

# Addressing Asia's New Green Jobs Challenge

## **EXECUTIVE SUMMARY**

The current global economic crisis has led to millions of job losses and likely will lead to more. As businesses and industries restructure, many of these jobs will not be recovered. At the same time, the world's top scientists are sounding warnings about urgent environmental concerns, including climate change and limited natural resources to produce energy and provide for the world's growing population. Amid these twin crises, governments and businesses around the world are realizing that future economic growth depends on producing less carbon and more jobs. The announced economic stimulus plans of China, Japan, and Korea contain green initiatives that could potentially generate more than a million green jobs in the next few years. These initiatives promise to improve real incomes and workers' quality of life around the world. In the past, Asia has succeeded in creating jobs in carbon-intensive manufacturing industries as well as offshore services industries, tapping into a vast supply of low-cost labor. What conditions does Asia need to create green jobs for the future, and how well are Asian economies doing on these conditions?

New research by the Asia Business Council provides a preliminary assessment through the creation of a "green jobs index," which measures current green employment needs, the market potential of various green industry segments, labor availability for green jobs, and government commitments to green job policies in various Asian economies.

Index results suggest that China possesses the most favorable conditions overall for green job creation, followed by Japan and India, whereas other economies can build on potential in specific areas. Economies should address specific deficiencies that hinder green job development by identifying business opportunities, improving workforce capability, and implementing coherent government policies to foster green job growth.

## **JOB CRISIS IN ASIA**

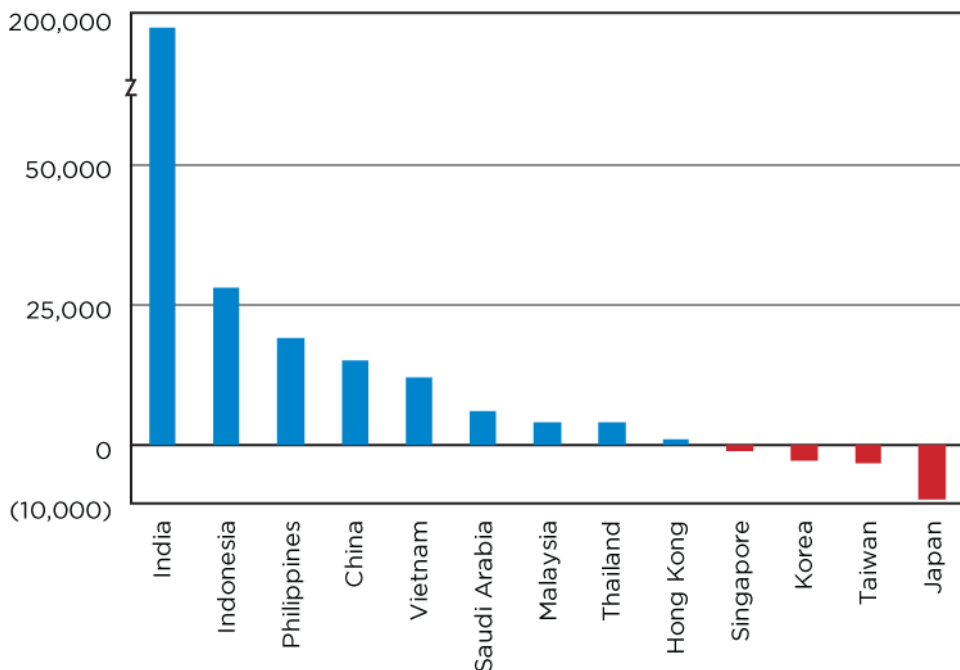
The current global financial crisis has become a global job crisis. The International Labour Organization (ILO) projects a scenario of 100 million total unemployed people in Asia and the Pacific in 2009, up from 80 million when job losses began in 2007.<sup>1</sup>

Tens of thousands of financial and professional services jobs in Asia have already been lost as a result of the global financial crisis; the estimates of losses of an even greater magnitude come as a result of the region's real economy slowing down, hitting non-financial industries. Some of these job losses are cyclical and may be recovered when the effects of government stimulus plans kick in and the global economy stabilizes. However, the financial industry will likely undergo fundamental restructuring, making some of the current white-collar financial and professional services industry jobs obsolete. In addition, as consumption-oriented economies like the United States resolve to fix their structural trade deficits and if protectionist sentiments increase, trade-oriented sectors in Asia may shrink, reducing jobs for migrant workers and blue-collar manufacturing workers. Massive numbers of jobs will need to be created in Asia to employ these excess migrant workers, blue-collar workers, and white-collar professionals, as well as a growing supply of new graduates.

Future demographics will present further challenges. The world's working age population will grow from 4.5 billion in 2010 to 5.2 billion in 2025. Based on current projected demographic trends, Asia will be home to 300 million of these 700 million additional workers.<sup>2</sup> Demographic structures in Asian economies vary, presenting different labor challenges. On the one hand, Japan, Taiwan, Korea, and Singapore already face an aging population pyramid and will see an absolute decline in working age populations by 2025. These economies will become relatively "labor-poor" over time. On the other hand, developing economies including India, Indonesia, the Philippines, Vietnam, Saudi Arabia, and Malaysia will have a large labor force in the future, making them relatively "labor-rich" (see Exhibit 1). China, Thailand, and Hong Kong, while making modest gains in working age population, will face an aging population in the same period, which means a larger dependency ratio. In that sense, they are more "labor-poor" than "labor-rich." For "labor-rich" economies, the main challenge will be to develop productive industries to employ the excess workers, to foster real income gains. For "labor-poor" economies, the main challenge will be to employ workers in higher value-added jobs in order to ease growing dependency burdens, as well as find workers with the right skills for new, technology-driven industries.

