概要

本提案書では、まずパリ協定と日本の温室効果ガス削減対策について述べた後、電源構成における再生可能電源の必要性を確認した。また、再生可能電源の大量導入が電力系統の安定性に与える影響を検討し、その解決策について解説した。次に、再生可能電源、特に太陽光発電の大量導入と電力系統の安定性を両立させるための技術的制約を考慮した電源構成モデルの計算方法を提案した。この電源構成モデルの適用対象として、九州の主たる送電系統を網羅し、長期的な CO_2 排出量制約下における電源構成を求めるモデルを提示した。さらに、上述した電源構成モデルによる分析の結果、電力系統の安定性を考慮した場合の太陽光発電システムの制御および水素発電との組み合わせによる再生可能エネルギーの有効利用法を示し、同時に電力システムの脱炭素化の可能性を示した。特に、電力系統の安定性を維持しつつ、発電プロセスからの CO_2 排出を極力小さくし、究極的には 0 とする電力システムの構成とその技術的・経済的性質を明らかにした。

Abstract

According to Paris Agreement, Japan has to reduce greenhouse gas emissions in 2030 to 26% below 2013 levels. Energy efficiency improvement and renewable energy will provide the primary source of greenhouse gas reductions. However, mass introduction of renewable power sources causes serious instability issues in power systems. One of these issues is that the mass introduction impacts to the transient stability in power systems. Since it could lead to a massive blackout in the worst case, the power system must be very carefully managed to maintain the transient stability. Another issue is that outputs of photovoltaic and wind power generations fluctuate, causing frequency instability. These fluctuations must be absorbed so as to keep stable frequency in each power system, which is called LFC, load frequency control. Issues on LFC are omitted in this article due to the page limit. In this article, we introduced the constraints on the transient stability in the power generation mix in Kyushu region, taking massive installation of photovoltaic systems into consideration. Next we described on our mathematical model of power systems for Kyusyu district, taking transient stability into consideration. Computed results quantified suppression of photovoltaic generation in each primary grid. Furthermore, we investigated the way to efficiently utilize the suppressed power, including estimation of economic feasibility to produce hydrogen utilizing electrolysis.