EXECUTIVE SUMMARY

Over the last half-decade, the clean energy economy has emerged around the world as a major new opportunity for investment, manufacturing, jobs and environmental protection. This report explores scenarios for the dynamic expansion of electricity from renewable resources over the next decade.

The future trajectory of investments in clean power projects over the next decade will be determined by the strength of policies adopted by G-20 countries. If clean energy policies are strengthened significantly in the coming years, we project that $2.3 trillion will be invested in clean power assets over the next 10 years, offering companies and countries enormous opportunities to compete for investments, jobs and export markets. Under current policies, however, cumulative investments would only reach $1.7 trillion over the next decade. In other words, strong policies would leverage an additional $546 billion worth of investment.

In all scenarios, clean energy power investments shift to Asia, led by dramatic increases in China and India. Still, all countries stand to gain from adoption of enhanced clean energy policies. The United States is a case in point as one of the three countries (along with India and the United Kingdom) that have the most to gain from adoption of aggressive clean energy policies, when enhanced policies are compared to current ones.

From an environmental perspective, current and Copenhagen policies (associated with pledges made at the 2009 Climate Summit) are insufficient – only enhanced clean energy policies will ensure that the power sector contributes to the scientific goal of curtailing global warming at 2 degrees Celsius.

The clean energy economy has emerged rapidly in recent years. The Pew Charitable Trusts' March 2010 report, *Who's Winning the Clean Energy Race? Growth, Competition and Opportunity in the World's Largest Economies*, chronicled the dawning of the global clean energy economy from 2005 to 2009. That report looked at 2009 investment totals and trends in the G-20 member nations, which together account for more than 90 percent of the world's clean energy finance and investment. Our first report found that clean energy investment increased by 230 percent from 2005 to 2009 to $162 billion.

We found that China, for the first time, led the world in attracting clean energy investment and ranked at or near the top of all G-20 countries in nearly every measurement of clean energy growth. In contrast, the report found that the United States fell to second in the world in attracting clean energy investment and lagged behind other leaders on a variety of key metrics.

While our first report looked at past trends, *Global Clean Power: A $2.3 Trillion Opportunity* examines three policy scenarios for future growth in clean energy investment, all of which present opportunities for the G-20 overall and for each nation comprising it.

The three scenarios modeled in this report are as follows:

Current Policies – This scenario assumes G-20 countries do not adopt any new climate or clean energy policies beyond those currently in effect.

Copenhagen Policies – This scenario assumes G-20 countries adopt and implement the policies required to meet pledges made pursuant to the United Nations Framework Convention on Climate Change Conference of the Parties (UNFCCC COP) in Copenhagen, Denmark, in 2009.

Enhanced Clean Energy Policies – This scenario assumes that G-20 countries pursue enhanced clean energy policies in order to further reduce greenhouse gas emissions and maximize clean energy investments.

These scenarios were developed in collaboration with Pew's research partner, Bloomberg New Energy Finance, the world's leading provider of data and analysis on clean energy finance and investment. For this report, Bloomberg New Energy Finance used its Global Energy and Emissions Model (GE^2M) to project G-20 asset financing for renewable energy technologies used to generate electricity. Asset financing is associated with the construction/installation of clean energy equipment and generating capacity. This report looks exclusively at asset financing for wind, solar, biomass and energy from waste, small-hydro, geothermal and marine technologies because these investments can be reliably modeled into the future (unlike technology innovation or initial public offerings).[2] Unlike the first report, this study does not examine investments in biofuels or energy efficiency due to significant questions surrounding the reliability of production targets for the former and the challenge of quantifying the latter, as described in detail in Appendix III.

KEY FINDINGS

1. OPPORTUNITY ABOUNDS

All G-20 countries have an opportunity to attract more private investment in renewable energy assets by adopting strong clean energy policies. In turn, these investments will yield economic and environmental benefits in terms of increased jobs and reduced emissions of greenhouse gases. From 2010 to 2020, enhanced clean energy policies could increase annual investments in G-20 renewable energy assets by more than $200 billion over 2010 levels, a 161 percent increase. In contrast, current and Copenhagen policies increase investment levels by a much more modest 46 and 64 percent above 2010 levels, respectively. Cumulatively, the enhanced clean energy policy scenario results in total investments in G-20 renewable energy assets of $2.3 trillion – $546 billion more than is projected under the current policy scenario.

The investment levels realized by individual members of the G-20 are not set in stone. With enhanced policies (e.g., strong renewable electricity standards, putting a price on carbon), countries can attract increased private investment in renewable energy projects. On average, enhanced clean energy investments will increase cumulative investments across the G-20 by more than 30 percent. Increased investment levels in the G-20, individually and collectively, present investment and economic opportunities for individuals and companies around the world. The private investments projected in this report are not tied to nations or boundaries – they are an opportunity for all. In today's integrated global marketplace, factories in one country are connected through supply chains with innovators, engineers and parts manufacturers in other countries. Companies that

[2] Research included the following renewable energy projects: all biomass, geothermal and wind generation projects larger than 1 megawatt, all hydro projects of between 0.5 and 50 megawatts, all solar projects of more than 0.3 megawatts, all marine energy projects.

create, produce and engineer clean energy goods and services have an opportunity to compete for business opportunities throughout the G-20.