**EXHIBIT 1: LABOR-RICH VS. LABOR-POOR ECONOMIES**

Change in working population (aged 15-64) from 2010 to 2025, thousands (medium variant scenario)



Sources: World Population Prospects, United Nations Population Division; ABC analysis

Although Asian economies have achieved high output and productivity growth in recent years, corresponding employment growth has slowed. Over the past decade, service-sector-driven economies in developed Asia, including Japan, Hong Kong, and Singapore, have seen manufacturing sector employment decline. More surprisingly, in emerging economies including China, Malaysia, the Philippines, Indonesia, and India, the number of jobs has also declined or stagnated.<sup>3</sup> Despite the growing workforce availability, manufacturing jobs have been lost in Asia in part as a result of automation and other technological advances. For instance, in China, a 3% growth rate of output was needed to induce a 1% increase in employment in the 1980s. In the 1990s, a growth rate of almost 8% was needed to achieve the same result.<sup>4</sup> Although it reflects dramatic increases in productivity and fosters income and wealth gains, these vastly more productive societies need to find new jobs for their workforces.

**GREEN JOBS: A NEW WAY FORWARD**

Asia’s manufacturing industries will almost certainly undergo dramatic changes, as increasingly stringent limits are put on global greenhouse gas emissions. Some capital- and carbon-intensive industries have already been going through structural changes. Employment in China’s mining industry fell from 9 million in 1996 to 5.6 million in 2006, a 38% decrease.<sup>5</sup> The average age of oil

industry professionals is 50, and three-quarters of them are over 40. Employment in the oil and gas and oil refining industry has been in steady decline since the mid-1990s. China has shed about 250,000 jobs in this sector over the past decade.<sup>6</sup> Japan's steel industry employment fell from 305,000 in 1990 to 197,000 in 2000, and Korea's from 67,000 to 57,000.

Future growth industries will likely be led by "green" industries, those that contribute to global carbon reduction. The urgency of climate change means that the timeline to reverse harmful consequences of a high-carbon global economy is shrinking. A new climate deal in the form of the Copenhagen protocol, to be created in December 2009, will include developing economies. Many Asian economies will likely have to commit to carbon reduction targets. Although they have not been significant contributors to carbon emissions in the past, they will be key determinants and home to affected populations in the future. The environmental standards and regulations that European governments have long implemented and the promise of the new administration in the United States to create stricter and more comprehensive environmental regulations will raise the bar for governments around the world.

These stricter international standards will likely pose more pressure for Asia to continue its development path with growth industries that are less carbon-intensive. Some of these will be labor-intensive, such as retrofitting buildings with energy-saving solutions such as solar water heaters, insulation, and better lighting controls. Some of the opportunities will be more technology-intensive, as Asia has significant strengths in many areas relating to greater energy efficiency, such as China's large solar industry and Japan's technologically advanced building controls industry. Asia also has a large market that can be jump-started with good government policies. Building energy efficiency is an obvious example, tapping into the vast pool of current and future workers in the region and closing the gap between available workers and available jobs.

Particularly for labor-rich economies, more jobs at home would drive domestic income gains by reducing the pressure to migrate or work abroad. In addition, the jobs generated at home, if they are in innovative green industries, can create decent and higher value-added work for populations. This is better for overall economic gains, as well as for a host of other social and political reasons.

The previous global "war for talent," which started in the 1990s and was at its fiercest during the IT and BPO offshoring industry boom in recent years, has created employment opportunities for university-trained, English-speaking graduates in Asia, notably in India and the Philippines. Today, the emerging green economy has the potential to employ workers with an even wider range of skills and experiences, in agriculture, manufacturing, and services industries, whose work contributes to a sustainable, low-carbon economy. (Representative examples of green jobs requiring different education levels and industry specializations are listed in Appendix 2.) Industries directly related to carbon reduction, such as renewable energy sectors and waste management, can create new jobs that did not exist before. In addition, the ultimate goal of combating climate change requires changes in production and consumption patterns of the whole economy and therefore creates opportunities for work in traditional industries to include environmental objectives.

The projected number of green jobs over the next two decades could reach 100 million worldwide.<sup>7</sup> This represents about 2% of the future global workforce of over 5 billion by 2030. Some of these green jobs will be newly created jobs, while others will be substitutes for existing jobs. If a similar percentage of the 2.5 billion working age people in Asia in 2025 work in green jobs, Asia would be home to 50 million green jobs. In addition, jobs can be created in existing industries that are not usually labeled as green industries. For instance, the expansion of mass transit can reduce carbon by reducing the need for cars. Various types of manufacturing industries can change their production processes or come up with new green products. Factoring in expanded production capacity, growing supply chains, and new servicing needs, the employment picture looks even more promising.

