon Development Strategy: A Possible New Future Area of Cross-Straits Co-operation?

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1. Low(er) Carbon Development: A Common Cross-Strait Challenge

There is growing acknowledgement on both sides of the Taiwan Straits that the respective techno-industrial paradigms that have delivered high rates of material-based prosperity improvement over the last few decades are ultimately unsustainable, both economically and environmentally. East Asia's economic development generally, driven essentially by rapid industrialisation, remains an energy-intensive process and conventional energy fuels are fast depleting, with the long-term prospect of continually rising prices for fossil fuels, especially oil. The environmental, health and welfare damaging effects of fossil fuel emissions are being particularly felt in mainland China, the country's structural dependence on coal for electricity generation exacerbating the situation. With nuclear now looking a less certain long-term option for lower carbon energy provision after the 2011 Fukushima disaster, both mainland China and Taiwan are looking increasingly to renewable energy and green energy solutions. In this paper, we look at the recent development of their renewable / green energy policies, how these fit into broader low carbon development strategies, and what might be the prospects for Cross-Straits green energy co-operation.

2. Recent Developments in Renewable and Green Energy

The renewable energy industry comprises a number of sectors. By far the largest and most established is the hydroelectric sector, which has been commercially operative for decades and accounts for around 80-85 percent of global electricity generation from renewables. Fast growth and increasingly competitive sectors are wind, solar photovoltaic (PV) and biomass. The geothermal sector has huge potential but its development is comparatively static, while the ocean energy technologies of tidal and wave power are still in the experimental stage with very few commercially operative plants worldwide.

Over 2005 to 2011, worldwide renewable energy power capacity increased from 931 gigawatts (GW) to 1,360GW, equating to 25 percent of total global power-generating capacity (estimated at 5,360GW in 2011) and 20.3 percent of total world electricity generation. From 2008 to 2011, renewables also accounted for half of all investment in new energy generation capacity worldwide (REN21 2006, 2012). Solar PV has been the fastest growing sector with an annual average growth rate of around 45 percent over 2005 to 2011, and total installed capacity stood at 70GW by 2011: in this year alone capacity increased by 74 percent. The wind energy sector has meanwhile grown at 28 percent annually during the same period and its installed capacity was 238GW by end of 2011, over three times that of solar PV. Both solar PV and wind energy are now mainstream mass-production

scale industries that are prioritised for development in the industrial policies of mainland China and Taiwan.

China has recently emerged as the world's largest producer of renewable energy (including non-hydro), overtaking the United States in 2009/2010. It dominates the East Asia renewables landscape in terms of installed capacity, accounting for example of almost 95 percent of the region's wind energy produced electricity. Six of the world's top 10 solar PV manufacturers are Chinese, and four of the world's top 10 wind turbine producers are also from mainland China. Taiwanese firms are at the technological forefront of the solar PV industry in particular, exploiting their economies of scope competences in electronics applied to this renewable sector, as well as other green energy areas such as fuel cell and energy efficiency / saving technologies.

3. China's Renewable and Green Energy Policies

3.1 Renewable Energy in China: An Overview

As East Asia's largest country by some distance, it is not surprising that China has more renewable energy resource potential than any other in the region. The pressures upon China to develop a robust and expanding renewable energy sector are also greater than for any other East Asian country. Furthermore, both the regional and global 'public good' benefits of China achieving this goal are enormous. China is the world's biggest polluter and largest contributor to climate change in absolute terms. Environmental degradation is apparent in the country's land, air, atmosphere and water resources, this being primarily caused by fossil fuel energy usage and other industrial waste discharges. Industry accounted for 72 percent of China's energy consumption in 2010, the second largest being urban residential users (Mastny 2010). Huge areas of the country have succumb to desertification, and almost 40 percent of the land had suffered from soil erosion by the early 2000s (World Bank 2001; World Bank / China State Environmental Protection Administration 2007). Urbanisation is now over 50 percent, up from just 19 percent in 1980, and set to steadily rise higher. Of the world's 20 most polluted cities, 13 are in China, most pollution produced by the country's 30,000 coal fired power stations (Worldwatch Institute 2006). In Beijing, up to 80 percent of all cancer deaths were reportedly due to pollution-related causes by the mid-2000s.[1]

1 Der Spiegel, 3rd July 2005, 'The Chinese Miracle Will End Soon: Interview with China's Deputy Minister of the Environment, http://www.spiegel.de/international/spiegel/0,1518,345694,00.html

China has developed critical mass level installed capacity across more renewable energy sectors than any other East Asian nation: wind, solar, hydroelectric (large and small), geothermal and biomass/bioenergy. Hydroelectric accounted for over 80 percent of renewable energy's share of electricity generation in China in 2011, this being comparable to the global norm. Wind energy was placed second with 17.0 percent and biomass third with 1.5 percent (REN21 2012). In 2010 alone, China's investments in clean energy amounted to US$54.4 billion, a 39 percent increase on the previous year. Germany (US$41.2 billion) and the United States (US$34.0 billion) were ranked second and third respectively (Pew Charitable Trusts 2011). By the end of 2010, China had become the world's largest producer of wind turbines, solar PV and thermal modules, biomass installations, hydroelectric plants and electric cars (Delman and Odgaard 2011).

