

Hydro + Storage

*Flexibility to enhance services and
enable new capabilities*

Thomas Mosier

ESIG Session 9

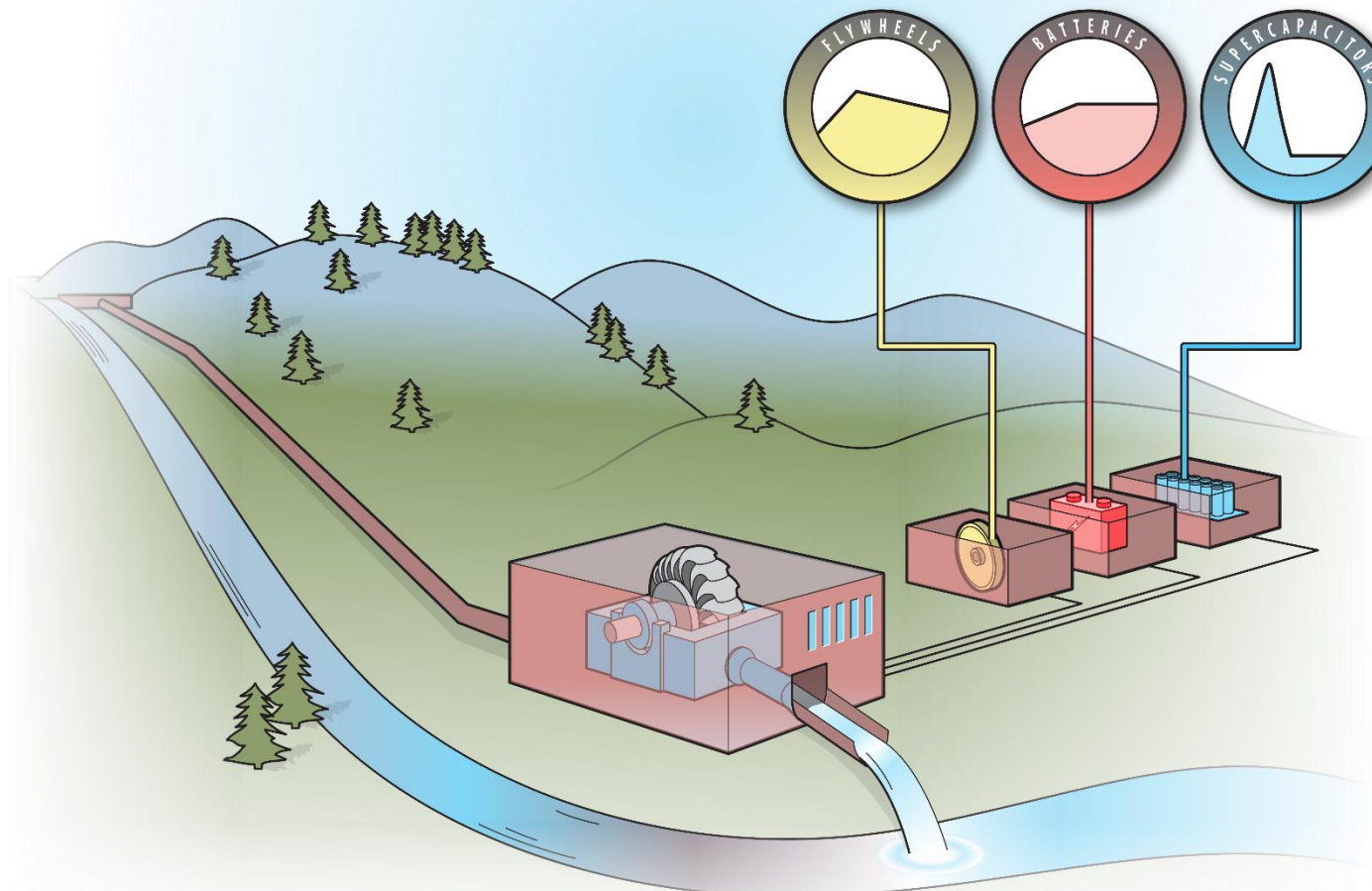
April 23rd, 2020

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Integrated hydropower and energy storage¹

Increasing flexibility through “virtual reservoirs”



[1] Integrated Hydropower and Storage Systems Operation for Enhanced Grid Services: Creating and Demonstrating “Virtual Reservoirs” (Forthcoming).