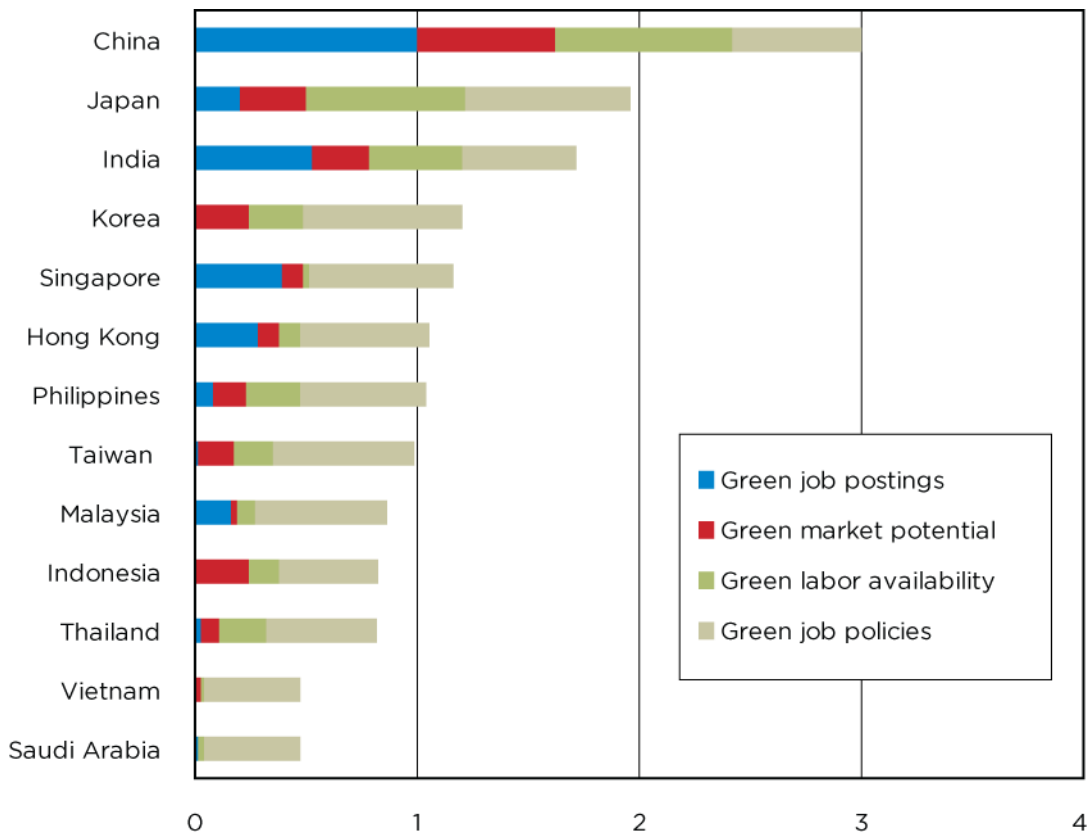
### **HOW WELL ARE ASIAN ECONOMIES DOING ON THE CONDITIONS TO CREATE GREEN JOBS?**

To examine the conditions in Asia that are needed to create green jobs, the Asia Business Council compiled a green jobs index that compares 13 Asian economies where the Council has members or activities in several dimensions crucial to green job creation. The index is composed of four equally weighted dimensions. Two of them measure green job market demand: green job postings indicating current employment needs; and green market potential identifying the main industry segments that can create green jobs. The other two dimensions measure green job enablers: green labor availability gauging the number of environmental programs offered by top universities, as well as the number of science and engineering graduates and managers in private and public enterprises with potentially transferable skills; and environmental performance according to key international standards, along with government policies to prepare the economy for green jobs.

Index results suggest that China possesses the most favorable conditions overall for green job creation, followed by Japan and India (see Exhibit 2). In the cases of China and India, the sheer size of many green industry sectors—such as renewables (e.g., wind for India and solar for China) and potential for carbon reduction, as well as the number of university-educated talent—provide market opportunities and human capital that can enable green development. Japan's high rank in areas including university environmental programs and national environmental performance reflects the economy's longstanding focus on developing green expertise and policies, well before environmental concerns gained widespread global attention.

**EXHIBIT 2: ASIA GREEN JOBS INDEX**

Index scores range from 0 to 4; a higher score means more favorable conditions for green jobs