However, while China's renewable energy sector generally has grown faster than any other East Asian nation this has been just one element of a broader rapid expansion of the country's energy sector generally. For example, over the 12th FYP period (2011-2015), the Chinese government expects the number of coal-fired power stations to increase by 33 percent, a growth in capacity equivalent to the total current EU capacity in this sector. Also, from one perspective, China's investment in RE sectors does not fare well by international comparison: despite the huge increase in absolute terms, renewables accounted for only around 26 percent of China's new additional installed power capacity in 2010, comparing to approximately 5o percent globally (Delman and Odgaard 2011, REN21 2011). The contribution made by renewables to China's total energy consumption has not risen that significantly. Aggregating renewable energy together with nuclear (for reasons later explained) in non-fossil fuels, the share of this category increased from 4.0 percent in 1980 to 8.3 percent by 2010.

The Chinese government has prioritised renewables both as an energy sector and industry for development in its strategic plans for two main reasons. First, China faces serious energy security challenges. The continued burgeoning industrial-based development of the economy and rising material demand levels of business and society have created expanding energy demand pressures on the country's own energy sources and foreign energy supplies. China is now consequently one of the world's major importers of fossil fuels. The aforementioned pollution levels in its cities caused largely by energy emissions are reaching dangerous levels, thought to be killing tens of thousands of people each year (Worldwatch Institute 2006). Developing renewable energy capacities thus help address China's energy security supply risk and environmental risk predicaments. Second, renewable energy sectors such as solar and wind are viewed as strategically important industries by the Chinese government, forming part of its push to make the country a more innovation-based economy, as is later discussed (APCO Worldwide 2010, CCICED 2010, Wang and Watson 2009).

3.2 China's Renewable Energy Policy Agencies and Stakeholders

As often arises in large state entities, where multiple competing interests tend to exist, China's energy policy was for some years pulled in many opposing directions due to the varying agendas and objectives of energy-related state agencies (Herberg 2009, Xu 2007). This was despite the creation of two centralised organisations – the National Energy Bureau (NEB) established in 2003 and the National Energy Administration (NEA) department in 2008, both within the National Development and Reform Commission (NDRC) – that were supposed to co-ordinate Chinese energy policy overall. These bodies had been vested with limited authority and resources to exercise meaningful control. In acknowledgement of growing co-ordination problems, the Chinese government set up a new National Energy Commission (NEC) in 2010 under the leadership of Premier Wen Jiabao, and whose membership comprises ministers from the NRDC, Ministry of Finance, Ministry of Foreign Affairs, Ministry of State Security and the People's Liberation Army. The NEC is responsible for national energy development strategy and strategic oversight generally, energy security reviews, co-ordinating on major energy issues, international co-operation on energy affairs, and therefore on all such matters concerning China's renewable energy policy. It is complemented by the still operational NEA which is responsible for the NEC's more day-to-day policy co-ordination and executive tasks, as well as performs certain analytical functions on renewable energy matters.

After the 2002 reform of the energy market, two state-owned grid companies now monopolise China's electricity generation grid system, the State Power Corporation of China and the China Southern Power Grid, which are responsible for power transmission. In addition, there are five large power generation companies (China Guodian Corporation, China Huaneng Group, China Datang Corporation, Huadian Corporation, and China Power Investment Corporation). The State-owned Assets Supervision and Administration Commission (SASAC), an agency under the State Council's purview, exercises central government representation across these companies with local government representation also exercised. In addition, the State Electricity Regulatory Commission (SERC) regulates the electricity generation sector on behalf of the State Council, with regional branches across the country.

The National Development and Reform Commission (NDRC) is another key player in China's renewable energy policy-making given its central role in formulating FYPs and development policies generally. As noted above, the NEA is located in the NDRC, which has also set up a China Renewable Energy Development Centre. The Ministry of Commerce (MOFCOM), Ministry of Foreign Affairs (MOFA), Ministry of Finance (MOF), Ministry of Water Resources (MWR, e.g. involved in the country's hydroelectric sector), Ministry of Science and Technology (MOST), Ministry of National Land and Resources

(MNLR), and Ministry of Environmental Protection (MEP) are other relevant state agencies involved in renewable policy-making. There are also a number of quasi-state and non-state agencies in China with stakeholder interests in renewable energy policy. The Energy Research Institute of the NDRC is the country's main think tank on energy issues, providing policy-related analytical studies on RE issues. The Chinese Renewable Energy Industry Association (CREIA) is the nation's most important non-state organisation on renewables whose members comprise firms working in the sector. Sector-based groups include the Chinese Wind Energy Association (CWEA).

