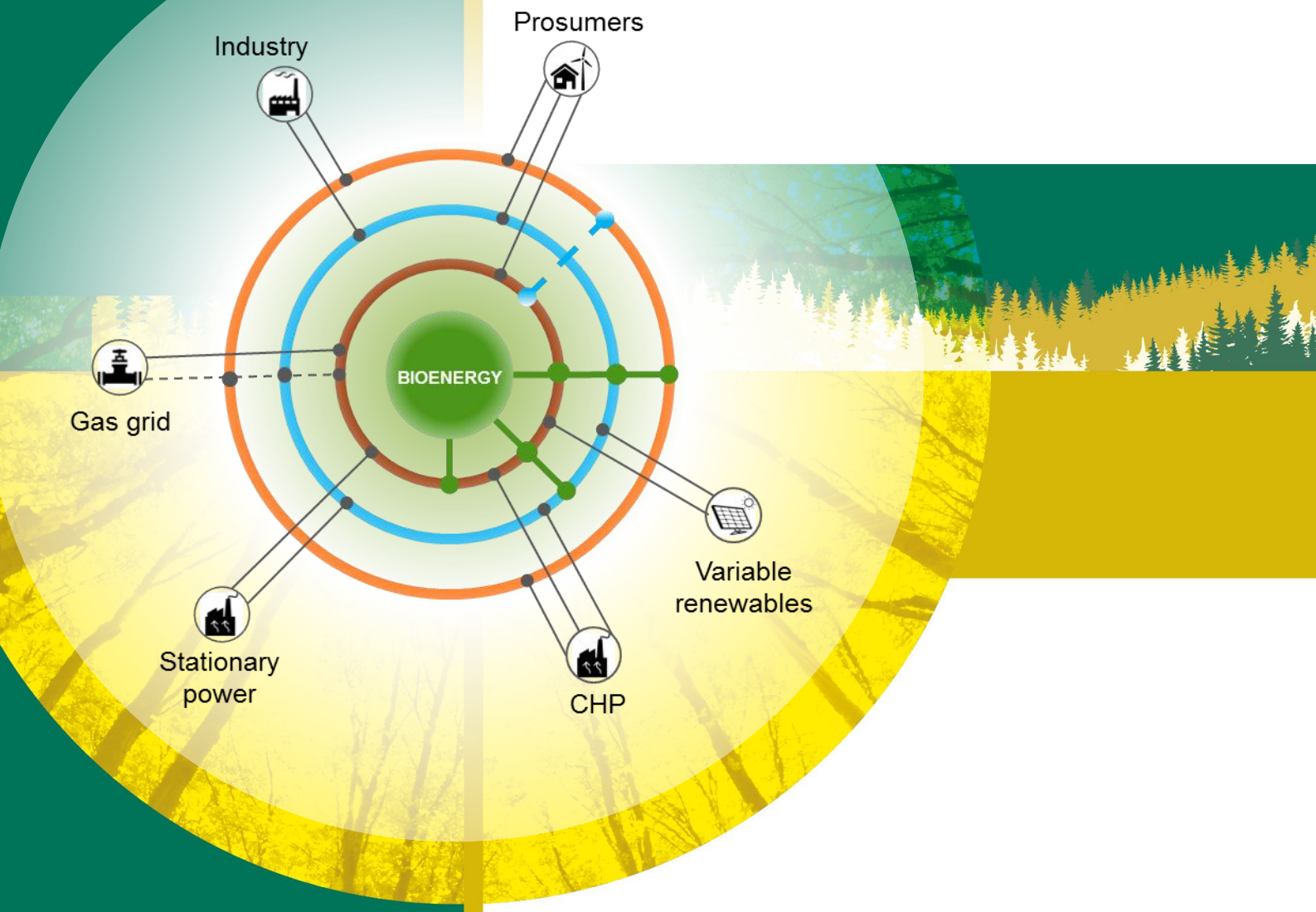
Summary Series

Bioenergy's role in balancing the electricity grid and providing storage options – an EU perspective



IEA Bioenergy

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Bioenergy's role in balancing the electricity grid and providing storage options – an EU perspective

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Summary

Low carbon energy targets and policy are driving renewable energy to markets. Widespread solar and wind electricity penetration of the energy system drives market change. Electrification and price formation change the role of energy consumables and distribution grids, further driving the change in earning logic that will eventually create new business models and radically modify old ones. The **energy market transformation from an energy optimized to capacity optimized system is expected** when the share of intermittent or uncontrollable electricity becomes large enough. Despite the significant regional differences in solar and wind resources, the unexpectedly fast declining production costs of solar and wind power will further drive and accelerate the transformation. In this kind of future energy system, energy will not be the limiting factor, but rather security of supply will instead. Conventional dispatchable energy production will be pushed out of the market due to higher operational costs, thus being dispatched less frequently; thus becoming even more unprofitable due to low operational hours. **Price fluctuation will increase, and capacity based market instruments will most probably be introduced to address security of supply**.

Bioenergy is currently the major source of renewable energy in the world, while wind, solar and geothermal are the fast growing alternatives. The role of wind and solar in electricity production will increase more rapidly compared to other renewable sources. However, bioenergy will continue to provide the bulk of heating and transport fuels for decades to come. Bioenergy, in its various forms, can eventually contribute to balancing the electricity grid, including as one form of solar energy storage. So far little attention has been paid to the possible role of bioenergy as an effective, low carbon and low cost grid management and energy storage option.