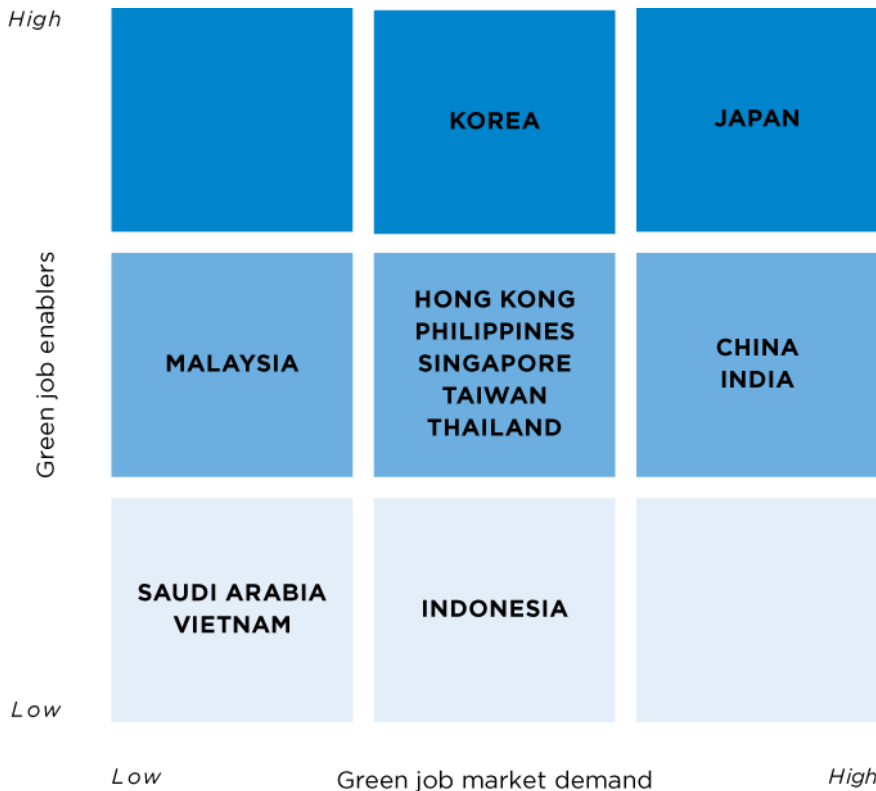


Source: ABC analysis (detailed data sources by indicator are available in Appendix 3)

In terms of green job policies, China lags slightly behind Japan and Korea. Comparing green job market demand and green job enablers, China and India have room for improvement in terms of green job enablers relative to the demand, whereas Korea has more proactive enablers than it has demand. Out of all economies measured, Japan has struck the best balance (see Exhibit 3).

**EXHIBIT 3: GREEN JOB ENABLERS AND GREEN JOB MARKET DEMAND**

Green job enablers (combined labor availability and job policies score) is plotted against green job market demand (combined job postings and market potential score)



**SUMMARY FINDINGS BY DIMENSION**

**China Leads in Green Job Postings, Followed by India and Singapore**

Green job postings reflect actual current hiring needs of green industries and other industries that are looking for talent in their environmental or sustainability units. The measure used was the average daily job postings on regional job websites that are popular among young professionals with a desire to work for companies that have national or global reach. (Most of these websites have English in addition to local language versions.) For the purposes of this index, we assume that globally competitive companies in green industries would likely use such websites to maximize exposure of their postings to potential job seekers.

China far exceeds other economies, with more than 3,000 daily postings. India follows with more than 1,600 postings, Singapore with 1,200 postings, Hong Kong with about 900, and Japan with about 600. Malaysia and the Philippines also have several hundred daily postings. Companies in other economies, however, have not been actively hiring through these sites.

### **China Has the Highest Green Market Potential but Other Economies Have Specific Areas of Strength**

Green jobs can only be created if a variety of green industry segments are expanding. Ten industry segments spanning primary energy and agriculture, manufacturing, and services sectors were included in the analysis. Market potential for each segment was measured by internationally comparable indicators that are commonly used, namely electricity production by wind, solar, biomass, and geothermal power; buildings registered under the LEED green building standard; stringency of fuel economy standards fueling demand for fuel-efficient cars; proportion of municipal waste composted or recycled indicating waste management practices; organic land area available for sustainable agriculture; average annual certified emissions reduction (CER) credits from registered projects indicating green financing market potential; and internationally recognized protected areas known as natural world heritage sites with potential for developing eco-tourism.

Again, China was the frontrunner in most indicators, including electricity production by solar energy, number of LEED-registered green buildings, available land for sustainable agriculture, and certified emissions reduction credits from registered projects that can be traded. Japan, whose auto companies are global leaders of fuel-efficient cars, has seen stringent fuel economy standards work to the country's advantage. Japan also far exceeds other Asian economies in biomass electricity generation. The country's biomass energy generation uses waste from manufacturing processes (e.g., black liquor and chip waste from the paper and pulp industry), waste and by-products from the agricultural and livestock industry (e.g., rice hull and cow manure), and household waste (e.g., garbage and used cooking oil) to generate energy. It is among the top three for wind, solar, and geothermal power generation. India, ranked third, is the regional leader in wind power generation, and second in LEED-registered buildings, available land for sustainable agriculture, and potential for trading certified emission reduction credits.

A number of other industry segment frontrunners are worth highlighting. Thailand's biomass energy ranked third, using rice husk, straw, sugarcane bagasse, palm oil waste, and wood waste to generate energy. The Philippines is already a leader in geothermal energy generation. Geothermal energy represents about 23% of the country's primary energy mix. It is a key focus in the updated Philippines' Energy Plan in 2007, designed to attain 60% energy self-sufficiency by 2010.<sup>8</sup> Indonesia, the runner-up, has more than 500 volcanoes, 130 of which are active, that provide geothermal energy. Korea has the region's third-largest number of expected average annual certified emissions reduction credits from registered projects, trailing just China and India. Although Korea is not an Annex I participant in the Kyoto Protocol with emissions cut requirements by 2012, it has planned to establish its first carbon exchange in May 2009.<sup>9</sup> Korea also has 49% of its collected municipal waste recycled and composted, the highest share among Asian economies. Korea has a nationwide waste management plan, including government financing of agent fees for new recycling businesses, polluter-pays levies, and packaging regulations. Major electronics companies have funded the construction of recycling centers.<sup>10</sup>



### **Japan Leads in Environmental Programs while China and India Have Large Numbers of University-trained Technical Talent**

The ability of Asian economies to compete in green industries is tied to the available supply of talent with direct training in environmental disciplines. In addition, existing technical and managerial talent can transfer from other industries and be trained to work in the green industry context. From the green job postings, for instance, companies are hiring engineers in traditional disciplines such as mechanical, electrical, and civil engineering to work in renewable energy industries.