In addition, various networks on renewables exist, including the China Renewable Energy Information Network, China Renewable Energy Scale-Up Programme, China Sustainable Development Programme, and China New Energy Network. While China's RE associations and networks do lobby the government on policy issues, they are generally more preoccupied with strengthening business relationships amongst their memberships and fostering international co-operative ventures with foreign firms and governments.

3.3 The Evolution of China's Renewable Energy Policy

China's 5-Year Plans (FYPs) have provided the main framework and reference points that orientate the nation's energy policy-making (Herberg 2009), and thereby renewable energy policy. The FYPs have also been the principal mechanism through which the Chinese government have channelled the world's largest public investment programme in renewable energy. Aside from the development of hydroelectric dam plants from the 1950s onwards, it has only been recently that renewables have been afforded significant profile in these Plans. The first notable RE policy landmark was the 1996 Brightness Programme, located in the 9th FYP (1996-2000) and based on approximately US$1.2 billion public investment to install hydroelectric, solar PV and wind energy facilities in over 1,000 townships and villages in rural communities (approx 23 million people), with financial and technical assistance from the German and Netherlands governments (see Table 1). This was followed by a series of financial instrument / direct financial support measures introduced in the 10th FYP period (2001-2005), these being mainly tax breaks aimed at raising investment in RE consumption, production and installations. Table 1 shows that these were mainly aimed at the wind, bioenergy and solar sectors.

The 10th FYP proclaimed that production capacities in the wind, solar and geothermal energy sectors should be increased but did not set forth any specific development objectives or targets (NDRC 2001, NREL 2004). However, the Wind Power Concession Programme established in 2003 during the 10th FYP period introduced China's first feed-in-tariff (FiT) scheme and also

development targets on wind farm development, these being to create up 20 farms with between 100-200MW capacity and an NDRC set national target of reaching 20GW of wind energy capacity by 2020. It is clear, then, that from the earliest beginnings of China's renewable energy policy, wind energy was afforded strategic priority over other sectors. China opted for wind turbine technology partly because it related closely to the engineering science competences of Chinese enterprises and was relatively lower-tech that solar PV.

The use of renewables has also been a core element of the Chinese government's endeavours to extend electricity generation capacity into rural areas (REN21 2009a). The 1996 Brightness Programme was replaced by the Township Electrification Programme in 2001 as part of the 10th FYP. This in turn was superseded by the considerably more ambitious US$5 billion Village Electrification Programme in 2006 under the 11th FYP. The previous year in October 2005, the NDRC, MOST, MOF and MOFA jointly issued the Measures on the Operation and Management of Clean Development Mechanism (CDM) Projects, leading to the creation of China's CDM Executive Board that has managerial oversight in this area of RE policy (REN21 2009b, Zhao *et al* 2011). China accounts for around two-thirds of total CDM projects globally.

The introduction of the Renewable Energy Law (REL) in January 2006 – at the start of the 11th FYP – remains arguably the most important foundation of China's RE policy, providing a much firmer legal framework in which to foster renewable energy development. The REL's structure is based on five main regulations (NEB 2008):

- *Feed-in Law*: Article 14 requires energy grid companies (State Power Corporation of China and the China Southern Power Grid) to take up purchase of all electricity generated from renewable energy installations in accordance to government-guided prices.
- *Price categorisation mechanisms*: these varied depending on the RE technology. The wholesale price for wind energy is derived from bid prices determined through a state-managed tendering process, while for other RE sectors electricity prices are based on a 'fair rate of return' principle, this being generation cost per unit plus a reasonable return on capital quotient.
- *Cost sharing mechanisms*: Article 20 of the REL, though, allows the grid companies to pass on to electricity customers certain costs, such as initially connecting RE installations.
- *Special fund mechanisms*: Article 25 provides incentives for financial institutions to offer preferential loans to investors in renewables, while Article 26 covers tax benefits for RE projects. However, the NDRC and SERC have been reportedly slow to publish the administrative orders necessary to implement these measures.[2]

2 REEEP renewable energy policy database, http://www.reeep.org/index.php?id=9353&text=policy-database&special=viewitem&cid=14 (China 2010… 2012 update??).

