

# Chapter 15

## Education and Skills in Asia: Responding to Greening Economies

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### Introduction

Countries in Asia and the Pacific have recorded spectacular growth rates that have been much celebrated, as they not only contributed to reducing poverty rates in the region but also to a shift in balance of economic power to Asia. A number of countries in Asia are reaching and surpassing middle income levels. The high growth rates are accompanied by concerns regarding environmental sustainability as the region also recorded marked adverse trends of reduced water and air quality, depleted natural resources, and threats to biodiversity. In 2005, the Asia and Pacific region required three times more resources than the rest of the world to create one unit of GDP. Asia's use of raw materials reached a world-leading 35 billion tons and can reach a figure of 80 billion tons by 2050. Asia Pacific's share of global energy demand was about 35% in 2005 and expected to reach 50% by 2028. Several studies point to Asia being the single largest source of black carbon emissions from combustion. There is an urgent need for the Asia and the Pacific region to consider resource efficiency of using fewer resources per unit of GDP to ensure the region's continued growth and sustainable development.

Asia has joined other parts of the world to put in place measures for climate change mitigation and adaptation. International commitments to climate change have contributed to "greening" of economies and corporations. The lead up to the recent Rio+20 Conference on Sustainable Development spurred a spate of initiatives and actions to reinforce a growth paradigm that integrates environment-friendly and sustainability features. There is now a considerable body of analytical work that provides compelling arguments for a transition to greener growth without

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compromising on rates of growth. A recent ADB report (2012b) notes that with the right policies and incentives, “greening” the economy can be made viable and profitable in the long term. An ILO report (2012) states that the transformation to a greener economy could generate 15–60 million additional jobs over the next 2 decades and lift tens of millions of workers out of poverty.

In fact, it is argued that greening growth is necessary, efficient, and affordable. Green growth is seen as a way to pursue economic growth and development while preventing environmental degradation, biodiversity loss, and unsustainable natural resource use (OECD 2010). The World Bank argues that what is needed is green growth that is efficient in terms of use of natural resources, clean in minimizing pollution and environmental impacts, and resilient in taking into account environmental management and natural capital and in preventing physical disasters (World Bank 2012b). Sustained growth is necessary to achieve the urgent development needs of the world’s poor, and it is believed that substantial scope exists for growing cleaner without growing slower.

There are ongoing discussions on the development of internationally agreed goals that incorporate sustainability principles, and it is expected that the Millennium Development Goals (MDGs) that have established targets till 2015 will be replaced or complemented with Sustainable Development Goals (SDGs). The transition to green economy will require new indicators that go beyond income poverty and GDP to a broader way of tracking economic, social, and environment progress and well-being.

Education and training have a crucial role to play in the successful transition of economies to green and clean development that is conducive to inclusive growth. Yet, there is no systematic and comprehensive approach to linking education and training policies with climate change adaptation, mitigation, and greening policies. Article 6 of the UN Framework Convention on Climate Change (UNFCCC) attributed only a minor role for education and training in terms of awareness to win public support for climate change policies.

Education institutions can contribute to R&D, to advances in technology, and to measuring and monitoring impact of climate change on occupations. They can help with setting standards, training of trainers, and certification in technical protocols concerned with climate change adapting/mitigating processes. Adequately trained and skilled workers would facilitate faster technology absorption and can help corporations to adopt “greening” strategies. The building up of a cadre of “green professionals” will provide the knowledge base necessary to blend technology, product, and process development with finance and marketing to open up cost-effective options and to speed up implementation. Investing in education constitutes a critical long-term strategy to facilitate changes in consumption and behavior patterns that contribute to sustainable and climate-resilient progress. The far-reaching influence of education and training in advancing policy commitments and policy options for climate change has so far been underestimated. Addressing issues related to skills for greening economies is the theme of this chapter.