Japan leads the region with 29 universities out of the country's globally ranked universities offering environment-related undergraduate and graduate programs.<sup>11</sup> China, Korea, Taiwan, and India follow. Many of the Japanese programs distinguish themselves by working on joint projects with foreign universities as well as industry, indicating the potential for training globally exposed graduates with applied skills. They are also available as undergraduate degrees, allowing the enrollment of a more diverse group of students.

China leads in terms of the sheer number of science and engineering graduates from four-year degree programs as well as current managers in private and public enterprises, followed by Japan for science and engineering graduates and India for managers in private and public enterprises.

Still, finding qualified talent that could hold senior positions presents great challenges for environmental businesses looking to scale up. Employment statistics on existing green jobs remain anecdotal and fragmented, with little internationally comparable data. (Current employment estimates for the green industry as a whole and various industry segments are available in Appendix 1.) The relative lack of information makes it more difficult for companies to gauge labor availability. A 2008 study by New Energy Finance and Heidrick & Struggles estimated the world's clean energy investment in 2007 at \$148.4 billion, a 60% growth from the previous year. However, their survey of 75 business leaders in the sector found that 37% of respondents viewed the challenge of recruiting qualified staff as "very serious," and a further 59% described it as "moderately serious."<sup>12</sup>

### **Japan and Korea Have the Most Proactive Green Job Policies**

The environmental performance of economies is indicative of the importance that Asian governments place on building a green economy. If governments do not focus on the policy objectives of improving environmental health and ecosystem vitality, economies cannot be expected to have the kind of innovative environmental regulations and incentives that encourage green industry development. Environmental performance was measured by the Yale University Environmental Performance index 2008, which scored economies on five core policy categories that are measured by internationally accepted standards: air quality, water resources, biodiversity and habitat, productive natural resources, and climate change.

In addition, economies that are not focused and deliberate in driving green job growth from the top levels of government will find themselves unprepared when companies are looking to hire

workers for the right skills. Climate change has become a key policy priority for some of the most important economies in the world, and governments have not just identified this policy area as key to reducing the negative impact on the environment, but as a future source of economic prosperity and jobs. However, only coherent, national-level policies that have been publicly announced by top government leaders or top environmental ministries in recent policy addresses, national plans, and/or economic stimulus packages, rather than piecemeal policy initiatives, can be assumed to be policy priorities. One of U.S. President Barack Obama's key policy initiatives aims at creating "green collar" jobs for the future. He promises a \$150 billion investment over 10 years to create 5 million green collar jobs focused on developing environmentally friendly energy sources. For instance, the \$25 billion proposed infrastructure spending of Obama's economic stimulus package toward making public buildings and homes more energy-efficient could create 100,000 on-site jobs and hundreds of thousands of indirect jobs, according to economists' estimates. The \$10 billion annual spending to develop renewable energy and to build a modern electrical grid could create half a million green collar jobs a year, according to an estimate supported by studies from the University of Massachusetts, Amherst, and the University of California, Berkeley. These jobs would include skilled technical professionals in trades and crafts, managers, as well as maintenance employees.<sup>13</sup> In January 2009, U.K. Prime Minister Gordon Brown announced plans to create 100,000 jobs through new infrastructure projects, some of which are specifically focused on curbing carbon emissions, including electric cars and wind and wave power.<sup>14</sup>

Policies targeted at green jobs that were assessed in the index include: worker education and retraining to ensure that workers can transfer skills from traditional industries; job creation initiatives related to green industry development; green enterprise and small business funding, investment incentives, and tax credits to encourage business expansion in green industry segments; government procurement of green products and services to jumpstart demand; and health and safety regulations to ensure that jobs are decent and not degrading to workers. Among policy areas, job creation and government procurement of green products and services are most common. More than half of the economies have announced policies in both areas.

Japan emerged as the Asian leader both in terms of environmental performance and green job policies. Japan's green business sector, including renewable energy firms and developers of energy-efficient technologies, currently employs 1.4 million people and generates sales of \$745 billion.<sup>15</sup> The Ministry of the Environment aims to expand the sector to \$1 trillion by 2020, creating employment for 2.2 million workers. Prime Minister Taro Aso was expected to announce in his March budget increased spending on low-carbon projects and zero-interest loans for green companies.<sup>16</sup>

Korea is also a leader in green job policies, with an announcement in January 2009 of about \$30 billion<sup>17</sup> in investments on environmental projects. Prime Minister Han Seung-soo coined his plan the "Green New Deal Job Creation Plan" and estimated that it would create 960,000 new jobs over the next four years, 140,000 of which would be created before the end of 2009. The government aims at boosting the use of renewable energy from the current 2% to more than 11% percent by 2030, as well as creating an added value of \$3.6 billion and 50,000 jobs in the new green financial industry by 2018.<sup>18</sup>