Even dispatchable hydropower plants have limits to their flexibility

- Ice House Dam flow requirements in FERC license:

- Minimum monthly flows (fishing and habitat)
- Minimum daily flows (recreation/boating)
- Maximum ramp rate (safety and habitat)
- Maximum discharge capacity (safety)
- Pulse requirements (mimic natural variability)

Sources: KOIN, Idaho News, American Water College, Phys.org, and Portland Monthly



Source: Phys.org

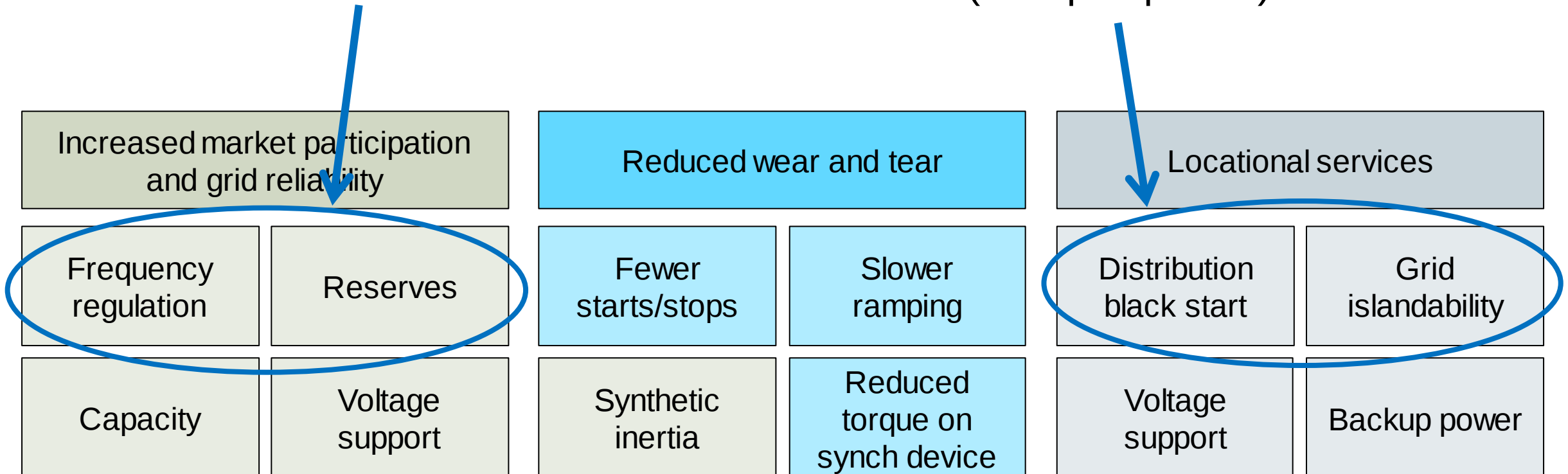


Increased flexibility from integrated storage enables diverse benefits

Examples with Idaho Falls Power highlight two markedly different use cases

Case study on enhanced
market revenue

Field demonstration on
local resilience capabilities
(now postponed)