## **Drivers of Change Toward Greener Economies**

### ***Prominent Trends and Developments***

It is believed that, if done right, moving to a low-carbon world can realize three significant benefits: reduced emissions, higher productivity of the economy, and inclusive growth. The most prominent aspects of a “green” transition include the following:

- Transition to greater use of energy from renewable sources – these could include solar, wind, biomass, geothermal, ocean, hydropower, landfill gas, and municipal solid waste.
- Transition to greater use of products and services that increase energy efficiency – these include energy-efficient equipment, appliances, vehicles, as well as products and services that improve the energy efficiency of buildings and the efficiency of energy storage and distribution, such as smart grid technologies.
- Transition to greater use of processes that reduce/remove pollution and greenhouse gas emission and transition to recycling and reuse.
- Transition to greater use of products and services that conserve natural resources – these include organic agriculture, sustainable forestry, land and soil management, soil and wildlife conservation, and water management.
- Transition to greater use of products and services that comply with environmental regulations and standards.

The slow but inexorable move toward greening economies is being propelled by climate change mitigation and adaptation commitments, the recognition of a business case in green economies, consumer preferences, and prospects of increasing quality employment.

### **Climate Change Adaptation and Mitigation Commitments**

The Asia and the Pacific region is highly vulnerable to the adverse effects of climate change with more people at risk than any other region. Accelerated implementation of adaptation and mitigation measures for climate change will have far-reaching changes in manufacturing and goods and services and labor markets. There would be a shift in demand, output, and employment away from energy generation from fossil fuels such as coal, oil, and gas. Sustaining economic growth without compromising the environment is a policy challenge that Asia has begun to address. Awareness is increasing that green growth approaches are economically and politically feasible and profitable. Several governments are building solid policy foundations toward green growth.

The Clean Development Mechanism (CDM) is a market-based mechanism under the Kyoto Protocol used by countries to meet commitments to limit or reduce their greenhouse gas emissions (GHGs) in order to meet their emission targets.

It has been operational since the beginning of 2006. As of mid-2012, there were 10,426 projects in the CDM pipeline. Although CDM projects are hosted globally, Asia and the Pacific host most of the CDM's projects, and in particular, the People's Republic of China (PRC) and India dominate the CDM market.

Sustainable energy has been a major aspect of the move toward green economies and the proposed UN goal of doubling the share of the world's energy supplied by renewable sources from 15% to 30% by 2030, and doubling the rate of improvement in energy efficiency is spurring nations to innovate and find new solutions. This is particularly crucial for Asia and the Pacific region. Energy demand in the region is rising and is estimated to grow at 2.4% annually till 2030, compared with the projected global rate of 1.5% for the same period. It is thus important for Asia to address actions to ensure energy efficiency, development of renewable energy, and energy security in Asia and the Pacific.

Accordingly, countries are formulating regulations, standards, and targets for renewable energy. The PRC has set a target of reaching 15% of energy supply from renewables by 2020 and the European Union has a target of 20% for the same period. The United States plans to generate 35 billion gallons of alternative fuels in 2017. Governments are offering subsidies and other domestic support mechanisms to promote renewable energy and subsidies to solar energy and biofuels are common in many developed and developing countries. Governments are also adopting green procurement policies in several countries. All these developments provide an added boost to the shift to greening economies by economic actors.

### **Business Case for Greening**

Investment in the green economy is not only considered good for the environment but also for business (World Bank 2010). Companies are moving to non-fossil fuel energy sources as a long-term measure which would also help to improve the image of the company and corporate branding. The notion of a triple bottom line, financial, social, and environmental, has gained much ground in business. The Economics of Ecosystems and Biodiversity (TEEB) Report for Business highlights the business case for biodiversity and ecosystem services (BES) and offers business models in this segment as they are clearly emerging alongside carbon markets. It identifies sustainable management of forests and enhancement of carbon stock initiatives as market opportunities.