Other notable initiatives driven from the top include China's recently announced fiscal stimulus package of \$586 billion,<sup>19</sup> which is expected to include an estimated \$140 billion for green investments to boost its \$17 billion renewable energy sector, which already employs about 1 million workers, and also to improve waste management, prevent water pollution, and promote energy and forest conservation.<sup>20</sup> Hong Kong's Financial Secretary John Tsang in his 2008-09 budget speech announced the allocation of an additional \$17 million<sup>21</sup> to carry out works to enhance energy efficiency of government buildings and public facilities. It is expected that this measure will create some 200 jobs while helping to improve the quality of public buildings. He has also allocated about \$58 million focused on job creation through installing energy-efficient components in government buildings in the next two years.<sup>22</sup> Philippine President Gloria Macapagal-Arroyo said the government's economic resiliency package of \$6.8 billion<sup>23</sup> would aim to create green collar jobs focused on energy independence and the environment, spanning from reforestation to re-electrification of villages using renewable energy, the retrofitting of public utility vehicles, and job creation for out-of-school youth to build designated bicycle lanes. The estimated number of green jobs created under the plan is more than 110,000.<sup>24</sup>

## **HOW TO IMPROVE CONDITIONS FOR GREEN JOB CREATION**

Improving the market demand and enablers for green jobs will help Asia become more competitive in the global green economy, helping to resolve the twin crises of unemployment and the environment. Increasing talent availability and market opportunities require long-term and coordinated efforts, but targeted improvements to address specific deficiencies could make a big difference. In addition, Asian economies could learn from innovative practices of others and examine the extent to which these practices would be applicable to the given context.

First, economies should identify existing but missed or neglected opportunities, for instance, in renewable energy generation. Japan offers an example of achieving waste and emissions reduction with the use of biomass from different industries. In addition, some of the currently publicly funded environmental efforts could benefit from private sector investment, for instance, waste management and sustainable agriculture.

Second, regardless of whether green industries are focused on the domestic market or international markets, increasingly stringent international environmental standards mean that those taking up green jobs, especially those with responsibility in management and compliance, must build knowledge beyond their own economies and narrow areas of specialty. Many of the green industries in Asia are currently fragmented. Policies are confined to designated ministries and not comprehensive. University offerings lack cross-disciplinary breadth and faculty that could train future workers in the technical, economic, social, and managerial challenges associated with green industry development.

Businesses also need to be a step ahead so they can be prepared for the human capital challenges associated with green economic growth. They will need to invest in training and developing talent, and create opportunities for current talent to extend its skills. Wal-Mart established a Green Jobs Council in December 2008, which aims to better define green jobs for the company and

implement projects across its operations with green job creation potential. One such project is to create jobs at Wal-Mart and its suppliers to support the transition of 360 stores and facilities in Texas to wind power, which will supply up to 15% of the total energy demand.<sup>25</sup> Companies could also work with universities and governments to develop cross-disciplinary environmental programs that will meet the needs of various green industry segments.

Asian economies also need to work on attracting more green-industry-ready talent from all around the world. From 1989 to 2003, foreign students earned nearly 40% of U.S. doctorates in science and engineering, with Asian students representing about 55% of this group. Four Asian economies accounted for nearly 90%: China with about 34,000 science and engineering doctorates from 1989 to 2003, Taiwan with 14,800, and South Korea and India with about 14,500 each. Moreover, the stay rate of students from China and India has reached 80% and higher since 1992.<sup>26</sup> The Chinese government in February 2009 went on a shopping spree in Europe, signing deals to purchase high-tech equipment and environmental protection products for Chinese enterprises. As the Chinese demand for these products increases, trained talent from Europe will be needed in sales, servicing, and operations in China. To attract and retain talent to live and work in Asia, Asian economies need to improve quality-of-life offerings for these skilled workers and their families. Doing so will help speed up industry building and company expansion efforts, but also ensure that the domestically trained talent for future green jobs will be trained according to global standards.

In each economy, developing a green economy to resolve the job crisis and environmental crisis will necessitate coordinated action among ministries and departments, a concerted national effort that goes beyond the work of a single environmental or energy ministry. In addition, the relative lack of specific health and safety regulations for green jobs will likely come to the attention of governments, as groups begin to hold them accountable for the number of promised jobs and scrutinize salaries, benefits, and working conditions. Some of the jobs in industries such as solid waste management and renewable energy, in their current forms, are dirty jobs that cause health and safety hazards for workers. Ensuring decent green jobs in trading, manufacturing, and agriculture that will generate incomes to sustain families and that do not endanger workers' health and safety should become more important considerations for governments.

**APPENDIX 1: HOW MANY GREEN JOBS ARE THERE?**

| <b>Category</b>   | <b>Global green job estimates (2006 or latest year available, including direct and indirect jobs)<sup>27</sup></b> | <b>Green job estimates in selected economies (2006 or latest year available, including direct and indirect jobs)</b>                |
|---|--|---|
| Overall green industry  | N/A  | Europe: 4,400,000 <sup>28</sup><br>Germany: 1,800,000<br>Japan: 1,400,000<br>United Kingdom: 800,000<br>United States: 750,000      |
| Building energy efficiency: retrofitting, weatherizing, urban development | N/A  | Germany: 285,000<br>United States: 40,000<br>India: 1,500 <sup>29</sup>   |
| Energy-efficient cars   | 800,000  | Europe: 250,000<br>Japan: 120,000<br>Korea: 72,000<br>United States: 13,000   |
| Wind power  | 300,000  | Germany: 82,100<br>United States: 36,800<br>Spain: 35,000<br>China: 22,200<br>Denmark: 16,000<br>India: 13,000                      |
| Solar power (PV and thermal)  | 800,000  | China: 655,000<br>Germany: 40,200<br>United States: 17,600  |
| Biomass   | 1,800,000  | Malaysia: 500,000<br>Brazil: 500,000<br>United States: 312,200<br>China: 266,000<br>India: 125,000 <sup>30</sup><br>Germany: 95,400 |
| Geothermal  | 26,000   | United States: 21,000<br>Germany: 4,200   |
| Waste management and recycling  | 12,000,000   | United States: 1,100,000<br>China: 700,000 <sup>31</sup><br>Brazil: 500,000   |
| Sustainable agriculture   | N/A  | N/A   |
| Green finance   | N/A  | N/A   |
| Eco-tourism   | N/A  | N/A   |

