



The Association of Academies of Sciences in Asia (AASA)

TOWARDS A SUSTAINABLE ASIA

ENERGY



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Beijing



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TOWARDS A SUSTAINABLE ASIA: ENERGY

With 22 figures



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Foreword

Asia is not only the largest and most populated continent in the world, but also the region with the most diverse development models and most dynamic economies. In the past half century, Asia has been witnessing rapid economic growth and playing an increasingly more important role in world's political and economic arena. At the same time, Asia has developed the commonly-called "Asia Model", which has attracted worldwide attention. The Asia Model shows a new way for the developing nations or late-development countries on how to realize industrialization and modernization. All these achievements are made by Asian countries with a focus on the advantages of their late development, re-examination of their internal cultural values, active absorption of modern S&T and management experiences and constant exploration and innovation.

These social progresses have made great contributions to the realization of the UN Millennium Development Goals and have played a pioneering and demonstration role on what can be accomplished in today's world. However, Asia is facing big challenges. The most prominent one is that the rapid development of Asian economies is based on large input of production factors at the huge expense of natural resources and environment, which has been sharpening the conflicts in population, resources, environment, socio-economic development. The sustainable development in the region is being severely threatened and challenged. The rethinking and questioning of the Asia Model in the international community is growing especially in the era of post Asia Financial Crisis and Global Financial Crisis.

It is not only a common challenge for the governments of Asian countries, but also a common task for the Asian scientific communities to cope with the resources and environment crisis and to seek a new way of sustainable development in Asia. AASA, as a non-governmental and regional international scientific organization with 26 member academies, is mandated to initiate and conduct investigation on issues concerning S&T, economic and social development. As early as April 2007, AASA proposed to initiate a project on "Sustainable Development in Asia" (SDA) within AASA framework in the hopes to provide consultation and advice for national and regional governments in Asia and relative international organizations. This study proposal was approved at AASA board meeting held in Russia in August 2007 with the Chinese Academy of Sciences as the initiator. The project covers environment, energy,

resources and culture with the establishment of four working groups among AASA member academies.

Soon after, the SDA project was officially launched and implemented at different levels. The efforts include the clarification of the research content, emphasis, structure and division of tasks. Various meetings at the working level and international workshops have been held to coordinate the research activities and project progress: the first international workshop under this project was held in February 2008; the AASA Workshop on Sustainable Energy Development in Asia in November 2008; the AASA Workshop on Agricultural Culture and Asian Sustainable Development in August 2009; and the AASA Workshop on Environment and Resources in September 2009.

With the joint efforts of AASA member academies, the SDA project has now come up with a series of studies including four thematic reports, namely, “Towards a Sustainable Asia: Energy”, “Towards a Sustainable Asia: Environment and Climate Change”, “Towards a Sustainable Asia: Natural Resources”, and “Towards a Sustainable Asia: The Cultural Perspectives”. Based on these four reports, a synthesis report has also been written entitled: “Toward a Sustainable Asia: Green Transition and Innovation”. All these reports have looked deeply into the common issues and challenges for the Asian sustainable development from different perspectives.

The synthesis report is an integration and extension of the four thematic reports. It aims at the major resource and environmental challenges and issues in Asia in the general context of the challenges of financial crisis and climate change, and in line with green transition and innovation in Asia. Of its major findings, it includes: the diagnosis of key resource and environmental issues in Asia, such as water, minerals, land resource, environmental pollution, eco-degradation, energy and environment and climate change, the revelation and reflection of the diverse, different, complicated and severe nature of resource and environmental issues in Asia, the systematic analysis of the main driving forces and future trends of resource and environmental changes in Asia, the empirical analysis and discretion of current evolution of the relationship between environment and development in Asia with the establishment of theoretical and conceptual models, the initiation of principals, strategic framework, focus and advice for promoting the green development of Asia on the basis of summarizing Asia's advantages and disadvantages.

The synthesis report differs from other similar reports. It focuses more on the combination of theoretical and empirical research in the evolution of environment and development, on the combination of trends analysis in time series and comparative study at spatial scale, and on the combination of Asia's integrated analysis and regional and national differences. Besides, attempts have been made here on the innovative modeling of the evolutionary and theoretical relationship between environment and development, analysis of the driving

forces in environmental evolution, and utilization of newly developed composite index to conduct empirical research of Asia's environment and development relation in the evolution.