A cleantech revolution is believed to be underway much like the digital and Internet revolution. Over 2000 corporations have links with cleantech innovation – as investors in cleantech funds and as partners, licensees, or acquirers of upcoming clean technology companies. With increasing capital flowing into green technology, clean energy could become an accepted part of business thinking. Vision 2050 of the World Business Council for Sustainable Development offers alternatives to “business as usual” that reduce the ecological footprint of development. The US Bureau of Labor Statistics has identified 333 industries ([http://www.nationalskillscoalition.org/pdf.html?file=http://www.bls.gov/green/final\\_green\\_def\\_8242010\\_pub.pdf](http://www.nationalskillscoalition.org/pdf.html?file=http://www.bls.gov/green/final_green_def_8242010_pub.pdf)), covering

more than 2 million establishments, which are likely to produce green goods and services. For business, adopting green strategies helps to remain relevant in the market, participate in growth segments, and realize new business opportunities.

There are examples from both developed and developing countries that demonstrate how integrating sustainability into core business activities can generate a positive return on investment (UNEP 2012). Companies that proactively participate in, perhaps even lead, the green transition will gain business benefits. There are now compelling empirical data to demonstrate that business strategies that integrate attributes of resource efficient and green economy principles can positively affect the financial metrics of companies of all sizes. Businesses that are early entrants in the use of such strategies are expected to strengthen their competitive advantage. It is estimated that the annual financing demand required to create the green economy is in the range of \$1–2.5 trillion. This level of investment represents an enormous opportunity for the private sector to provide the infrastructure, equipment, goods, and services that will drive the transition. With this in mind, investors are increasingly considering environmental performance as a proxy for management quality. About two-thirds of the \$8 trillion needed for infrastructure investment in Asia and the Pacific between 2010 and 2020 will be in the form of new investments similarly creating tremendous opportunities to design, finance, and manage green growth. At the Rio+20 Conference, the Asian Development Bank (ADB) and seven other multilateral development banks (MDBs) today announced their commitment to provide more than \$175 billion of loans and grants for transport in developing countries over the next decade.

### Consumer Preferences

The global market for environmental products and services is projected to rise from the current level of about \$1,370 billion to an estimated \$2,740 billion by 2020 according to German Roland Berger Strategy Consultants. Projections for individual market segments are the following:

- Energy efficiency technologies (appliances, industrial processes, electrical motors, insulation, etc.) to increase from \$617 to \$1,233 billion by 2020
- Waste management/recycling to increase from \$41 to \$63 billion by 2020
- Water supply/sanitation/water efficiency to increase from \$253 to \$658 billion by 2020
- Sustainable transport (more-efficient engines, hybrids, fuel cells, alternative fuels, etc.) to increase from \$247 to \$493 billion by 2020

Consumers are opting for green products on the basis of health and safety considerations. Preference for organic produce is an example of this. This extends to a number of domains such as energy-efficient appliances and products, using water harvesting structures and renewable sources of energy and ecotourism.

Energy efficiency standards have been introduced in most OECD countries but also in certain developing countries. In 2006, 57 countries with 80% of the world's

population had energy efficiency standards and labeling programs in place. Environmental labeling schemes such as carbon labeling schemes describe the carbon dioxide emissions created as a by-product of manufacturing, transporting, and disposing of a consumer product are also beginning to be used. These trends are likely to tilt consumer behavior toward environment-friendly products and services.

### **Prospects of Creating Incremental Green Jobs**

Greening of economies can also contribute to reinvigorating employment in green sectors. Governments could consider green economies as the means for more and better jobs. A flagship report on green jobs by the United Nations Environment Program (2008) provided comprehensive insights on the impact of a green economy on the world of work. The report argued that, rather than being a drag on growth, the greening of economies can spur additional growth and contribute to additional creation of decent jobs. The report pointed out that green growth would in fact help economies to create jobs that did not exist before and provide opportunities for governments to reinvigorate employment in new and transformed occupations and bring higher value-added work for populations. Such an expansion of green jobs would bring overall economic gains, as well as a host of social and political gains.