- *Renewable energy policy targets*: national targets set for renewables overall and by sector (e.g. 30 large-scale wind farm of minimum 100MW capacity by 2010) as part of, and at the start of the 11th FYP (2006-2010). These were later refined and incorporated into China's Medium and Long-Term Development Plan for Renewable Energy and the National Climate Change Programme (see below).

The Law also established national standards for renewable energy technologies and production. While the implementation of the REL has been somewhat patchy in parts, it helped create a much stronger investment environment for renewable energy industries. The increase in the number of firms entering the wind energy sector after 2006 was particularly noteworthy, and investment levels in all RE sectors rose significantly after the Law's introduction (NEB 2008). The REL created the necessary legal framework to foster growth in China's renewable energy industry, and the Medium and Long-Term Development Plan for Renewable Energy, rolled out in September 2007, created the required strategic policy framework to complement it. The Plan, covering the 2007-2020 period and integrated into the 11th FYP, set out China's ambitious targets for renewable energy development and was backed up with government investment amounting to approximately US$263 billion. The main specific year 2020 targets were to increase hydroelectric installed capacity to 300GW, wind energy (30GW), biomass (30GW), solar (1.8GW), and 300 million m^2 of installed solar hot water heaters. Overall, it set a general target of increasing renewable energy's contribution towards non-fossil primary energy consumption to 10 percent by 2010 (not reached, only 8.4 percent achieved), 15% by 2020 (up from 7.5% achieved by 2005).[3] Due to the subsequent dramatic growth of China's wind and solar energy sectors, the 2007 plan targets for both later significantly revised upwards in 2010 from 30GW to 150GW by 2020 in wind's case, and from 1.8GW to 20GW in solar's.[4]

The REL and Medium and Long-Term Development Plan for Renewable Energy fed into another key policy development at this time, namely China's National Climate Change Programme (NCCP) that was introduced in July 2007. The NCCP aimed to reduce China's carbon emission levels per unit GDP through economic restructuring, energy efficiency improvement, vehicle emission standards, participation in international research, development and deployment (RD&D) programmes, promoting the development and utilisation of renewable energies, ecological restoration and protection, family planning, and other measures. Thus, by 2007 China's renewable energy policy had a stronger legal and strategic foundation for development, as was more firmly integrated into the

3 This more specifically set a mandatory market share target for electricity production from non-hydro renewables of 3 percent by 2020.

4 The target for solar power is unofficial and informal, to be confirmed.

country's broader development strategy and emerging environmental policy framework.

Further developments in China's renewable energy policy over the remainder of the 11th FYP term of 2006-2010 concentrated mainly on revisions and extensions to existing policy measures (Table 1). This includes changes to FiT schemes, strategic targets, and planning, funding and co-ordinating mechanisms. In 2008, the Shandong Provincial Government introduced its own local schemes on supporting renewable energy investment in rural areas and urban construction projects. At the national level, the 2009 Golden Sun Programme provided US$2.9 billion worth of investment subsidies for new solar PV installation projects of a minimum 300kw size capacity, as well as new preferential tariff rates in this sector. In terms of the RE sector's general development, the 11th FYP set the target that renewables should contribute to 10 percent of total energy consumption by 2010, and later on decided the renewable energy's share should rise to 15 percent by 2020. However, as the 2010 deadline approached, the Chinese government revised the energy category from renewables to non-fossil fuels, hence including nuclear power. Even with this adjustment, non-fossil fuel energy only reached the 8.3 percent mark by 2010 (Delman and Odgaard 2011).

The 12th FYP (2011-2015) provided the next important impetus to China's renewable policy. Managing China's increasingly acute energy security challenges have become an increasingly central theme of national strategic planning, and in the 12th FYP there is a stronger acknowledgement than before of the imperative to find low carbon solutions to the country's many development challenges (NDRC 2011). Subsequent revisions to these targets and plans made over the 11th FYP period have been carried into the 12th FYP, including a RMB4 trillion (US$610 billion) funded programme to promote seven Strategic Emerging Industries (SEIs) for 'clean' development and a new industry base, namely: new generation ICT, energy-saving and environment protection, new energy, biotechnology, high-end equipment, new materials and alternative energy cars. These are intended to form the new future backbone of the Chinese economy with the aim of increasing their GDP share from the current 5 percent to 8 percent by 2015 and 15 percent by 2020 (NDRC 2011). Renewables are specified as a key component of the 'new energy' SEI sector that in addition includes nuclear power (40GW additional capacity by 2015) and large hydro (50 percent increase in installed capacity by 2015). Under the SEI programme, China also plans to enhance its new technological and innovation capabilities in wind energy, solar PV, fuel cells and electric vehicles as part of a broader strategy of moving China from 'world factory' to a 'innovative hub' economy. Notwithstanding the persistent fixation with expanding installed generation capacity regarding renewables, there is also a clear indication in the current FYP that China intends also to develop over time a more technology-oriented renewable energy policy. China's CO2 emission reduction target of 40-45

percent per GDP unit by 2020 set in the 11th FYP and the National Climate Change Policy (NCCP) has been maintained, and the 12th FYP set the intermediate target of achieving a 17 percent reduction by 2015.

