

TECHNICAL SUMMARY

Johansson; Thomas B.; Nakicenovic, Nebojsa; Patwardhan, Anand; Gomez-Echeverri, Luis; Banerjee, Rangan; Benson, Sally M.; Bouille, Daniel H.; Brew-Hammond, Abeeku; Cherp, Aleh; Coelho, Suani T.; Emberson, Lisa; Figueroa, Maria Josefina; Grubler, Arnulf., He, Kebin; Jaccard, Mark; Ribeiro, Suzana Kahn; Karekezi, Stephen; Larson, Eric D.; Li, Zheng; McDade; Susan; Mytelka, Lyn K.; Pachauri, Shonali; Riahi, Keywan; Rockström, Johan; Rogner, Hans-Holger; Roy, Joyashree; Schock, Robert N.; Sims, Ralph; Smith, Kir R.; Turkenburg, Wim C.; Ürge-Vorsatz, Diana; Hoppel, Frank von; Yeager, Kurt

The world is undergoing severe and rapid change involving significant challenges. Although this situation poses a threat, it also offers a unique opportunity – a window of time in which to create a new, more sustainable, more equitable world, provided that the challenges can be addressed promptly and adequately. Energy is a pivotal area for actions to help address the challenges.

The interrelated world brought about by growth and globalization has increased the linkages among the major challenges of the 21st century. We do not have the luxury of being able to rank them in order of priority. As they are closely linked and interdependent, the task of addressing them simultaneously is imperative.

Energy offers a useful entry point into many of the challenges because of its immediate and direct connections with major social, economic, security, and development goals of the day. Among many other challenges, energy systems are tightly linked to global economic activities, to freshwater and land resources for energy generation and food production, to biodiversity and air quality through emissions of particulate matter and precursors of tropospheric ozone, and to climate change.

Most of all, access to affordable and cleaner energy carriers is a fundamental prerequisite for development, which is why GEA places great emphasis on the need to integrate energy policy with social, economic, security, development, and environment policies.

JOHANSSON; Thomas B.; NAKICENOVIC, Nebojsa; PATWARDHAN, Anand; GOMEZ-ECHEVERRI, Luis; BANERJEE, Rangan; BENSON, Sally M.; BOUILLE, Daniel H. ; BREW-HAMMOND , Abeeku; CHERP, Aleh; COELHO, Suani T. Coelho; Emberson, Lisa; Figueroa, Maria Josefina; Grubler, Arnulf., He, Kebin; Jaccard, Mark; Ribeiro, Suzana Kahn; Karekezi, Stephen; Larson, Eric D.; Li, Zheng; McDade; Susan; Mytelka, Lyn K.; Pachauri, Shonali; Riahi, Keywan; Rockström, Johan; Rogner, Hans-Holger; Roy, Joyashree; Schock, Robert N.; Sims, Ralph; Smith, Kir R.; Turkenburg, Wim C.; Ürge-Vorsatz, Diana; Hoppel, Frank von; Yeager, Kurt. **Technical Summary**. In: JOHANSSON; Thomas B.; NAKICENOVIC, Nebojsa; PATWARDHAN, Anand; GOMEZ-ECHEVERRI, Luis. **GLOBAL ENERGY ASSESSMENT TOWARD A SUSTAINABLE FUTURE**, Cambridge: Cambridge University, 2012 , 1900p. Cap. 2. p.31-94.

TECHNICAL SUMMARY

The good news is that humanity has the resources, the ingenuity, and the technologies to create a better world. The bad news is that the lack of appropriate institutions, their interaction and integration, capacities, and governance structures makes the task difficult. Raising the level of political will to address some of these challenges could go a long way toward making significant progress in achieving multiple goals. This is a major task, however, given the tendency of current decision-making processes to aim for short-term, quick results. GEA endeavors to make a compelling case for the adoption of a new set of pathways – pathways that are essential, required urgently, and – most important – achievable.

GEA highlights essential technology-related requirements for radical energy transformation:

- significantly larger investment in energy efficiency improvements, especially end-use, across all sectors, with a focus on new investments as well as major retrofits;
- rapid escalation of investments in renewable energies: hydropower, wind, solar energy, modern bioenergy, and geothermal, as well as the smart and super grids that enable renewable energies to become the dominant sources of energy;
- reaching universal access to modern forms of energy and cleaner cooking through micro-financing and subsidies;
- use of fossil fuels and bioenergy at the same facilities for the efficient co-production of multiple energy carriers and chemicals;
- full-scale deployment of CCS; and
- on one extreme nuclear energy could make a significant contribution to the global electricity, but in the other, it could be phased out.

To meet humanity's need for energy services, comprehensive diffusion of advanced energy technologies and an increased contribution of energy efficiencies are required throughout the energy system – from energy collection and conversion to end-use. Rapid diffusion of renewable energies is the second, but equally most effective, option for reaching multiple objectives. Sustainable conversion to carriers such as electricity, hydrogen, and heat, along with smart transmission and distribution systems for the most important end-uses are crucial.