Balancing can be roughly divided into two time periods. Most of the variability in load and variable generation is balanced by committing generation units to dispatch. This is mid-term balancing. Short-term balancing is mainly about correcting forecast errors in the original dispatch. This is achieved with intra-day and balancing markets and finally, in real time by activating frequency reserves either automatically or manually. Both mid-term and short-term balancing are affected by long-term decisions on investments and retirements of generation and consumption units.
Seasonality, i.e. energy demand fluctuations in the winter and summer seasons, is one of the key challenges for future smart energy system management, which will have various consequences for optimization in various parts of Europe and globally. Photovoltaic power production goes down dramatically in winter time, especially in northern countries, while electricity consumption grows (e.g. for heat pumps). **The backup need in winter time also coincides with increased heat demand, which is a perfect fit with combined heat and power.** This shows a clear synergy in seasonal balancing between photovoltaics and biomass. In addition, solid biomass co-firing, power and combined heat power and cooling (CHP-C) systems add synchronous generators to the transmission grid which in itself is a stabilizing factor. These can also contribute to primary

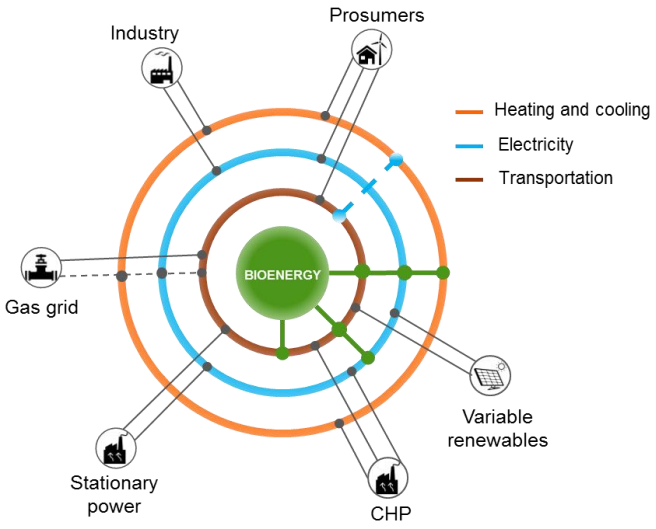
frequency control.

Regional differences in challenges for future grid balancing are mainly due to availability of hydro power and integrated markets (strong electricity grid). Regarding bioenergy, using the heat and gas networks for flexibility will be another important flexibility factor that will be enabled by existing and planned heat and gas network infrastructure. From this perspective, European regions can roughly be divided in three categories:

- Areas with high interconnectivity, high use of biomass, a lot of hydro and existing CHP infrastructure, no gas grid
- Areas with medium power interconnectivity, existing gas grid, moderate biomass resources
- Areas with low interconnectivity, medium biomass resources and no gas grid

Bioenergy power plants can contribute to balancing by participating in day-ahead, intra-day and balancing markets as well as by offering frequency control reserves in addition to seasonal balancing. The use of bioenergy for balancing and frequency control is currently limited, since many bioenergy plants often do not have the required control capability. However, something needs to replace the controllability offered by fossil fuel power plants when they are pushed out of the European power systems. There bioenergy could have an important role.

Conclusions



Bioenergy is already used for balancing and it could be used more extensively in the future as fossil generation is phased out. In this respect, bioenergy has potential to play a focal role as a flexible resource in the renewable power supply system. While bioenergy could certainly contribute in a significant way to balancing future grids, it can also be expected that competition between different forms of flexibility will occur. Hydropower, batteries, demand side management, power to heat, etc. will be alternatives to bioenergy for balancing. It is not likely that there will be "one-solution", but rather different options will be used to different combination degrees depending on different flexibility needs and local characteristics. Balancing represents a challenge of a different magnitude in different parts of Europe depending on the characteristics of the generation portfolio, availability of demand response and interconnections to neighbours. Moreover, gas and heat networks can and should also play a bigger role in balancing the electrical grid. With the advent of electric vehicles the transport sector is also poised to become more integrated with the power system and, if implemented with price sensitivity, could bring considerable flexibility to balancing the power grid. In all these, bioenergy can play a central role.

IEA BIOENERGY

The IEA Bioenergy Technology Collaboration Programme (www.ieabioenergy.com) is a global government-to-government collaboration on research in bioenergy, which functions within a framework created by the International Energy Agency (IEA - www.iea.org). As of the 1st January 2016, 23 parties participated in IEA Bioenergy: Australia, Austria, Belgium, Brazil, Canada, Croatia, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Republic of Korea, the Netherlands, New Zealand, Norway, South Africa, Sweden, Switzerland, the United Kingdom, the USA, and the European Commission.

The mission of IEA Bioenergy is to increase knowledge and understanding of bioenergy systems in order to facilitate the commercialisation and market deployment of environmentally sound, socially acceptable, and cost-competitive bioenergy systems and technologies, and to advise policy and industrial decision makers accordingly. The Agreement provides platforms for international collaboration and information exchange in bioenergy research, technology development, demonstration, and policy analysis with a focus on overcoming the environmental, institutional, technological, social, and market barriers to the near- and long-term deployment of bioenergy technologies.

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