4. Taiwan's Renewable and Green Energy Policies

4.1 Renewable Energy in Taiwan: An Overview

Like its fellow Northeast Asian neighbours, Taiwan is heavily dependent on foreign energy supplies, importing 99.3 percent of its energy requirements by the 2010s. By this time it had become the world's 13th largest oil importer, seventh largest LNG importer, and fifth largest coal importer.[5] As with mainland China, the vast majority of these imported fuels are transported through the maritime security chokepoint straits of Southeast Asia, and mainly through the Malacca Straits. Renewables are similarly therefore a vital element in mitigating energy supply security risks. As one of the region's first generation 'tiger economies', it has also faced over time the environmental hazards and challenges that accompany rapid techno-industrial development. Taiwan has developed a particularly high dependence on coal, the most carbon-intensive fossil fuel, which accounts for a half of the island economy's power generation (BOE 2012). Only mainland China has higher coal dependence than Taiwan in the region. It is currently ranked as the world's 22nd largest carbon emission producer and contributes 1 percent of total global emissions (Huang and Wu 2011). Taiwan is itself highly susceptible to climate change risks, being prone to extreme weathers and rising sea-levels.

Although bereft of conventional energy fuels, Taiwan has significant renewable energy resources, on a per capita basis one of the highest in East Asia (Chen *et al* 2010a). Located in a subtropical zone, the island has considerable potential for solar power given angle of daylight deflection is small for the majority of the year cycle. The wind resources of the Taiwan Strait are sizable, very conducive to offshore wind farm development, and onshore wind field potential is also of a high quality. Taiwan is also situated at the juncture of the Eurasian Plate and Philippine Sea Plate, making for good prospects to develop geothermal energy. The island's high mountain terrain and historic abundant rainfall pattern offer considerable potential for hydroelectric development although extreme weather (droughts and storms) have recently impaired efficacy levels in this sector. Like other materially prosperous East Asian societies, Taiwan produces high per capita levels of biomass wastes that can be used for power generation. As an island, its potential to tap ocean energy resources is also considerable. Taiwan is also renowned for

5 Taiwan did once have its own fossil fuel resources but these are now virtually all depleted except for some small residual levels of natural gas. Coal production ceased in 2001.

having a strong techno-entrepreneurial culture and impressive industrial competences in key fields underpinning the development of many renewable energy sectors, such as electronics, engineering, material sciences, fuel cells and aerospace.

However, Taiwan has only just begun to exploit its huge renewable energy potential. In 2010, renewables only accounted for 3.5 percent of total electricity generation, hydroelectric providing 2.9 percent, wind 0.4 percent, biomass (0.2 percent) and solar PV 0.01 percent (BOE 2012). This total figure would be much higher if Taiwan's hydroelectric dams were operating at efficiency levels they used to enjoy a decade or two ago. In the 1990s, hydroelectric contributed between 5.3 percent to 9.1 percent of the island's power generation with much lower installed capacity levels but that still produced 50 percent higher power output in 1990 compared to 2010[6] (BOE 2012). The increased frequency of extreme weather conditions is partly to blame, for example high intensity rainfall that causes serious storm damage deposit problems that take time to resolve, and low frequency rainfall at other times that reduces load capacity levels. Taiwan's wind energy capacity has gradually increased from 188MW in 2006 to 564MW by 2011. In 2010, its solar PV capacity stood at 50MW and many Taiwanese firms have become major manufacturers in this sector, such as Motech and Gintech. The Solar City project in Tainan County located in the south of the island aims to deliver solar PV power to 12,000 households by 2014. Taiwan is currently ranked fifth globally in the solar water heater sector, having installations on 7 percent (520,000 households) of residential buildings producing 142 million litres oil equivalent. Biomass power had meanwhile reached 799MW installed, this mostly comprising municipal solid waste incineration (622MW, 25 plants) but also waste from industries and agriculture (168MW) and biogas (9MW).

4.2 Taiwan's Renewable Energy Policy Agencies and Stakeholders

Created in 2004, the Bureau of Energy (BOE) located in the Ministry of Economic Affairs (MOEA) is Taiwan's main state agency responsible for renewable energy policy and sector development. Its antecedent, the Energy Commission (also located in the MOEA), was established in 1979 as Taipei began to build a more comprehensive energy policy in the 1970s. The Council for Economic Planning and Development (CEPD) is the Taiwan state's principal agency for strategic economic planning and often is involved in energy policy planning matters. Meanwhile, the Industrial Development Bureau (IDB) is specifically involved in the industrial policy aspects of energy sector development, and the Industrial

6 In 1990, Taiwan's conventional hydroelectric installed capacity was 2,562MW, which produced 610 million litres of oil equivalent (mloe). In 2010, its capacity level was rated at 4,579MW but which only produced 401 mloe.