2. ASIA LEADS THE WORLD IN CLEAN ENERGY INVESTMENTS BASED ON SURGING GROWTH IN CHINA AND INDIA

In 2010, Asia emerged as the top regional destination for clean energy finance and investment – a position that it is projected to maintain through 2020 thanks to the rapid investment growth in the region. Within the G-20, China, India, Japan and South Korea are projected to account for approximately 40 percent of clean energy project investments in 2020 under all three scenarios, with the Americas and Europe trailing. Asia's growth is driven in large part by increased demand. It is expected that 90 percent of future energy demand growth will come from developing countries over the next 20 years. Of that incremental energy demand growth, 53 percent is expected to come from China and India alone.[3]

China leads the way in attracting clean energy investments. Under the enhanced clean energy scenario, China could attract $93 billion worth of clean energy asset financing in 2020. Cumulatively, in this scenario, $620 billion is projected to be invested in renewable energy assets in China over the next 10 years. India is the other rising clean energy leader in Asia. While India ranked 10th in private clean energy investments among G-20 members in 2009, over the next 10 years it is expected to rise to third under all three 2020 scenarios modeled in this report. Annual clean energy investment in India is forecast to grow by as much as 763 percent between 2010 and 2020 under enhanced clean energy policies, and 369 percent under current policies.

3. THE UNITED STATES WOULD BENEFIT FROM STRONG CLEAN ENERGY POLICIES

While renewable energy asset financing is projected to rise in the United States under all scenarios, the United States would benefit from strong clean energy policies. If enhanced national clean energy policies were enacted, investment would ramp up to $53 billion annually by 2020—a rise of 237 percent over 2010 levels. Under current and Copenhagen policies, investment rises 73 and 90 percent, respectively. Cumulatively, the United States has the potential to attract $342 billion in private clean energy investments over the next decade. In fact, the United States is one of the three countries with the most to gain from adoption of aggressive clean energy policies, when enhanced policies are compared to current policies. The difference between cumulative investments in the current policies and enhanced clean energy policies scenarios for the United States is $97 billion (40 percent). Only India and the United Kingdom, which could increase cumulative investments 48 percent under the enhanced policy scenario, have the potential to increase investments at a higher rate.

4. EUROPE'S CLEAN ENERGY ECONOMY MATURES

The European Union has the potential to increase cumulative investments by 20 percent to $705 billion from 2010 to 2020 if the enhanced policy scenario is realized. Given its early leadership in clean energy

[3] World Energy Outlook 2009 Fact Sheet, *Why is our current energy pathway unsustainable?* International Energy Agency, www.iea.org/weo/docs/weo2009/fact_sheets_WEO_2009.pdf.

development, it is expected that the European marketplace will mature in the coming decade, as investment in some of the early leaders declines and new entrants step forward. Growth opportunities are greatest for Southern Europe and offshore wind. Under all scenarios, over the next decade Europe falls behind Asia in renewable energy asset financing. Nonetheless, clean energy investments in Europe will remain sizable. Taken together, EU Member States are expected to attract $56 billion in annual investments by 2020 under current policies, $62 billion if Copenhagen pledges are met and $85 billion if enhanced clean energy policies are pursued. In this scenario, investments in the United Kingdom increase by a robust 260 percent but fall in Germany and grow by less than 50 percent in France and Italy. In terms of cumulative investments over the next decade, Germany has the potential to realize more than $208 billion worth of investment in the enhanced policy scenario, followed by the United Kingdom at $134 billion and Italy at $90 billion. Strong European growth rates in the enhanced policies scenario occur in the other EU Member States, which collectively could see cumulative investments of $216 billion from 2010-2020.

5. CLEAN ENERGY POLICIES REDUCE GREENHOUSE GAS EMISSIONS

Under all scenarios, increased investment helps to stem greenhouse gas emissions by G-20 members, which account for the overwhelming majority of global emissions. That said, only the enhanced clean energy policy scenario is consistent with the absolute reductions in greenhouse gas emissions by 2020 that scientists suggest are necessary to avoid global warming in excess of 2 degrees Celsius. In the current policies scenario, global carbon emissions increase by 24 percent over 2005 levels. Our modeling also shows that pledges made by nations in conjunction with the UNFCCC COP in Copenhagen (see Appendix II) have only a modest environmental impact – with