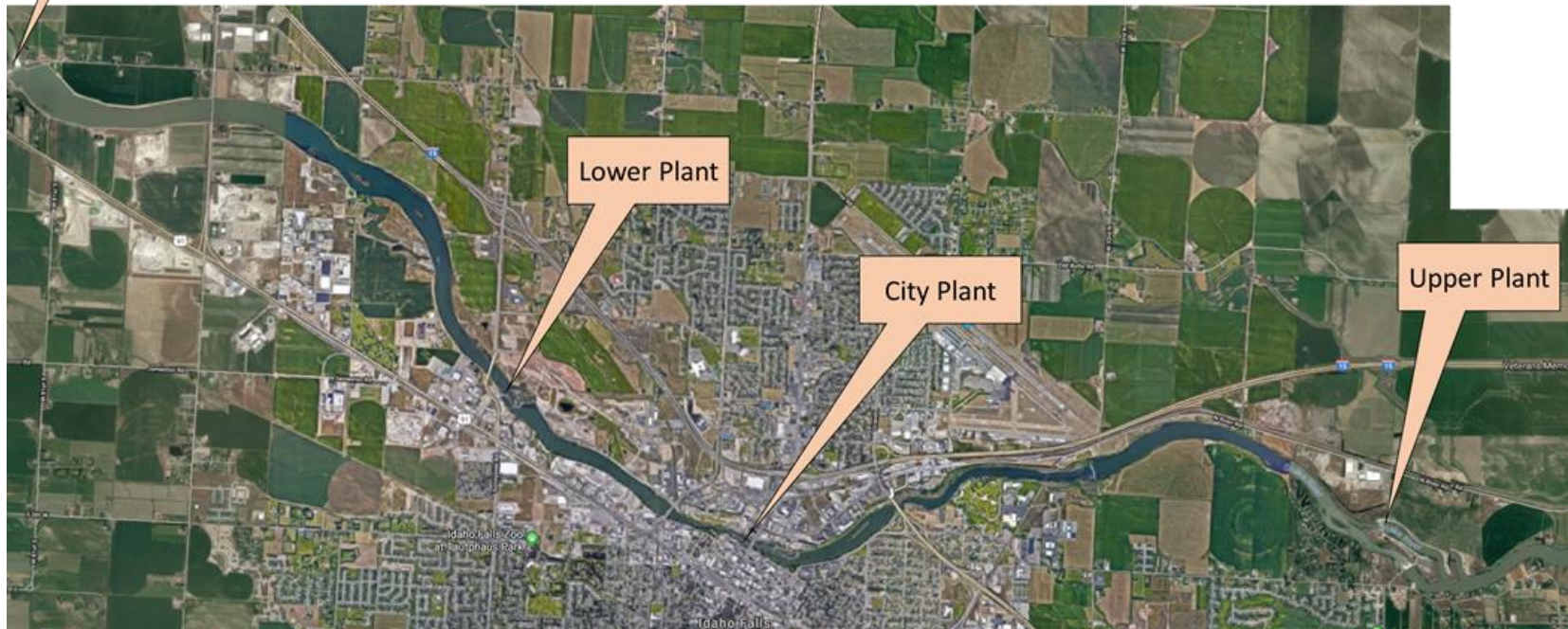


Idaho Falls Power: municipal hydropower utility on the Snake River

Four run of river hydropower plants:

- Upper: 8.9 MW - City: 8.9 MW
- Lower: 8.9 MW - Gem State: 26 MW

- These plants connected to the distribution and sub-transmission systems.
- Under normal conditions, balancing is performed by Rocky Mountain Power.



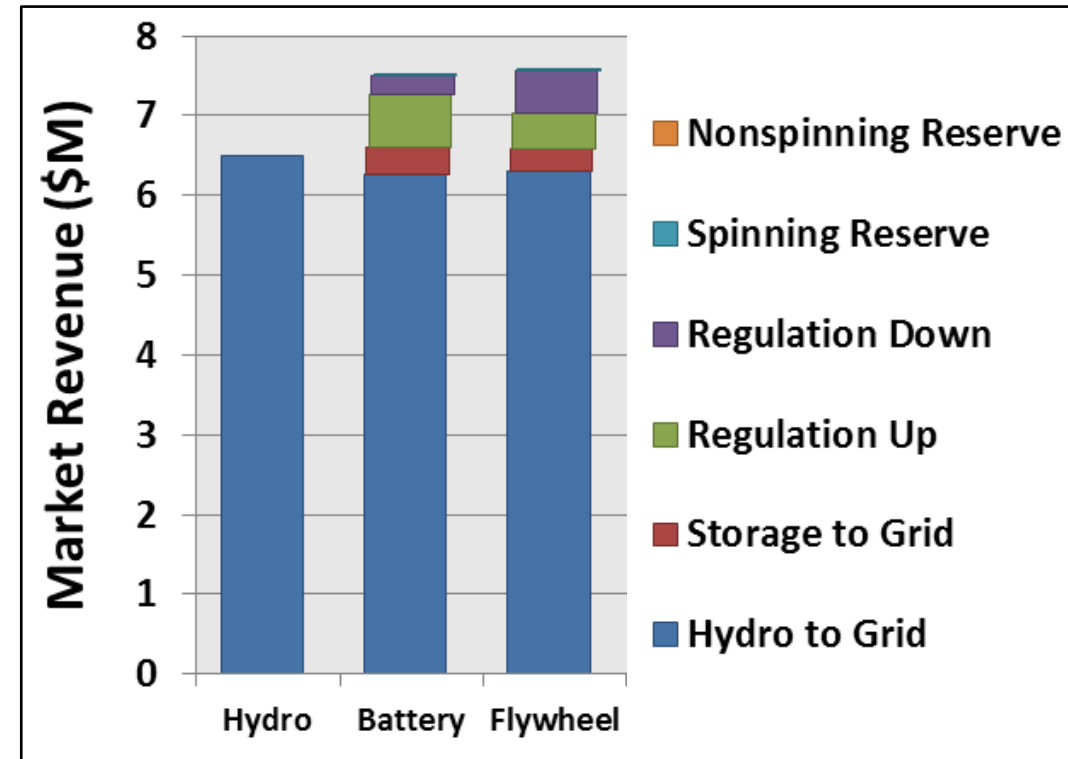
Integrated Storage can boost ancillary service market participation: Case study based on four run of river hydropower plants