Technology Research Institute (ITRI) and the National Science Council contribute to energy science and technology policy-making.

4.3 The Evolution of Taiwan's Renewable Energy Policy

In the East Asia regional context, Taiwan has been a relative latecomer in developing many aspects of a substantive renewable energy policy. Although we can date its first RE-specific policy measures back to the early 1980s (wind and geothermal prototype equipment R&D support), most studies reference the start of Taiwan's RE policy to more substantive measures arising from the 1998 First National Energy Conference (Chen *et al* 2010a, 2010b; Huang and Wu 2008, 2011; Hwang 2010; Liou 2010, 2011; Wu and Huang 2006). The Conference, held primarily in response to the Kyoto Protocol, signalled the government's priority it intended to afford to renewable energy development, new policy measures in the planning process, and set a target for renewables to account for 3 percent of total energy consumption by 2020.

Over the early 2000s, and leading up to the Second National Energy Conference convened in 2005, the Taiwanese government introduced a series of sector-specific focused measures of mostly a direct financial support nature (subsidies and tax incentives) under the broader Statute for Upgrading Industries framework aimed at promoting R&D activity, demonstration projects and installation deployment (Table 2)[7]. Targeted sectors comprised wind, solar PV, solar thermal, biomass waste, biogas and geothermal. A Renewable Energy Promotion Plan (REPP) was launched in 2002 to try to bring greater coherence to Taiwan's emerging renewable energy policy framework. Of the Plan's eight key elements arguably the most important were the intention of the government to establish a feed-in tariff scheme and legislate a comprehensive Renewable Energy Development Act (REDA). The FiT scheme was established a year later in 2003 with the Ministry of Economic Affairs with in unison with the Taiwan Electricity Company (TEC) based on a tariff rate of NT$2 p/kW and an upper limit of 600MW on total RE power capacity, excluding waste incinerators and hydropower systems generating above 20MW. However, the scheme was largely unsuccessful because the tariff was too low to attract widespread investment (Liou 2010). Meanwhile, target-setting on RE sector development were revised in 2003 and then again in 2005, at the Second National Energy Conference. Later revisions were made in 2009 and 2011, making five phases of target-setting in total from 1998: no other East Asian government has revised their renewable energy targets as often as Taiwan.

7 Renewable energy was discussed in other related 'national conference' processes, such as the Sixth National Science and Technology Conference (2001), the National Nuclear-Free Homeland Conference (2003), the Second National Energy Conference (2005), and the National Conference on Sustainable Development in 2006 (Hwang 2010).

After seven years of first being proposed – and mostly delayed due to the opposing positions of the major political parties over nuclear power – the landmark Renewable Energy Development Act (REDA) was finally passed in Taiwan's legislative Yuan in 2009. This was a comprehensive general policy framework with multiple key elements spread over 23 constituent articles, and had broad stated aims of reducing CO2 emissions, improving energy diversification, reduce environmental pollution, enhance sustainable development and promoting green energy industries (Huang and Wu 2011). REDA contained upward revised targets of 8 percent electricity generation by 2025 and reaching RE installed capacity between 6.5GW and 10.0GW by 2030, and a completely revamped FiT scheme. Regulations that had hitherto limited land use and independent power facility deployment for renewables were streamlined or removed. Public construction projects were obligated to greater use of RE technologies. New financial incentives and direct financial support measures were introduced to promote demonstration projects on ocean and offshore wind energy, as well as a new subsidy mechanism to support solar thermal and biofuel development financed through the Petroleum Fund and Agricultural Development Fund. In addition, a new Renewable Energy Development Foundation was created, funded primarily by the Taiwan Power Company, but also other fossil fuel and nuclear power utility enterprises exceeding 300MW capacity, to support research and promotion activities on renewables. Finally, local utility companies were now obligated to extend interconnection services to RE producers and sign power purchase agreements with them (Chen *et al* 2010b, Hwang 2010, Liou 2010).

While REDA may appear in many respects to be one of the most comprehensive legislative acts passed on renewable energy in East Asia, according to Liou (2010) it has notable gaps and weaknesses, especially when compared to similar legislation in force in other countries in terms of level of financial support, regulatory clarity, strength of market mechanisms, enforceable standards and the extent to which REDA improved upon existing laws and measures. Liou has too been critical of Taiwan's comparatively low level of R&D policy support when compared to similar developed economies such as South Korea.