We hope the reports will be of good value to the facilitation of the green development in Asia, providing advice on dealing with the shortage of conventional resources, environment pollution and climate change, fostering new economic growth and enhancing Asia's competitive advantages. This is the first time that AASA has ever undertaken such a study, and it surely leaves grounds for more detailed study and analysis of various issues and challenges that Asian countries face in the future.

The SDA project is sponsored by AASA. I want to give my special thanks to all AASA member academies for their consistent support, advice and assistance, without which, the accomplishment of such an internationally interdisciplinary scientific project would be impossible. My thanks also go to all the members in the working groups, especially Professors Namık Aras and Yi Wang, co-chairs of this study, without whom, efficiency and quality of the study would not be guaranteed. I also need to thank United Nations Environment Programme (UNEP), InterAcademy Council (IAC) and InterAcademy Panel (IAP) etc. for providing us the references and various advice and inspirations. Last but not the least, I want to express my thanks to all friends and the institutions that have rendered us encouragement and assistance all the way along.

The SDA project features with a wide range of fields and a huge amount of data, some of which are still in their early stage of development. Any comments or suggestions from our friends and various international institutions are warmly appreciated.

Prof. Jinghai Li

President

The Association of Academies of Sciences in Asia (AASA)

September 20, 2010

Preface

Vision of the Association of Academies of Sciences in Asia (AASA) is to provide a forum to discuss and provide advice on issues related to science and technology and the application of technology for national development. During the year 2008, two workshops were organized by AASA in Beijing. These workshops were devoted to sustainable energy development in Asia. This report was based on presentation paper and meeting discussion. The whole project is coordinated by Prof. Wang Yi from the Chinese Academy of Sciences and Prof. Namik K. Aras, the secretary general of AASA, from the Turkish Academy of Sciences. The energy group work is coordinated by Prof. Yan Luguang from China and Prof. Seung Mo Oh from Republic of Korea.

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This report is inevitable to be imperfect due to the limitation of knowledge and time of the Study Group. Comments and corrections are welcomed.

Study Group on Energy

August 2010

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1 | Introduction

The Association of Academies of Sciences in Asia (AASA) is a non-profit organization, established in 2000, comprising 26 Academies. The vision of AASA is to provide a forum to discuss and provide advice on issues related to science and technology and the application of technology for national development. Since its establishment, AASA has held many symposia, conferences and scientific meetings. Based on several proposals from member academies, it was decided in April 2007 to organize a new project termed as “Sustainable Development in Asia”, covering four main areas: energy, environment, natural resources and social & cultural development. The whole project is coordinated by Prof. Wang Yi from the Chinese Academy of Sciences and Prof. Namik K. Aras, the secretary general of AASA, from the Turkish Academy of Sciences. The energy group work is coordinated by Prof. Yan Luguang from China and Prof. Seung Mo Oh from Republic of Korea.

During the year 2008 two workshops were organized in Beijing. The first workshop was held during February 25-26 and was devoted to the whole project “Sustainable Development in Asia”, including the four groups—energy, environment, natural resources and social development & culture, 27 experts from 10 countries attended, 8 papers related to energy from 8 countries were presented (see Appendix A). From the information exchange and discussion that followed it was clear that the energy situation and conditions are quite different in different Asian countries. So to make a more reliable report for sustainable energy development in Asia, it was suggested that every country should provide a national report concerning its energy situation, perspective, main features, challenges and opportunities, policies and sustainable development suggestions. Based on these national reports a summary report for the whole of Asia was to be formulated. As such, it was decided to organize a second workshop in winter 2008 devoted entirely to sustainable energy development in Asia.