Revenue increases due to integrated energy storage:

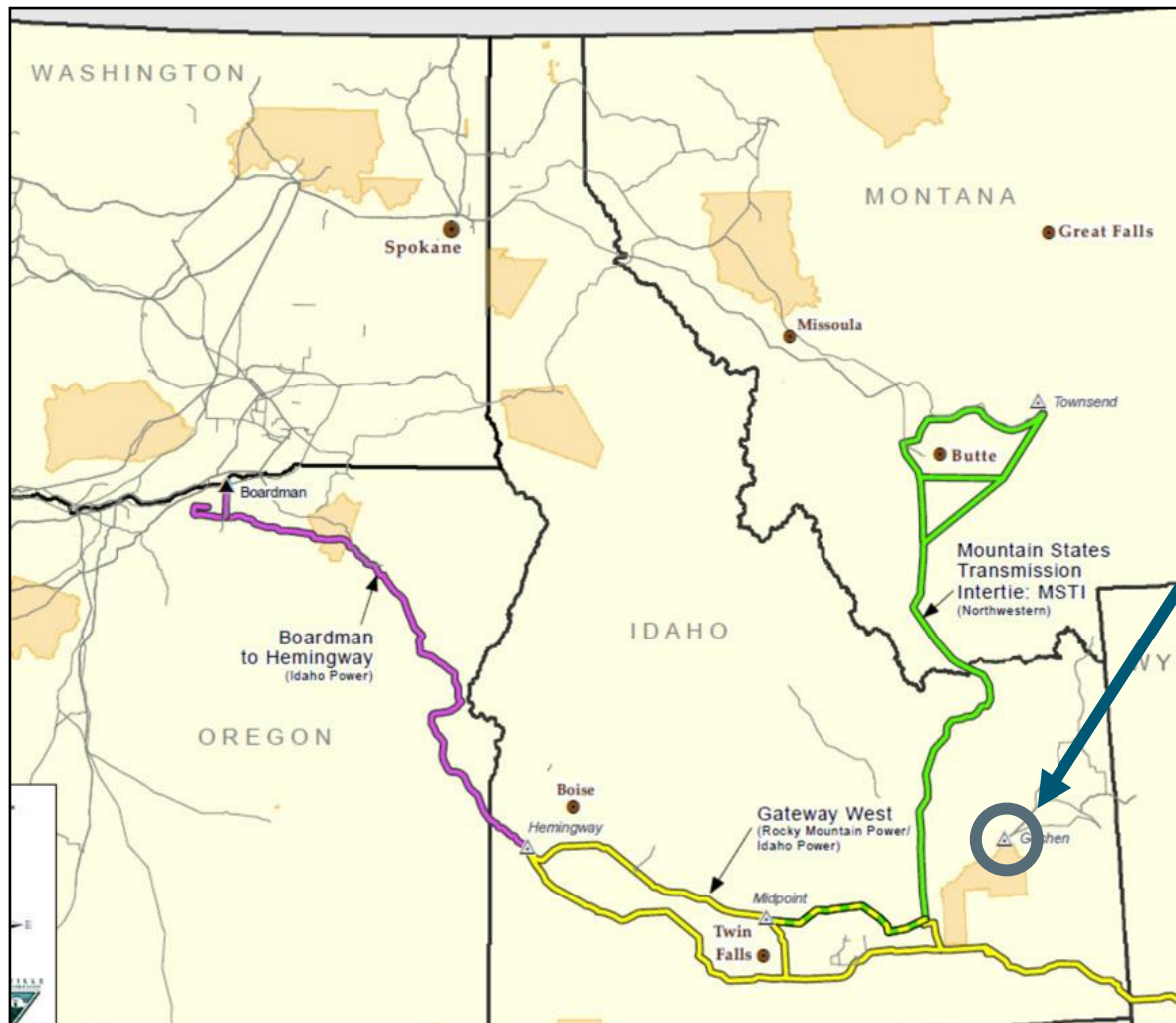
- Battery: +12.2% to +15.8%
- Flywheel: +12.0% to +16.3%
- Range is based on market assumptions