In 2010, a National Energy Plan was rolled out by the National Science Council, and the research focus for this plan was to develop technology needed to conduct wind energy assessments, develop small and mid-sized key components needed to exploit wind power, to establish a national testing and authentication platform and develop engineering and marine technology needed to build offshore wind power turbines (Liou 2011). This was then augmented by the New Energy Policy in November 2011 with the following targets for renewables:

- Total installed capacity of 9,952MW (14.8% of total installed capacity) by 2025 planned based on new installed capacity of 6,600MW, thus bringing forward earlier set target in 2009 under REDA by 5 years

- By 2030, total renewable installed capacity of 12,502MW (16.1% of total) capable of 35.6 billion kWh electricity generation, equivalent to annual electricity consumptions of 8.9 million households, or 78% of total.
- '1,000 on-and off-shore wind turbines' project (onshore wind farms developed first, followed by exploration of offshore) with target of increasing wind energy installed capacity to 4,200MW by 2030
- 'Million Solar Roofs' project with target of increasing solar PV installed capacity to 3,100MW by 2030
- Smaller scale plans for bioenergy, hydroelectric, geothermal and ocean energy.

A year before in 2009, the Taiwan government brought together various strands of industrial policy (e.g. the 2005 Renewable Energy Equipment Industry Developing Plan, the 2006 Green Industry Plan, and the 2008 New Energy Industry Flagship Plan) to form the 'Green Energy Industry Sunrise Plan' (Chen 2009, Lee and Shih 2011). This new Plan was based on two broad sectoral foundations. The first is the already well established 'twin-pillar industries' of solar PV and LED lighting technology, where Taiwan enjoys considerable competitive advantage in world markets. The second concerns the lesser established 'five potential growth industries' of wind energy, bioenergy, hydrogen and fuel cells, energy information and communication technology (EICT), and electric vehicles. Hydroelectric, geothermal and ocean energy are covered under the Plan's clean energy development component. It aspires to harness five driving forces behind green energy development, namely: technology breakthrough, critical investment, conducive environment (which includes helping Taiwanese firms reach green industry and technology standards through R&D support), export market expansion, and domestic market growth. The government also set a target for increasing Taiwan's green energy sector production value over six-fold, from NT$179 billion in 2009 to NT$1,158 billion by 2015. The Plan can be seen as complementary to REDA, further promoting renewables as part of a broader green industrial policy that in turn was constituent to the international trend of 'new green deals' arising in response to the 2008/09 global financial crisis.

5. Green Energy and Low Carbon Development Strategies: East Asia's 'New Developmentalism'?

Mainland China and Taiwan's promotion of their respective renewable and green energy sectors are part of a wider trend in East Asia, this being the emergence of a more defined 'clean industrial policy' approach that is closely linked to evolving and reinvigorated forms of state capacity in the region: what may be termed a 'new developmentalism' (Dent 2012). This is evident in China's 12th FYP as earlier discussed, and in Taiwan's 'Green Energy Industry Sunrise Plan'. Other

examples of East Asia's low carbon development strategies include Japan's 'New Growth Strategy', Singapore's 'Sustainable Singapore Blueprint' and South Korea's 'Green Growth Strategy'. The introduction of strategic master plans specifically for renewables and their programmatic integration with broader macro-development and other strategic plans has been a generally unique feature of East Asia's approach to promoting renewable energy and green energy sector development generally. Yet, while the transformative goal of low carbon development forms a key element of East Asia's new developmentalism, this is not the only main objective, and its associated macro-development plans may furthermore involve the simultaneous promotion of high carbon industrial activities, including conventional fossil fuel based sectors. Such apparent contradictions are likely to persist for some time given the structural dependencies of East Asian economies on high carbon intensive industries for delivering material growth and prosperity, and that, like most others around the world, East Asian states have only just embarked on the very long transition to meaningful low carbon development, a process that most expect to take many decades if indeed it is to be achieved.

Furthermore, East Asia's new developmentalism has tended generally to afford primacy to economistic objectives rather than environmentalism, to economic growth (or 'old developmentalism') rather than sustainable development *per se*. For example, the expansion of physical infrastructures, export-oriented manufacturing, and an emphasis on state direct financial support remain defining characteristics of China's 12th FYP, while its promotion of higher levels of domestic consumption somewhat contradict the plan's low carbon objectives. It should too be noted that in the 11th FYP, the increase in coal-fired power station capacity was greater than that for wind energy, although the current 2011-2015 plan has the target for reducing the nation's electricity generation dependence on coal from the present 70 percent to 62 percent. Meanwhile, conventional energy and chemicals are amongst the 20 strategic areas that comprise the Singapore Economic Development Board's industrial master-plan, which includes the further expansion of the city-state's already huge petrochemical complex and the construction of a large new liquefied natural gas terminal. In South Korea, the Green Growth Strategy must simultaneously contend with parallel industrial policy objectives for upgrading the traditional 'flagship industries', including the energy-intensive sectors of shipbuilding and steel.