Since the InterAcademy Council (IAC) had carried out a sustainable energy study in 2005-2007 and published a report entitled “Lighting the Way: Toward a sustainable energy future” in October 2007, Nobel Laureate Steven Chu pointed out that “This report represents the convergence of some of the

best minds and top institutions in the world to establish the necessary direction for governments, scientists, engineers, and industry—indeed society as a whole—to secure clean, sustainable energy required for our prosperity” and that it can serve as some basis for our future work for Asia. Accepting this proposal, the IAC and InterAcademy Panel (IAP) very actively supported to organize this second workshop. This second workshop was held during November 17-18, 2008, and was attended by 31 experts from 11 countries, who presented 15 papers and 3 papers from the first workshop from Russia, Mongolia and Azerbaijan were also included. Thus representing totally 14 national reports from 14 countries. On behalf of IAC, Prof. Dato Engr. Lee Yee Cheong presented the IAC report “Lighting the Way: Toward a sustainable energy future” (see Appendix A). On the basis of all reports and discussions held after each presentation, a half day special session devoted to discuss the content and organization of the final report was held. At this discussion, it was decided to organize a study panel with 17 members to provide maximum possible material and data, mobilize all AASA member-countries to provide their national reports with all necessary data, information and suggestion, and also to collect all possible statistical data and suggestion from official publications. A small group was assigned to plan and write the draft report “Sustainable Energy Development in Asia”, the first draft report was sent to all panel members to get their comments, modifications and opinions. After amendments based on the comments and opinions, the present report—the second draft report was prepared. Finally the complete report will be sent to Prof. Yi Wang and Prof. Namik K. Aras and the project office to form the synthesis report and to organize the necessary peer review.

2 | General Situation of Energy Development in Asia

There are many publications with statistical data of the energy development in the world, in Appendix 3 we have presented in 6 tables the current data for 2005-2007, including the area, population, GDP, the primary energy consumption and its structure, the primary energy production and its balance with consumption, the electricity generation, installed capacity and its structure for all 48 Asia countries. Since Russia is located such that a part of it belongs to Asia and the remainder to Europe, it is difficult to separate the corresponding data for Asia and Europe, so the data cited for Russia, refers to the entire country and as such, the figures may include those belonging to the European part of Russia.

From Appendix B, it can be seen that the total land area of Asia is 48.9 Mkm², it is 32.7% of the total earth land area (149.5 Mkm²); the total population of Asia in 2007 was 4,108 millions, it is 62.3% of the total world population (6,596 millions); the total GDP of Asia in 2007 was 14,713 billion US dollars, it is 27.1% of the world GDP (54,347 billion US dollars); the GDP per population in Asia was 3,582 US dollars/person in 2007, it is 43.5% of the world average (8,240 US dollars/person); the total energy consumption in 2006 was 5,290 Mtoe in Asia, it is 44.7% of the world consumption (11,844 Mtoe). The energy consumption per unit GDP in 2006 was 0.417 toe/k US dollars in Asia. It is 170% of the world average (0.246 toe/k US dollars). Per capita energy consumption in Asia is 1.30 toe/(person-year), it is 71.4% of the world average (1.82 toe/(person-year)). Figures 2.1-2.4 illustrate respectively the world population, GDP, energy consumption, per capita energy consumption and their distribution among different countries.

Geographically, Asia is divided into 6 regions, i.e.: East Asia, South-East Asia, South Asia, West Asia, Central Asia and North Asia. The East Asia has 5 countries (China, DPR of Korea, Republic of Korea, Mongolia and Japan) with a total area of 11.76 Mkm² (24.0% of that of Asia), 1,525 M population (37.1% of the total population of Asia), 8,630 Billion US dollars GDP (58.7% of the Asia GDP) and 2,702 Mtoe energy consumption (51.1% of the Asia energy consumption). South-East Asia has 11 countries (Vietnam, Lao PDR,