Sources: "Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World," United Nations Environment Programme; U.S. Conference of Mayors; government statistics; news reports

**APPENDIX 2: REPRESENTATIVE GREEN JOBS**

| <b>Job Requirements</b>                                     | <b>Does not require green industry-specific skills</b>  | <b>Requires green industry-specific skills</b>   |
|---|---|--|
| <p><b>Requires four-year university degree or above</b></p> | <p>Construction engineers<br/>Electrical engineers<br/>Mechanical engineers<br/>Civil engineers<br/>Aerodynamic engineers<br/>Software engineers<br/>Chemical engineers<br/>Material scientists<br/>Construction managers<br/>Industrial production managers<br/>Laboratory assistants<br/>Investment bankers<br/>Venture capitalists</p>   | <p>Environmental architects<br/>Environmental engineers<br/>Photovoltaic engineers<br/>Geotechnical engineers<br/>Agronomists<br/>Water and waste treatment engineers<br/>Ecologists<br/>Marine biologists<br/>Sustainability executives/managers<br/>Compliance managers<br/>Power grid integration managers<br/>Energy efficiency auditors/ inspectors<br/>Carbon auditors<br/>Pollution monitoring consultants<br/>Health and safety officers<br/>Agricultural inspectors</p> |
| <p><b>Does not require four-year university degree</b></p>  | <p>Electricians<br/>HVAC technicians<br/>Heating/air conditioning installers<br/>Carpenters<br/>Roofers<br/>Insulation workers<br/>Welders<br/>Metal fabricators<br/>Machinists<br/>Mechanics<br/>Computer-controlled machine operators<br/>Engine and equipment assemblers<br/>Industrial truck drivers<br/>Iron and steel worker<br/>Millwrights<br/>Material handlers<br/>Laborers<br/>Retailers<br/>Marketers</p> | <p>Mixing and blending machine operators<br/>Sustainable farmers<br/>Farm product purchasers<br/>Recycling coordinators<br/>Carbon traders<br/>Eco tour guides<br/>Park rangers</p>  |

Sources: International and national job websites; industry associations; ABC analysis

**APPENDIX 3: GREEN JOBS INDEX FRAMEWORK, DIMENSIONS, INDICATORS, AND DATA SOURCES**

Economies covered: China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, Philippines, Saudi Arabia, Singapore, Taiwan, Thailand, and Vietnam

| <b>Indicator (each weighted equally within dimension)</b>   | <b>Measure</b>   | <b>Source</b>   |
|---|--|---|
| <i>Green job postings (25% weighting)</i>                   |  |   |
| Current job postings in environmental areas                 | Average daily number of career site job postings   | jobsdb.com, monster.com, recruit.net, and classified ads of highest circulation English daily broadsheet (2009) |
| <i>Green market potential by sub-sector (25% weighting)</i> |  |   |
| Wind  | Electricity production by wind (GWh)   | International Energy Agency (2006)  |
| Solar   | Electricity production by solar (GWh)  | International Energy Agency (2006)  |
| Biomass   | Electricity production by biomass (GWh)  | International Energy Agency (2006)  |
| Geothermal  | Electricity production by geothermal (GWh)   | International Energy Agency (2006)  |
| Green buildings   | Number of LEED registered buildings  | U.S. Green Building Council (2009)  |
| Energy-efficient cars                                       | Fuel economy standard for new passenger vehicles (MPG-converted to Cafe test cycle)—2010 estimate                                      | International Council on Clean Transportation (2007)  |
| Waste management  | % of waste recycled and composted (% of all municipal waste collected)   | United Nations Statistics Division, United Nations Environment Programme (2007)                                 |
| Sustainable agriculture                                     | Organic land area (hectares)   | Food and Agriculture Organization (2006)  |
| Green finance   | Expected average annual certified emissions reduction (CER) credits from registered projects by host party (average annual reductions) | United Nations Framework Convention on Climate Change (2009)  |