More generally, East Asia's national energy strategies and systems are still heavily dependent on securing fossil fuel resources. This is indicative of the broader problem of how many of East Asia's core industrial structures, policies and practices remain high carbon development geared. In Indonesia, for instance, the continued heavy subsidisation of fossil fuel prices make it difficult for the nation's geothermal sector to seriously compete in the electricity generation

market. Furthermore, many countries persist with old industrial policies involving mass-scale ecological damage (e.g. Indonesia and Malaysia's palm oil industries) whilst rolling out low carbon development strategies (Gunningham 2011). Despite the March/April 2011 Fukushima disaster, many East Asian countries may still maintain their ambitious plans on nuclear power sector development, and moreover include nuclear under the policy rubric of 'green' or 'clean' energy. While the inclusion of nuclear power in low carbon strategies may be defensible, it remains highly contentious given the very serious environmental risks associated with the by-products of nuclear fission. East Asia's 'modernist' industrialised development is likely to remain entrenched for some considerable time given the enormity of the structural change required to establish the broad foundations of low carbon development.

East Asia's developing countries especially face difficult challenges moving toward low carbon development given both the high proportionate GDP costs of replacing old or rudimentary equipment and infrastructure, and their relative lack of indigenous technological and innovatory capacity. Furthermore, there are domestic political pressures to meet more immediate socio-economic needs (e.g. poverty alleviation, provision of basic welfare and utility services) than to prioritise environmental-related goals. This being said, socio-economic and environmental problems are increasingly conflating in developing country regions. Many of East Asia's major cities (most notably China's, as discussed earlier) are subject to acute levels of pollution, causing chronic health problems on a mass scale and palpably deteriorating societal welfare. Across the region, there has been mounting civil unrest regarding pollution and a growing acknowledgement of problems caused by pursuing economic growth whatever the costs.

In sum, East Asia's 'new developmentalism' may not yet mark a clear departure from the economic modernisation oriented policies of the past, and it is perhaps better considered an intermediate concept through which *relatively lower* carbon development can be achieved over the medium-term. Moreover, achieving low carbon development requires deep social transformations, especially changing people's mindsets towards creating sustainable energy futures and a green energy society that cannot be realised solely through a top-down policy process.

6. Renewable and Green Energy: Prospects for Future Cross-Straits Co-operation?

Notwithstanding the problems that lie ahead for the future development of renewable and green energy sectors in mainland China and Taiwan, it is an area of considerable potential and significance in further augmenting Cross-Straits relations. Both sides face very similar and considerable energy security and environmental security challenges. Their dependency ratios on foreign energy

supplies are high by international comparison, and even though we may be entering a so called 'golden age of gas' based on the unconventional gas revolution there is generally intensified competition worldwide for increasingly scarce and ultimately finite fossil fuels. Renewable energy offers the only viable long-term 'silver bullet' combination of being inherently indigenous energy sources that are potentially unlimited in supply. Both mainland China and Taiwan have sizable renewable energy resources when calculated on a per capita basis, much to learn from each other in terms of renewable / green energy policy-making (this being still a relatively formative field for most governments), and even more to gain from fostering multiple-level co-operation in this area.

As yet, the extent to which energy affairs generally are discussed in Cross-Strait diplomacy is uncertain, something which the author plans to investigate in future research. Business co-operation between Taiwanese and mainland Chinese firms in sectors such as solar PV, wind energy, electric vehicles and fuel cells is growing although this may be more based on production network arrangements rather than technology development collaboration. General areas of Cross-Strait co-operation on renewable and green energy could include the following:

- *General renewable / green energy policy-making*: approaches, instruments, strategic planning, inter-agency co-ordination, legislation, infrastructure issues, e.g. grid connectivity and utilisation
- *Eco-cities or zones*: sharing of ideas and 'best practice' regarding the deployment of renewables / green energy technologies in eco-city and zone development.
- *Science and technology co-operation*: between business, research institutes, etc.
- *Low carbon development strategies*: sharing of ideas in this area too, linked to climate change strategy and diplomacy.
- *Broader international endeavours on renewable / green energy development*: working together to support the work of key agencies such as the recently established International Renewable Energy Agency (IRENA) and the REN21 policy network.

The deepening economic linkages between mainland China and Taiwan will only make it more imperative for Cross-Strait relations to focus increasingly on energy-related matters generally, which over time will inevitably become more concerned with renewable / green energy issues given the likely path ahead of global energy security challenges.

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