Cambodia, Burma, Thailand, Malaysia, Singapore, Indonesia, Philippines, Brunei and Timor-Leste), with a total area of 4.51 Mkm² (9.2% of that of Asia), 574.8 M population (14.0% of the total population of Asia), 1,261 Billion US dollars GDP (8.6% of the Asia GDP) and 396 Mtoe energy consumption (7.5% of the Asia energy consumption). South Asia has 7 countries (India, Pakistan, Sri Lanka, Bangladesh, Nepal, Bhutan and Maldives) with a total area of 4.5 Mkm² (9.2% of that of Asia), 1,496 M population (36.4% of the total population of Asia), 1,427 Billion US dollars GDP (9.7% of the Asia GDP) and 531 Mtoe energy consumption (10.0% of the Asia energy consumption). West Asia has 16 countries (Afghanistan, Iran, Turkey, Cyprus, Syria, Lebanon, Jordan, Iraq, Kuwait, Saudi Arabia, Yemen Arab Republic, Oman, United Arab Emirates, Qatar, Bahrain and Israel), with a total area of 6.8 Mkm² (14.0% of that of Asia), 295 M population (7.2% of the total population of Asia), 1,907 Billion US dollars GDP (13.0% of the Asia GDP) and 703 Mtoe energy consumption (13.3% of the Asia energy consumption). Central Asia has 8 countries (Turkmenistan, Uzbekistan, Kirgizstan, Kazakhstan, Tajikistan, Armenia, Azerbaijan and Georgia) with a total area of 4.2 Mkm² (8.6% of that of Asia), 76 M population (1.86% of the Asia population), 197 Billion US dollars GDP (1.34% of The Asia GDP) and 191 Mtoe energy consumption (3.6% of the Asia energy consumption). North Asia is Russia with a total area of 17.1 Mkm² (34.9% of that of Asia), a population of 141.4 M (3.4% of that of Asia), GDP is 1,291 Billion US dollars (8.8% of that of Asia), energy consumption is 768 Mtoe (14.5% of that of Asia). The countries in each of the above regions have close similarities, though different regions are quite diverse.

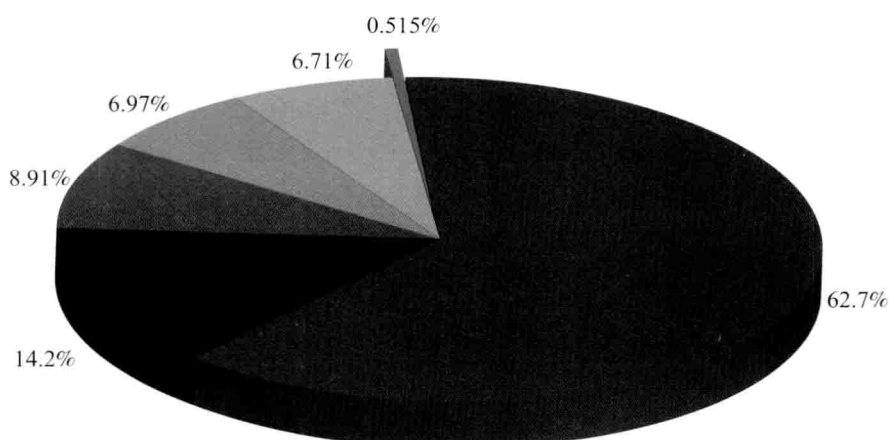
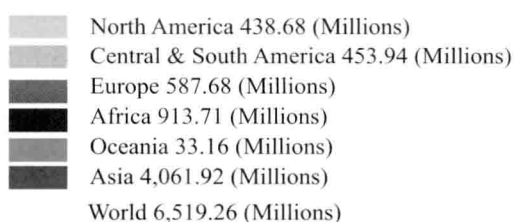


