




Utilizing unused renewable energy



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Problem

- Wind power plant power production fluctuates and is weather dependent
- 3.23 billion kilowatthours were restricted in the first quarter of 2019
- Is it possible to store or use this restricted energy?

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Introduction

1. Vehicle to grid
2. Hydrogen as an energy storage system
3. Pumped storage hydropower
4. Power-to-Gas
5. Batteries

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Vehicle to grid

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Hydrogen as an energy storage system




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Pumped storage hydropower


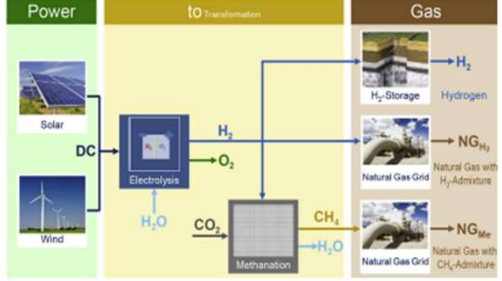


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Power-to-Gas


The diagram illustrates the Power-to-Gas process flow. It is divided into three main stages: Power, t₀ Transformation, and Gas. In the Power stage, Solar and Wind energy sources provide DC power. This DC power is used in the t₀ Transformation stage for Electrolysis, which splits H₂O into H₂ and O₂. The H₂ is then used in a Methanation process along with CO₂ to produce CH₄. The Gas stage shows three output options: H₂ (Hydrogen), NG_{H₂} (Natural Gas with H₂-Admixture), and NG_{CH₄} (Natural Gas with CH₄-Admixture). The H₂ and CH₄ are then fed into H₂-Storage and Natural Gas Grids respectively.

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Batteries




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Comparison



	Cost	Efficiency	Safety	Scalability	Technical feasibility
Vehicle to grid					
Hydrogen					
Pumped storage hydropower					
Power-to-Gas	- -	+ / -	+ +	+ +	+
Batteries					

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Conclusion



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Recommendations



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