Prospects of green jobs have increased not least because of the substantial green stimulus packages that Asian countries put in place in the aftermath of the fiscal crisis with significant “green” elements. A number of countries increased public investments in green infrastructure – particularly in terms of public transport, low-carbon energy production, smart electricity grids, energy efficiency of public buildings, and water and sanitation infrastructure. Employment opportunities were extensive in stimulus packages and measures to move toward a low-carbon economy were seen to help stimulate sustained employment (Anbumozhi and Bauer 2010). The emerging green economy has the potential to employ workers with an even wider range of skills and experiences in a variety of sectors and contribute to a sustainable, low-carbon economy. Industries directly related to carbon reduction, such as renewable energy sectors and waste management, can create new jobs that did not exist before.

To examine conditions needed to create green jobs, the Asia Business Council compiled a green jobs index that compared 13 Asian economies, and the results suggest that the PRC possesses the most favorable conditions for green job creation, followed by Japan and India (Asia Business Council 2009). The Republic of Korea; Singapore; Hong Kong, China; the PRC; the Philippines; Taipei, China; Malaysia; Indonesia; Thailand; and Viet Nam also exhibit potential for green jobs at different levels.

In India, a study finds that low-carbon employment is one of the key co-benefits of promoting the renewables sector (Global Climate Network 2010). It notes that solar power is more labor intensive than wind power and better able to meet India’s requirements for small-scale, off-grid power. Biomass, green transport, and public works in water and forest management are also attractive ways of achieving both

employment and environmental objectives. Similarly, increased employment in the renewables sector is estimated for the PRC and Brazil too.

### ***Asian Economies and Green Transition***

While Asia has a highly resource-intensive and emission-intensive growth model, green growth projects are rapidly gaining ground. The PRC has become a leader in the development of green technologies. In 2009, the PRC overtook Denmark, Germany, Spain, and the United States to become the world's top manufacturer of wind turbines, and its domestic market for turbines has already become the world's largest (ADB 2012a). A comparison of public investments in key Asian countries and the United States in core clean energy technologies (including solar, wind, and nuclear power; carbon capture and storage; advanced vehicles and batteries; and high-speed rail) reveals that Asia's rising "clean technology tigers" – the PRC, Japan, and the Republic of Korea – have already passed the United States in the production of virtually all clean energy technologies. It is expected that over the next 5 years, the governments of these nations will out-invest the United States three to one in these sectors. Such large public investments will enable these Asian nations to attract significant private sector investments in clean energy technology, estimated to total in the trillions of dollars over the next decade (Breakthrough Institute and the Information Technology and Innovation Foundation 2009).

Large developing countries have emerged as world leaders in clean technology production, exports, and use (UNCSD 2012). Patenting rates for clean energy technologies have increased faster than for other sectors, at about 20% per year since the adoption of the Kyoto Protocol in 1997. The leading six countries patenting clean technologies (Japan, the United States, Germany, the Republic of Korea, the UK and France) account for almost 80% of all patent applications in clean energy technology, but large emerging economies are rapidly emerging as leaders in clean technology patents in their own rights. India features within the top five countries for solar PV, while Brazil and Mexico share the top two positions in hydro/marine (ICTSD 2011).

## **Implications of Green Growth for Education and Training Systems**

### ***Skills Are Crucial to a Green Transition***

The emergence of green economies and green jobs is contributing to important adjustments and refinements to skill formation. The demand for skills is being affected in three ways by the transition to green growth (ILO and Cedefop 2011):

(1) growing demand for skills specific to expanding industries such as renewable energy and declining demand for skills in fossil fuel-based industries; (2) new demand for green skills in emerging occupations such as photovoltaic (PV) fitters and carbon-footprint assessors; (3) demand for re-skilling or up-skilling for jobs that are transforming due to transition to renewable sources of energy-efficient technologies and practices. Development of adequate skilled and trained workers and professionals is a key aspect of planning a rapid transition to green economies.