Figure 2.1 Percent and value of world population in 2006

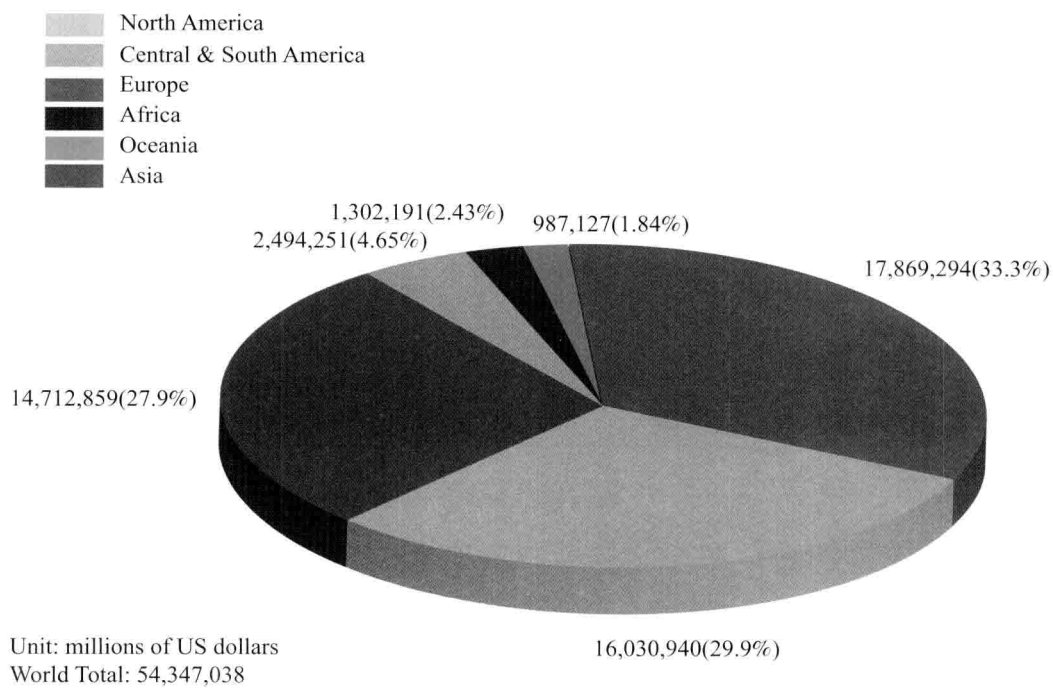


Figure 2.2 World GDP and it's distribution in 2007

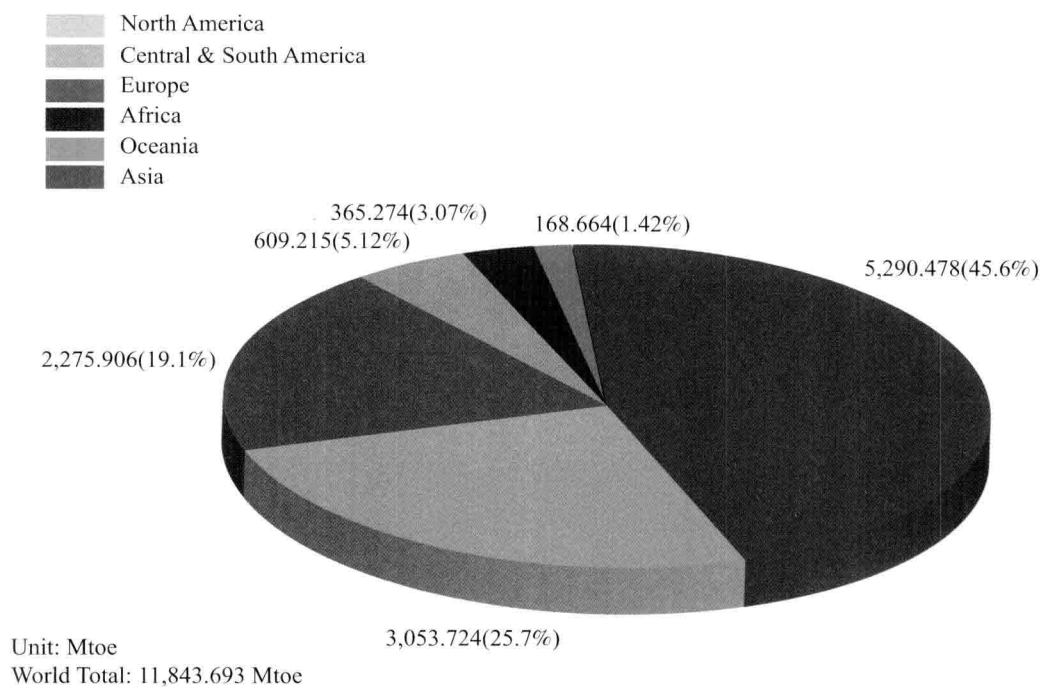


Figure 2.3 Percent of world energy consumption in 2006

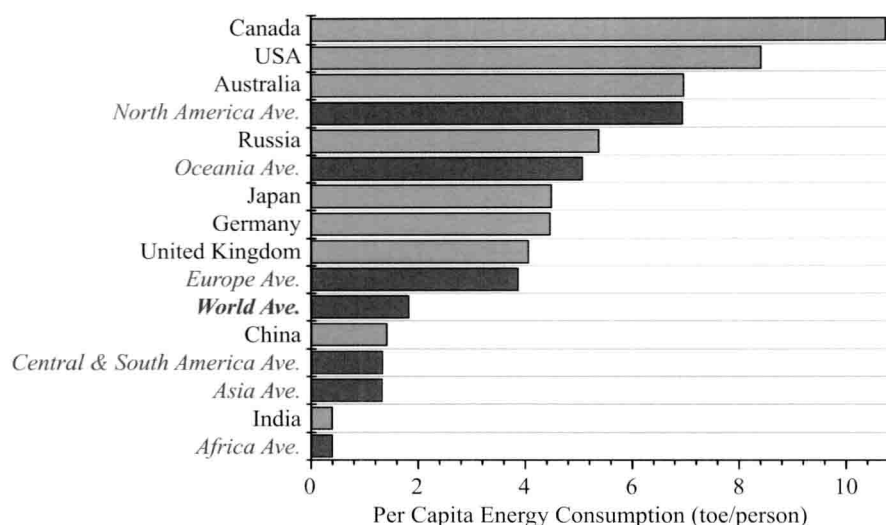
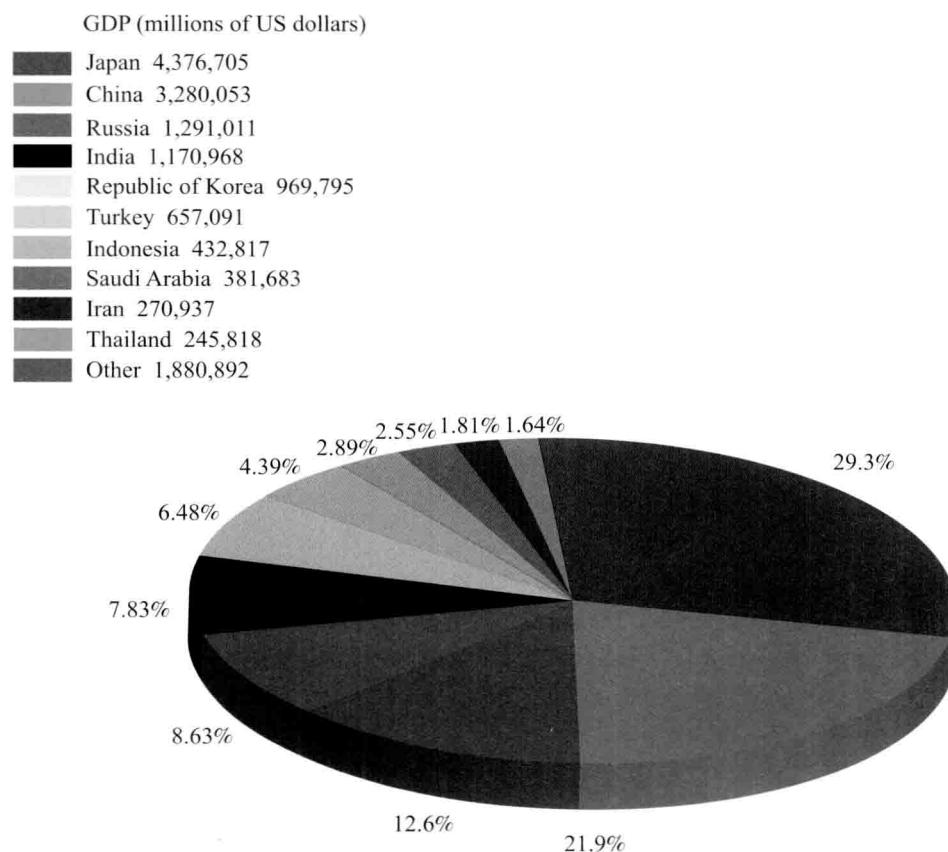


Figure 2.4 Per capita energy consumption of world in 2006

The economic development level of every country can be determined by its GDP and per Capita GDP values. Figures 2.5-2.7 present the corresponding curves for 2007. It can be seen that Japan, China, Russia, India and Republic of Korea have a total GDP of over 1,000 Billion US dollars, the sum of their contribution reaching 74.1% of the total GDP of Asia, the total contribution



Asia Total GDP in 2007: 14,712,859 (millions of US dollars)

Figure 2.5 Asia total GDP in 2007 and it's distribution