| <b>Indicator (each weighted equally within dimension)</b>   | <b>Measure</b>  | <b>Source</b>   |
|---|---|---|
| Eco-tourism   | Protected natural areas: world heritage sites (thousands of hectares)   | United Nations Environment Programme World Database on Protected Areas (2009)           |
| <i>Green labor availability (25% weighting)</i>   |   |   |
| University training for green jobs  | Number of top 500-ranked universities with environmental engineering/management/studies programs  | Times Higher Education Supplement World University Rankings, university websites (2008) |
| Science and engineering graduates   | Annual number of university graduates in science and engineering  | National Science Foundation (2007)  |
| Managers  | Number of workers in managerial functions   | International Labour Organization (2007)  |
| <i>Green job policies (25% weighting)</i>   |   |   |
| Current environmental policy development  | Score in EPI Environmental Performance Index—scores for each of the five core policy categories— Air Quality, Water Resources, Biodiversity and Habitat, Productive Natural Resources, and Climate Change | Yale University Environmental Performance Index (2008)                                  |
| Specific green jobs policies (1 point if there is existing program in each area at national level or if program is mentioned in top government leader's policy address or economic stimulus plan) | Worker education and training/re-training for green jobs  | Government websites (2009)  |
|   | Green job creation  | Government websites (2009)  |
|   | Green enterprise and small business funding/investment incentives/tax credits   | Government websites (2009)  |
|   | Government procurement of green products and services   | Government websites (2009)  |
|   | Health and safety regulations for green jobs  | Government websites (2009)  |

<sup>1</sup> Estimates for "Asia and the Pacific" include East Asia, Southeast Asia and the Pacific, and South Asia. "Global Employment Trends," International Labour Organization, January 2009.

<sup>2</sup> "World Population Prospects," United Nations Population Division, 2009. See <http://esa.un.org/unpp/index.asp>

<sup>3</sup> LABORSTA database, International Labour Organization, 2009. See <http://laborsta.ilo.org/STP/do>

<sup>4</sup> "The Challenge of Job Creation in Asia," Asian Development Bank, April 2006.

<sup>5</sup> LABORSTA database, International Labour Organization, 2009. See <http://laborsta.ilo.org/STP/do>

<sup>6</sup> "Oil and gas production and oil refining: global employment trends," International Labour Organization, 2002.

<sup>7</sup> "Global Challenges for Sustainable Development: Strategies for Green Jobs," International Labour Organization, May 2008.

<sup>8</sup> Official website of the Philippine Department of Energy. See <http://www.doe.gov.ph/PEP/>

<sup>9</sup> "Korea gets first carbon exchange," The JoongAng Daily, 4 December 2008.

<sup>10</sup> "Waste Management System in Korea," Asia Pacific Economic Cooperation (APEC) Human Resources Development Working Group (HRDWG) Knowledge Bank, 2004. See <http://www.apecknowledgebank.org/>

<sup>11</sup> "World University Rankings," Times Higher Education Supplement, 2008. See <http://www.topuniversities.com/worlduniversityrankings/>



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<sup>12</sup> “Talent shortage threatens growth of clean energy sector,” New Energy Finance and Heidrick & Struggles, 14 April 2008.

<sup>13</sup> “Obama’s Plan: Clean Energy Will Help Drive a Recovery” Yale Environment 360, 19 January 2009. See <http://www.e360.yale.edu/content/feature.msp?id=2110>

<sup>14</sup> “Gordon Brown unveils plan to create 100,000 jobs,” The Observer, 4 January 2009. See <http://www.guardian.co.uk/politics/2009/jan/04/gordon-brown-employment-new-deal>

<sup>15</sup> Equivalent to 70 trillion Japanese yen.

<sup>16</sup> “Asian giants sign up to ‘Green New Deal’ policies,” BusinessGreen, 9 January 2009.

<sup>17</sup> Equivalent to 43 trillion Korean won.

<sup>18</sup> “Five high-value industries to be promoted,” Korea.net, 16 February 2009. See

[http://www.korea.net/News/News/NewsView.asp?from=todaynews&serial\\_no=20090216001&part=101](http://www.korea.net/News/News/NewsView.asp?from=todaynews&serial_no=20090216001&part=101)

<sup>19</sup> Equivalent to 4 trillion Chinese yuan.

<sup>20</sup> “China plans 10 major steps to spark growth,” Xinhua News Agency, 10 November 2008.

<sup>21</sup> Equivalent to HK\$130 million.

<sup>22</sup> “The 2008-09 Budget,” The Government of the Hong Kong Special Administrative Region, 25 February 2009. See <http://www.budget.gov.hk/2008/eng/speech.html>

<sup>23</sup> Equivalent to 330 billion Philippine pesos.

<sup>24</sup> “Government to offer green collar jobs,” Inquirer.net, 9 February 2009. See

<http://newsinfo.inquirer.net/breakingnews/nation/view/20090209-188305/Govt-to-offer-green-collar-jobs>

<sup>25</sup> “Wal-Mart Launches Green Jobs Council; Council to Identify Opportunities for Green Job Creation,” PR Newswire, 2 December 2008.

<sup>26</sup> “Asia’s Rising Science and Technology Strength: Comparative Indicators for Asia, the European Union, and the United States,” National Science Foundation, May 2007.

<sup>27</sup> Note that comparisons across industry segments and economies are not always possible due to differences in definitions and estimation methodologies.

<sup>28</sup> Numbers indicate those employed in environment-related industries (largely pollution prevention or treatment) and activities that are closely dependent on a good quality environment (environment-related tourism, sustainable forestry, organic agriculture, and renewable energy).

<sup>29</sup> U.S. and India numbers include LEED-certified professionals.

<sup>30</sup> Malaysia estimates are for palm oil, Brazil estimates are for sugarcane, and India estimates are for jatropha.

<sup>31</sup> Estimates include collection, disassembly, material recovery, and final disposal.

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