Other studies stress that a successful transition toward a greener economy will create new opportunities for workers but also new risks. The challenge for labor market and skill policies is to maximize the benefits for workers while also supporting broader green growth policies. Four main policy priorities that are identified (OECD 2012) are to do with:

- Supporting a smooth reallocation of workers from declining to growing firms while reducing the adjustment costs borne by displaced workers
- Supporting eco-innovation and the diffusion of green technologies by strengthening initial education and vocational training and ensuring that overly strict product market regulations are not blunting the incentive to innovate
- Reforming tax and benefit systems for workers to make sure that cost pressures generated by environmental policies do not become a barrier to employment
- Designing policies, programs, and strategies for sectoral adjustments as well as local development strategies through partnerships with local stakeholders

According to the OECD, there is evidence that skill shortages may be impeding the transition to green growth in sectors such as energy-efficient construction and retrofitting, renewable energy, energy and resource efficiency, and environmental services. Skill shortages already appear to be impeding the greening of growth. In the PRC and India, rural electrification programs are suffering from a lack of skilled workers. Reasons for these shortages include a scarcity of scientists and engineers, the poor reputation and limited attractiveness of some sectors important for the green transition such as waste management, and a limited number of teachers and trainers in environmental services.

The Rio+20 Conference outcome document (UN 2012) calls for the development of sustainability curricula and training programs for careers in fields related to sustainability. It advocates support to higher education institutions to carry out research and innovation for sustainable development. Entrepreneurship and technical and vocational training to bridge skills gaps to meet sustainable development objectives are also stressed. 250 higher education institutions joined together to issue a declaration at Rio in support of sustainable development, by agreeing to take actions to teach sustainable development concepts across all disciplines, encourage research on sustainable development issues to improve scientific understanding and transfer of technologies and undertake greening of campuses by reducing environmental footprint and promoting sustainable practices.

The UN Decade of Education for Sustainable Development (2005–2015) has contributed significantly to advancing sustainability education in countries, particularly environmental education in school. Education for Sustainable Development



**Table 15.1** Integrating biodiversity and climate change education

|  | Biodiversity education (%) | Climate change education (%) |
|--|----------------------------|------------------------------|
| Percentage of countries reporting implementation | 59                         | 59                           |
| of which, included in                            |                            |                              |
| Primary education                                | 95                         | 35                           |
| Secondary education                              | 100                        | 50                           |
| Higher education                                 | 83                         | 80                           |
| Teacher education                                | 85                         | 88                           |
| Technical and vocational education and training  | 73                         | 60                           |
| Nonformal education                              | 48                         | 56                           |

Source: UNESCO (2012).

(ESD) encompasses environmental, peace, human rights, consumer, development, health, HIV/AIDS, biodiversity, gender, inclusive, multicultural, holistic, global, citizenship, disaster risk reduction (DRR), climate change (CC), and food security. A report on ESD (UNESCO 2012) released at the Rio+20 Conference recorded the efforts made in countries in integrating sustainability education. See Table 15.1.

### *There Is Need for a New Cadre of Green Professionals*

The implementation of climate change commitments is leading to new skill requirements. While some areas require altogether new skills, a large number of existing occupations require additional skills and competencies in the context of efforts to move toward a low-carbon world. New types of skills and competencies will need to be incorporated into existing occupational profiles of the workforce. There is need for developing new training curricula and launching green entrepreneurship promotion campaigns. Vocational and technical training will be critical in building the necessary skill base for green jobs. Link with education and training at higher levels through the tertiary sector is required. Comprehensive green skill standards and certification systems need to be developed. Benchmarking standards, establishing protocols for standards in new green jobs, existing but “transformed” jobs, and in green processes will require participation of higher education institutions. Countries need to establish pathways for training, skill development, and advanced knowledge building between skill development and TVET institutions and higher education institutions.

