The overall efficiency of converting electricity to hydrogen and then back to electricity, often called "round-trip efficiency," is typically **around 40%** meaning that only about 40% of the initial electrical energy used to produce hydrogen can be recovered as electricity when the hydrogen is converted back to power through a fuel cell; this is considered relatively low compared to other energy storage methods. [[1](https://www.sandia.gov/app/uploads/sites/163/2022/03/ESHB_Ch11_Hydrogen_Headley.pdf#:~:text=The%20roundtrip%20efficiency%20of%20hydrogen%20storage%20based,electricity%20can%20be%20turned%20back%20into%20electricity.), [2](https://blog.burges-salmon.com/post/102hprr/hydrogen-the-most-dumb-thing-i-could-possibly-imagine-for-energy-storage-is-e), [3](https://www.eeca.govt.nz/insights/energy-in-new-zealand/renewable-energy/hydrogen/#:~:text=Energy%20inefficiencies%20*%20When%20renewable%20electricity%20is,around%2020%%2D60%%20depending%20on%20the%20conversion%20technology.)]

**Key points about this process: [**[**2**](https://blog.burges-salmon.com/post/102hprr/hydrogen-the-most-dumb-thing-i-could-possibly-imagine-for-energy-storage-is-e)**,** [**3**](https://www.eeca.govt.nz/insights/energy-in-new-zealand/renewable-energy/hydrogen/#:~:text=Energy%20inefficiencies%20*%20When%20renewable%20electricity%20is,around%2020%%2D60%%20depending%20on%20the%20conversion%20technology.)**,** [**4**](https://www.fluxpower.com/blog/hydrogen-fuel-cell-efficiency-how-does-it-compare-to-lithium-ion)**]**

* **Energy losses in electrolysis:** When electricity is used to produce hydrogen through electrolysis, some energy is always lost due to inefficiencies in the process, typically around 20-30%. [[2](https://blog.burges-salmon.com/post/102hprr/hydrogen-the-most-dumb-thing-i-could-possibly-imagine-for-energy-storage-is-e), [3](https://www.eeca.govt.nz/insights/energy-in-new-zealand/renewable-energy/hydrogen/#:~:text=Energy%20inefficiencies%20*%20When%20renewable%20electricity%20is,around%2020%%2D60%%20depending%20on%20the%20conversion%20technology.), [4](https://www.fluxpower.com/blog/hydrogen-fuel-cell-efficiency-how-does-it-compare-to-lithium-ion)]
* **Energy losses in fuel cells:** Converting hydrogen back to electricity in a fuel cell also involves energy losses, usually around 20-60% depending on the technology. [[3](https://www.eeca.govt.nz/insights/energy-in-new-zealand/renewable-energy/hydrogen/#:~:text=Energy%20inefficiencies%20*%20When%20renewable%20electricity%20is,around%2020%%2D60%%20depending%20on%20the%20conversion%20technology.), [4](https://www.fluxpower.com/blog/hydrogen-fuel-cell-efficiency-how-does-it-compare-to-lithium-ion), [5](https://www.plugpower.com/fuel-cell-power/fuel-cell-benefits/)]
* **Factors affecting efficiency:** The efficiency of the entire process can be impacted by factors like the type of electrolyzer used, the operating conditions, and the design of the fuel cell. [[2](https://blog.burges-salmon.com/post/102hprr/hydrogen-the-most-dumb-thing-i-could-possibly-imagine-for-energy-storage-is-e), [3](https://www.eeca.govt.nz/insights/energy-in-new-zealand/renewable-energy/hydrogen/#:~:text=Energy%20inefficiencies%20*%20When%20renewable%20electricity%20is,around%2020%%2D60%%20depending%20on%20the%20conversion%20technology.), [6](https://www.sciencedirect.com/science/article/pii/S0960148124000983)]

*Generative AI is experimental.*

[1] [https://www.sandia.gov/app/uploads/sites/163/2022/03/ESHB\_Ch11\_Hydrogen\_Headley.pdf](https://www.sandia.gov/app/uploads/sites/163/2022/03/ESHB_Ch11_Hydrogen_Headley.pdf#:~:text=The%20roundtrip%20efficiency%20of%20hydrogen%20storage%20based,electricity%20can%20be%20turned%20back%20into%20electricity.)

[2] <https://blog.burges-salmon.com/post/102hprr/hydrogen-the-most-dumb-thing-i-could-possibly-imagine-for-energy-storage-is-e>

[3] [https://www.eeca.govt.nz/insights/energy-in-new-zealand/renewable-energy/hydrogen/](https://www.eeca.govt.nz/insights/energy-in-new-zealand/renewable-energy/hydrogen/#:~:text=Energy%20inefficiencies%20*%20When%20renewable%20electricity%20is,around%2020%%2D60%%20depending%20on%20the%20conversion%20technology.)

[4] <https://www.fluxpower.com/blog/hydrogen-fuel-cell-efficiency-how-does-it-compare-to-lithium-ion>

[5] <https://www.plugpower.com/fuel-cell-power/fuel-cell-benefits/>

[6] <https://www.sciencedirect.com/science/article/pii/S0960148124000983>

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