FIGURE 1. GLOBAL AVERAGE TEMPERATURES AND CORRELATING EXPECTED SEA-LEVEL RISE

Category	CO_2 concentration at stabilization (2005 = 379 ppm)	CO_2 equivalent concentration at stabilization including GHGs and aerosols (2005 = 375 ppm)[b]	Peaking year for CO_2 emissions[a,c]	Change in global CO_2 emissions in 2050 (percent of 2000 emissions)	Global average temperature increase above pre industrial at equilibrium, using "best estimate" climate sensitivity	Global average sea-level rise above pre industrial at equilibrium from thermal expansion only	Number of assessed scenarios
	ppm	ppm	year	percent	°C	meters	
I	350 – 400	445 – 490	2000 – 2015	-85 to -50	2.0 – 2.4	0.4 – 1.4	6
II	400 – 440	490 – 535	2000 – 2020	-60 to -30	2.4 – 2.8	0.5 – 1.7	18
III	440 – 485	535 – 590	2010 – 2030	-30 to +5	2.8 – 3.2	0.6 – 1.9	21
IV	485 – 570	590 – 710	2020 – 2060	+10 to +60	3.2 – 4.0	0.6 – 2.4	118
V	570 – 660	710 – 855	2050 – 2080	+25 to +85	4.0 – 4.9	0.8 – 2.9	9
VI	660 – 790	855 – 1130	2060 – 2090	+90 to +140	4.9 – 6.1	1.0 – 3.7	5

Source: *Climate Change 2007: Synthesis Report*, Intergovernmental Panel on Climate Change, www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf, p. 67.

global carbon emissions increasing 21 percent over 2005 levels in the next decade, not enough to stabilize concentrations at the level identified by the Intergovernmental Panel on Climate Change (IPCC) to avert far-reaching effects of climate change. But emissions in the enhanced policy scenario are just over 44 gigatons of carbon equivalent, the level that the United Nations Environment Programme recently estimated[4] as consistent with the goal of keeping global warming below 2 degrees, as Figure 1 presents.

6. RENEWABLE ENERGY CAPACITY ADDITIONS COULD EXCEED 177 GIGAWATTS ANNUALLY BY 2020

All clean energy technologies will be deployed in increasing quantities over the next 10 years. Under the enhanced clean energy policies scenario, annual renewable energy capacity additions could exceed 177 gigawatts (GW) by 2020. Collectively, the G-20 could see cumulative capacity additions of 1,180 gigawatts over the next decade if the enhanced policy scenario is realized.

WIND

Wind energy is projected to be the leading recipient of asset financing through 2020, reflecting its status as a relatively mature and cost-competitive large-scale clean energy technology. Under the enhanced clean energy scenario, asset financing in wind power escalates to $190 billion—an increase of 222 percent over 10 years. Wind accounts for more than 50 percent of China's investments in each scenario.

SOLAR

Solar accounts for the second-largest share of asset financing in G-20 countries and maintains this position under all scenarios, retaining a fairly constant 18 percent share of total renewable energy investment. That said, the value of solar investments is projected to decline under the current and Copenhagen policy scenarios because increased sales are unlikely to keep pace with the rapid decline in prices for solar panels. Under the enhanced policies scenario, solar investments increase by 53 percent.

OTHER RENEWABLE ENERGY TECHNOLOGIES

The good news for biomass, geothermal, waste energy and small-hydro power is that, collectively, investment levels in this category rise more than wind and solar if countries implement more ambitious clean energy policies. Overall, investment could grow by 263 percent to $69 billion in 2020 under the enhanced policy scenario. Biomass and energy from waste, and small-hydro receive the most financing, while comparatively little is spent on geothermal and marine technologies.

[4] United Nations Environment Program, "Are the Copenhagen Pledges Sufficient to Limit Global Warming to 2° C or 1.5° C? A Preliminary Assessment." November 2010, p. 4, www.unep.org/publications/ebooks/emissionsgapreport/pdfs/EMISSIONS_GAP_TECHNICAL_SUMMARY.pdf

7. POLICY MATTERS

The extraordinary worldwide growth in clean energy investment over the past five years has been defined by a simple fact: Where supportive clean energy policies are adopted, investment follows. Time and again, it has been shown that nations with the strongest policy frameworks have attracted the most capital and enjoyed the associated economic benefits, including job creation. In today's integrated global economy, no country or company can develop a monopoly on clean energy production. Growth in the clean energy sector creates jobs up and down the supply chain – from engineering to shipping – and market expansion can benefit workers and businesses all over the world.

If G-20 countries do not implement any further policies, investment in renewable energy assets is projected to reach $189 billion by 2020—a modest 46 percent above 2010 levels. If those same nations implement their pledges made in Copenhagen, financing grows incrementally to $212 billion—growth of 64 percent over 2010. However, if comprehensive and effective measures are introduced to maximize a nation's share of the global clean energy economy, investment could reach $337 billion annually in 2020—an increase of 161 percent compared with 2010 investments in renewable energy assets.

These impressive investment levels reveal the enormous potential for nations to benefit from renewable energy investment growth over the next decade if countries adopt enhanced energy and climate policies. It is clear from the research that neither current policies nor the emission-reduction targets pledged by member nations under the Copenhagen Accord in January 2010 are sufficient to maximize renewable energy investment or to meet worldwide goals for curbing global warming.