It is not just about technical skills but a broad spectrum of skills and competencies that are required to support the trend toward green economies, which is not yet addressed in a systematic fashion by technical and tertiary level education systems. International commitments to clean and green growth are requiring a new cadre of green professionals in fields like assessment, reporting, and certification. Currently, they are primarily from developed countries; developing countries in Asia have not yet developed a professional skill base. Knowledge

**Table 15.2** Competencies and professional base required for greening economies

| Objectives   | Enabling  | Promoting   | Verifying  |
|--|---|---|--|
| Expanding low-carbon and green approaches to growth                | Environmental and climate change  | Skills for implementing environmental services  | Knowledge of green accounting and carbon footprinting  |
| Accelerating energy efficiency solutions                           | Regulations awareness   | Skills to commercialize environmental products  | Knowledge of greenhouse gas accounting<br>Knowledge of certified carbon reduction accounting |
| Increasing adoption of clean energy solutions and renewable energy | Awareness of behavior changes and consumption patterns to support low carbon growth | Capacities for developing technology options and technology absorption                                      | Knowledge and license for eco-labeling   |
| Increasing energy security and assuring energy for all             | Knowledge of choice of appropriate technology                                       | Abilities to implement eco-friendly services such as eco-villages and smart electricity grids               | Knowledge and license for ISO 14001 and ISO 50001 certification                              |
| Expanding environmentally friendly products and services           | Technology absorption and adaptation capacities                                     | Technical and managerial skills to implement low carbon production and processing systems                   | Knowledge for energy audits  |
|  | Product development capacities  | Skills to implement business models that meet the triple bottom line – financial, social, and environmental | Knowledge for certifying legal compliance with regulations                                   |
|  | Environment services and advisory services capacities                               |   | Knowledge of protocols for MRV requirements  |

MRV=measurement, reporting, and verification.

Source: Compiled by author.

sharing and exposure to how Western countries developed these green certification professional cadres are insufficient. There is need for finance professionals who can tackle issues relating to carbon finance and return on investment (ROI) analysts who can build a business case for green technologies, in addition to engineers and technicians with knowledge of renewable and energy-efficient systems and services. Table 15.2 provides an illustrative sample of skills and knowledge that are needed to enable, support, and verify greening initiatives.

### ***Training, Retraining, and Knowledge Advancement for Greening Economies***

Labor markets will be affected in a number of ways as climate change regulations are enforced and green growth proceeds further. Some jobs will be substituted in the process of shifting from say fossil fuels to renewables or from land filling and waste incineration to recycling; some jobs will be altogether lost without direct replacement when production of certain products is banned by regulation; additional jobs will be created, e.g., in the manufacture of new products or offering of new services in a pro-environment economy; and a number of existing jobs will be transformed with new competencies, such as those of plumbers, electricians, and metal and construction workers as corporations adopt greening measures or retrofit or build new buildings with energy-efficient equipment.

Thus, a greening economy would require new training and retraining of the workforce to adopt new production processes. As fossil fuel-based industries move toward greening, a number of workers may lose their jobs or could be at risk of losing jobs unless their skills are updated and they are retrained.

### ***Education and Skill Strategy Needs to be Integral to Overall Green Economy Initiatives***

The overarching policy challenge is how best to coordinate employment and skills development policies with environmental and sector policies for more sustainable development and low-carbon economies. Skills development is a precondition for reaping the economic, carbon reducing, and job opportunity benefits of low-carbon investments. The greening of jobs in industries with high technology and innovation content would rely on specialist knowledge, especially in the fields of science, technology, engineering, and mathematics (STEM). Close cooperation between education institutions, governments, and the business community will be essential to ensure that education equips individuals with the skills necessary to be competitive in a greening job market (International Organization of Employers 2010).