JOHANSSON; Thomas B.; NAKICENOVIC, Nebojsa; PATWARDHAN, Anand; GOMEZ-ECHEVERRI, Luis; BANERJEE, Rangan; BENSON, Sally M.; BOUILLE, Daniel H. ; BREW-HAMMOND , Abeeku; CHERP, Aleh; COELHO, Suani T. Coelho; Emberson, Lisa; Figueroa, Maria Josefina; Grubler, Arnulf., He, Kebin; Jaccard, Mark; Ribeiro, Suzana Kahn; Karekezi, Stephen; Larson, Eric D.; Li, Zheng; McDade; Susan; Mytelka, Lyn K.; Pachauri, Shonali; Riahi, Keywan; Rockström, Johan; Rogner, Hans-Holger; Roy, Joyashree; Schock, Robert N.; Sims, Ralph; Smith, Kir R.; Turkenburg, Wim C.; Ürge-Vorsatz, Diana; Hoppel, Frank von; Yeager, Kurt. **Technical Summary**. In: JOHANSSON; Thomas B.; NAKICENOVIC, Nebojsa; PATWARDHAN, Anand; GOMEZ-ECHEVERRI, Luis. **GLOBAL ENERGY ASSESSMENT TOWARD A SUSTAINABLE FUTURE**, Cambridge: Cambridge University, 2012 , 1900p. Cap. 2. p.31-94.

TECHNICAL SUMMARY

A major policy challenge is to resolve the current issue of split incentives, in the sense that those who would be paying for efficiency improvements and other energy investments are more oriented toward short-term rates of return than to the long-term profitability of the investments and, likewise, that they are rarely the beneficiaries of reduced energy bills and other public benefits.

GEA makes the case that energy system transformation is possible only if there is also an interactive and iterative transformation of the policy and regulatory landscape, thereby fostering a buildup of skills and institutions that encourage innovation to thrive, create conditions for business to invest, and generate new jobs and livelihood opportunities.

It is projected that, by mid-century, more than six billion people will live in urban environments. This underscores the importance for policymakers to consider the window of opportunity available in designing the urban landscape, specifically in terms of urban layout, transport structure, and individual buildings/structures and their energy use.

A major finding of GEA is that some energy options provide multiple benefits. This is particularly true of energy efficiency, renewables, and the co-production of synthetic transportation fuels, cooking fuels, and electricity with CCS, which offer advantages in terms of supporting all of the goals related to economic growth, jobs, energy security, local and regional environmental benefits, health, and climate change mitigation.

All these advantages imply the creation of value. This value should be incorporated into the evaluation of these measures (and others) and in creating incentives for their use.

One implication of this is that nations and corporations can invest in efficiency and renewable energy for the reasons that are important to them, not just because of a global concern about, for example, climate change mitigation or energy security. But incentives for individual players to invest in options with large societal values must be strong and effective.

Finally, the GEA pathways describe the transformative changes needed to achieve development pathways toward a more sustainable future – a ‘sustainable future’ that simultaneously achieves normative goals related to the economic growth, energy security, health, and environmental impacts of energy conversion and use, including the mitigation of climate change.

JOHANSSON; Thomas B.; NAKICENOVIC, Nebojsa; PATWARDHAN, Anand; GOMEZ-ECHEVERRI, Luis; BANERJEE, Rangan; BENSON, Sally M.; BOUILLE, Daniel H. ; BREW-HAMMOND , Abeeku; CHERP, Aleh; COELHO, Suani T. Coelho; Emberson, Lisa; Figueroa, Maria Josefina; Grubler, Arnulf., He, Kebin; Jaccard, Mark; Ribeiro, Suzana Kahn; Karekezi, Stephen; Larson, Eric D.; Li, Zheng; McDade; Susan; Mytelka, Lyn K.; Pachauri, Shonali; Riahi, Keywan; Rockström, Johan; Rogner, Hans-Holger; Roy, Joyashree; Schock, Robert N.; Sims, Ralph; Smith, Kir R.; Turkenburg, Wim C.; Ürge-Vorsatz, Diana; Hoppel, Frank von; Yeager, Kurt. **Technical Summary**. In: JOHANSSON; Thomas B.; NAKICENOVIC, Nebojsa; PATWARDHAN, Anand; GOMEZ-ECHEVERRI, Luis. **GLOBAL ENERGY ASSESSMENT TOWARD A SUSTAINABLE FUTURE**, Cambridge: Cambridge University, 2012 , 1900p. Cap. 2. p.31-94.

TECHNICAL SUMMARY

In sum, GEA finds that attainment of a sustainable future for all is predicated on resolving energy challenges. This requires the creation of market conditions, via government interventions, that invite and stimulate investments in energy options that provide incentives for rapid investments in energy end-use and supply technologies and systems.

JOHANSSON; Thomas B.; NAKICENOVIC, Nebojsa; PATWARDHAN, Anand; GOMEZ-ECHEVERRI, Luis; BANERJEE, Rangan; BENSON, Sally M.; BOUILLE, Daniel H. ; BREW-HAMMOND , Abeeku; CHERP, Aleh; COELHO, Suani T. Coelho; Emberson, Lisa; Figueroa, Maria Josefina; Grubler, Arnulf., He, Kebin; Jaccard, Mark; Ribeiro, Suzana Kahn; Karekezi, Stephen; Larson, Eric D.; Li, Zheng; McDade; Susan; Mytelka, Lyn K.; Pachauri, Shonali; Riahi, Keywan; Rockström, Johan; Rogner, Hans-Holger; Roy, Joyashree; Schock, Robert N.; Sims, Ralph; Smith, Kir R.; Turkenburg, Wim C.; Ürge-Vorsatz, Diana; Hoppel, Frank von; Yeager, Kurt. **Technical Summary**. In: JOHANSSON; Thomas B.; NAKICENOVIC, Nebojsa; PATWARDHAN, Anand; GOMEZ-ECHEVERRI, Luis. **GLOBAL ENERGY ASSESSMENT TOWARD A SUSTAINABLE FUTURE**, Cambridge: Cambridge University, 2012 , 1900p. Cap. 2. p.31-94.