CHEERS model by Argonne optimizes market participation

- Uses range of CAISO market conditions
- Maximizes revenue over each 24-hour period
- Energy storage likely oversized and not optimized to maximize financial performance



Idaho Falls Power provides critical services for Eastern Idaho and would like to enhance resilience of electric supply

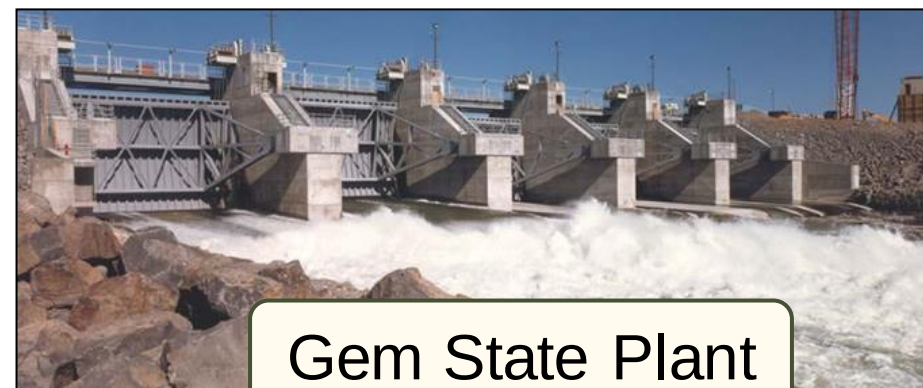


Idaho Falls connection to transmission system

Goshen Wind Project



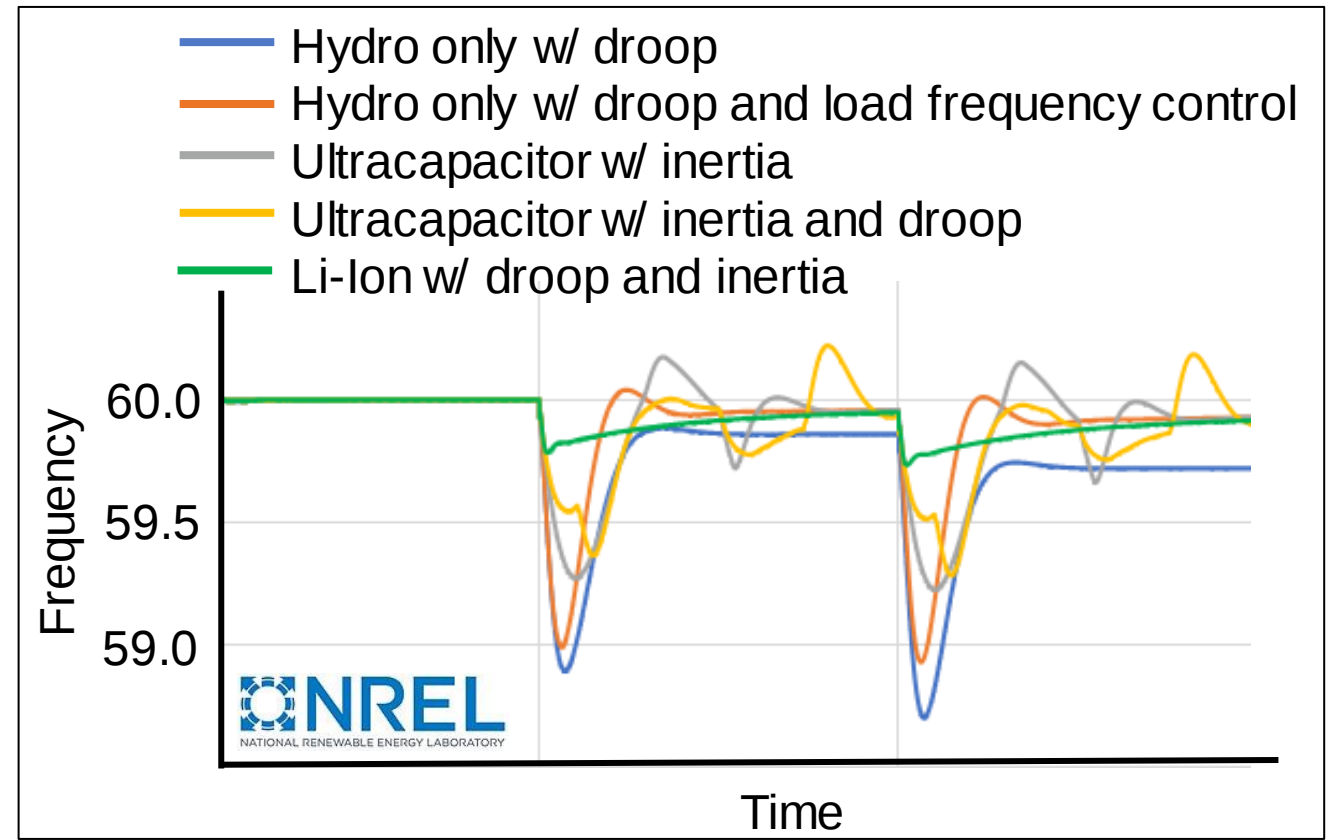
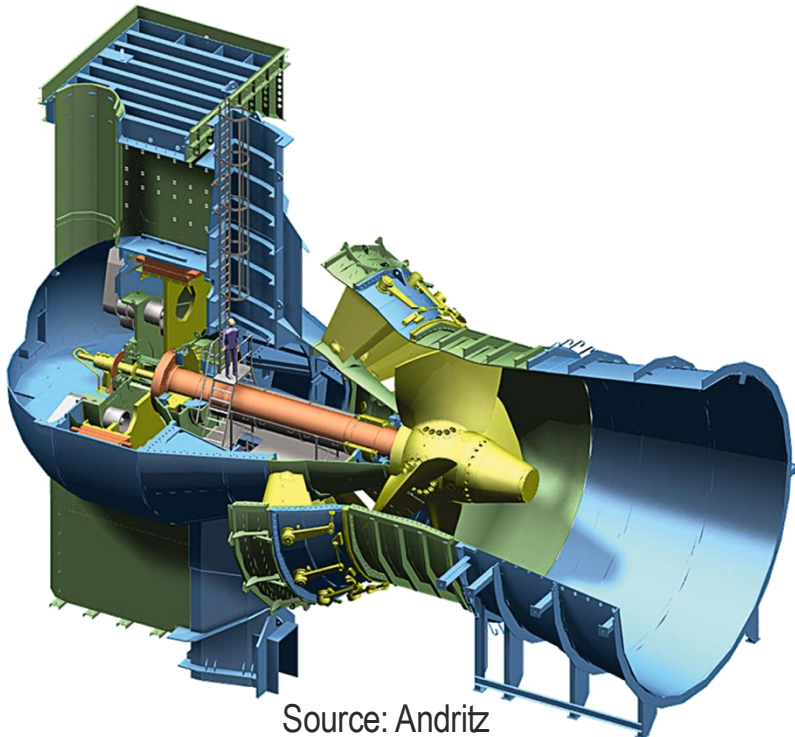
Credits: BP Energy and IFP



Gem State Plant

Integrated storage can enable new capabilities: Islanding and black start using small, low-head hydropower

- IFP's ROR hydropower plants are tied to distribution but unable to use them for black start or islanded operation because they cannot ride through step changes.
- Integrated storage can sufficiently enhance stability properties to enable these uses.





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Hydro + Storage
*What would you do with
the extra flexibility?*

Frequency
regulation

Slower
ramping

Distribution
black start

Capacity

Fewer
starts/stops

Grid
islandability



Vladimir Koritarov



Vahan Gevorgian





Idaho National Laboratory