A study by the European Centre for the Development of Vocational Training (Cedefop 2010) revealed none of the EU Member States, with the exception of France, had put in place integral skills response strategies as part of their environmental and green growth strategies. Many of the green industries in Asia are currently fragmented. University offerings lack cross-disciplinary breadth and faculty needed to train future workers in the technical, economic, social, and managerial challenges associated with green industry development.

Green economies and green jobs are also spurred by innovation. In addition to technical training, there is a need to facilitate entrepreneurship training, business incubation services, and access to finance. This can help low-income countries to

leapfrog on the technology spectrum and turn innovation for a green economy into successful business models.

In addition to skills training, addressing a wider range of institutional regulatory and quality assurance issues will help Asia to benchmark its progress against well-articulated standards. For example, the Leadership in Energy and Environmental Design (LEED) Green Building Rating System is a third-party certification program and the nationally accepted benchmark for the design, construction, and operation of high-performance green buildings. LEED provides building owners and operators with the tools they need to have an immediate and measurable impact on their buildings' performance. An Asia Pacific Certification is on the cards for green buildings. Further work in this domain will establish Asia's leadership in green growth.

Green jobs have great potential; however, they need not automatically be quality jobs, constituting "decent" work, i.e., with adequate wages, safe working conditions, job security, career prospects, and worker rights. There are dangers of "green washing" where only nominal support to environmental goals actually provides very poor-quality employment. An example could be poor-quality electronics recycling which may give rise to employment in hazardous conditions. The use of unskilled labor in biofuel and biomass production may give rise to numerous jobs but at subsistence wages and poor working conditions. In this case, green jobs do not constitute quality employment. Thus, it is important to ensure that green jobs are also "decent" jobs in pursuit of inclusive growth. For example, providing energy access to rural India and a distributed model of generating jobs that is not urban centric will support inclusive growth.

There is need to consider active strategies in skills for green employment that take into account inclusive models. For example, renewable energy models are fairly small scale and distributed – small-scale solar and wind projects which can give rise to the need for an extensive technical support service network, which can be addressed by skills training systems. There could well be a case here for multiple skilling techniques as it may become unfeasible to send a number of different experts to various rural locations.

### ***Mapping Occupational Profiles for Green Economies Across Different Levels of Education***

Education and training for greening economies and corporations need to address all levels of education. At the basic education level, environmental education has an important role to play in creating awareness. The Johannesburg Sustainable Development Summit resulted in the announcement of a new decade – Education for Sustainable Development Decade from 2005 to 2015 – and this led to the incorporation of curricula on environment and sustainable development at the school level. Recent advances on climate change mitigation and adaptation efforts and the

discourse on the agenda for green growth have given rise to a range of skill needs at technical and vocational education and at tertiary education levels.

In order to respond comprehensively to the needs of economies making the transition to green economies, education and training systems need to take an integrated view of potential opportunities and constraints for green initiatives. An integrated approach takes into account how the spectrum of competencies can be addressed at different levels of education. For effective greening initiatives, not only the main manufacturing company but the supply chain companies also need to adopt “greening” measures. Technology, materials management, processes, and products all embody “green” elements. In addition to engineers, scientists, and technicians, finance and accounting professionals also have a role to play. Table 15.3 provides an illustrative example of how different levels of education and training contribute to the competencies, knowledge, and skills needed in a green economy.

## Conclusions

Issues relating to education and training for greening economies should be viewed in the overall context of skills for inclusive employment. Discussions on green skills are juxtaposed on the broader skills discourse. Green growth is a proxy for an ever-changing world; the pace of transformation is much faster now than ever before. There is need for education and skills training systems to be flexible and adaptive.

Skills development, training, and education for greening economies are constrained by the general problems confronting education and training institutions. The general failings of the education system also create problems for the greening sector; particularly, the slow responsiveness of education institutions to new trends and demands exacerbates skills shortages. Poorly performing universities and lack of good-quality research and the overall problem of skills mismatch that is an overriding problem in recent years also apply to green skills and green professionals. The lack of employer incentives and lack of access to finance for training are generic problems. However, integrating skills strategies for green occupations and ensuring that education and training for fast-changing green sectors would also benefit the overall rate of responsiveness of training institutions to emerging new demands for skills. In this scenario, the agility of training institutions to greening sectors could be replicated as a systemic feature. Developing countries need to increase their enrollment in technical tertiary education and improve the quality and relevance of such education. Such an increase would accelerate growth and help with skill limitations created by green policies.

Leading educational institutions of the world are already on this track. Stanford University now has 500 courses that include a component of sustainability embedded across the curriculum for various disciplines – medicine, mathematics, economics, engineering, law, and life sciences. The University’s Sustainability 3.0

**Table 15.3** Education and training for greening in one industry: green construction

| Objectives  | Basic education   | Skills, technical education, training   | Tertiary/professional education  |
|---|---|---|--|
| Reducing CO <sub>2</sub> emissions                        | Investments to strengthen STEM teaching   | Technicians (fitting, retrofitting), plumbers, masons, painters, electricians   | Planners, architects, interior designers   |
| Improving energy efficiency                               |   |   | Engineers certified for green building skills  |
| Expanding use of clean energy technologies                | Incorporating Education for Sustainable Development in school curriculum                                    | HVAC installers for using energy efficiency tools and techniques  | Marketing managers appraisers, valuers, property managers certified for green  |
| Ensuring safety   | Quality improvements in secondary school curriculum   | Contractors and materials managers for using appropriate materials and processes for insulation, roof, walls, lighting, appliances, water heating, water harvesting | Energy auditors, building inspectors   |
| Implementing environmental protection, water conservation | Improving teacher training for developing young scientists and turning student into enquirers and explorers |   | Finance and accounting professionals<br>Insurance and credit valuation   |
| Promoting recycling                                       | Strengthening the measurement and monitoring of learning outcomes   | Safety engineers (disaster proofing)  | Certification – of processes, professionals, and products (certified architects, finance professionals, marketing managers, appraisers, valuers) |
|   | Using schools as “green” buildings and implementing practical greening initiatives                          | Supply chain managers and inventory managers  |  |
|   | Green schools   | Installation and maintenance of equipment and materials<br>Green TVET institutions  | LEED certification<br>Trainers and instructors for green or greening occupations   |

HVAC=Heating, Ventilating, and Air Conditioning; LEED=Leadership in Energy and Environmental Design; STEM=Science, Technology, Engineering, and Math.

Source: Compiled by author.

Strategy aims to reduce the environmental impact of students and campus buildings. Columbia University has a Master of Science in Sustainability Management and an extensive array of sustainability management courses. Columbia and IBM have partnered to launch a green-tech skills initiative to provide next-generation entrepreneurs access to skills needed to accelerate sustainability projects and to be competitive when they enter the workforce. Hong Kong University proposes to start a Master of Arts in Education for Sustainability. TERI University of India as a specialized

institution focuses on courses in climate science and policy, natural resource management, environment studies, renewable energy engineering and management, sustainable development practices, etc. The Petroleum University of Gujarat has established a school of solar energy. Much more work is at hand to increase the global availability of qualified and skilled professionals.

There is need for education and training systems to consider the breadth and depth of skills, education, and training needed across the entire spectrum of greening economies and corporations. The advancement of green growth theories would require capacities and knowledge for valuation of ecosystem and measurement of natural capital in macroeconomic terms and incorporating them into systems of national accounts. A whole new world of finance has opened up as a requirement to advance the green agenda – from carbon finance, financial modeling for sustainable cities, buildings, and townships to sustainability finance managers. Highly technical and scientific skills are needed in the context of reducing emission, enabling cleaner and lower-carbon cities, transport systems, and habitats. But the most important aspect is to ensure that education and training systems themselves become more innovative and forward looking, so that while they respond to the emerging needs of green professionals, they also play a more influential and far-reaching role in anticipating and preparing for sustainable and resilient societies.

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