National Hydropower Asset Assessment Project: a path to better understanding of critical resources

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and

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Hydropower is the foundation of renewables in the U.S

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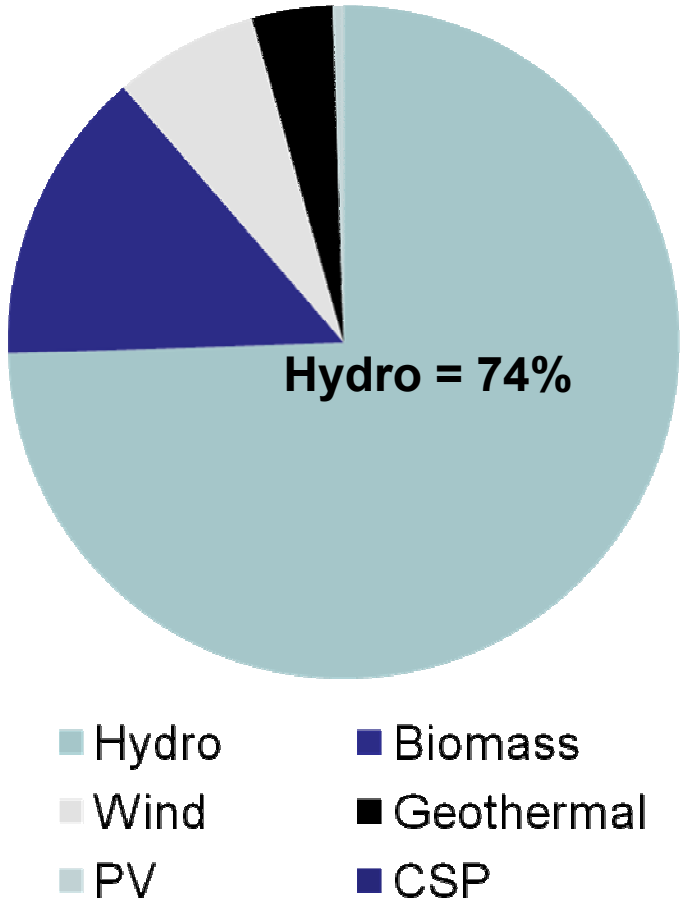
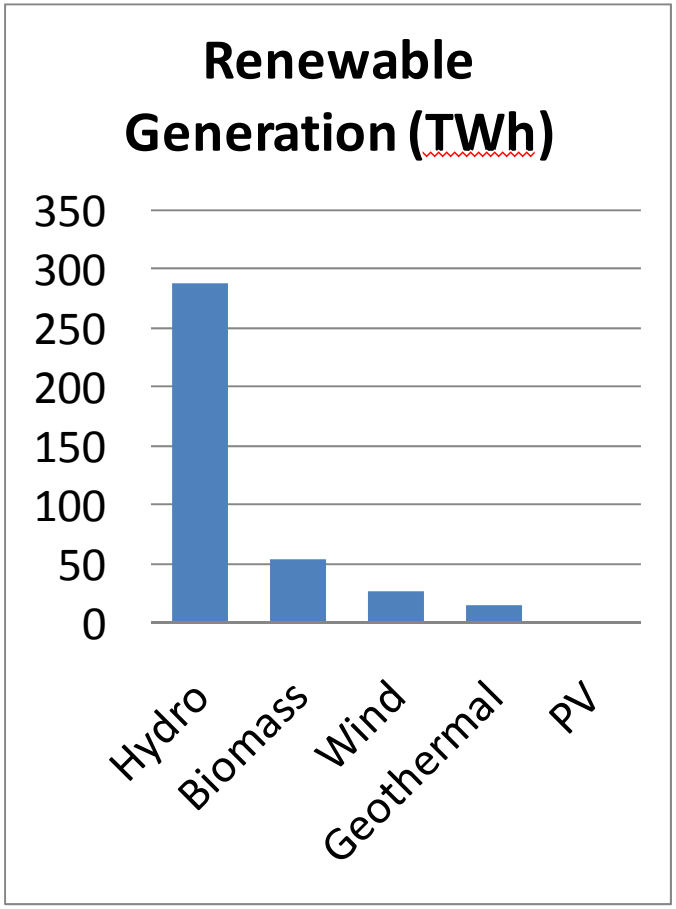
EIA generation data from 2006





Trends in hydropower are troubling

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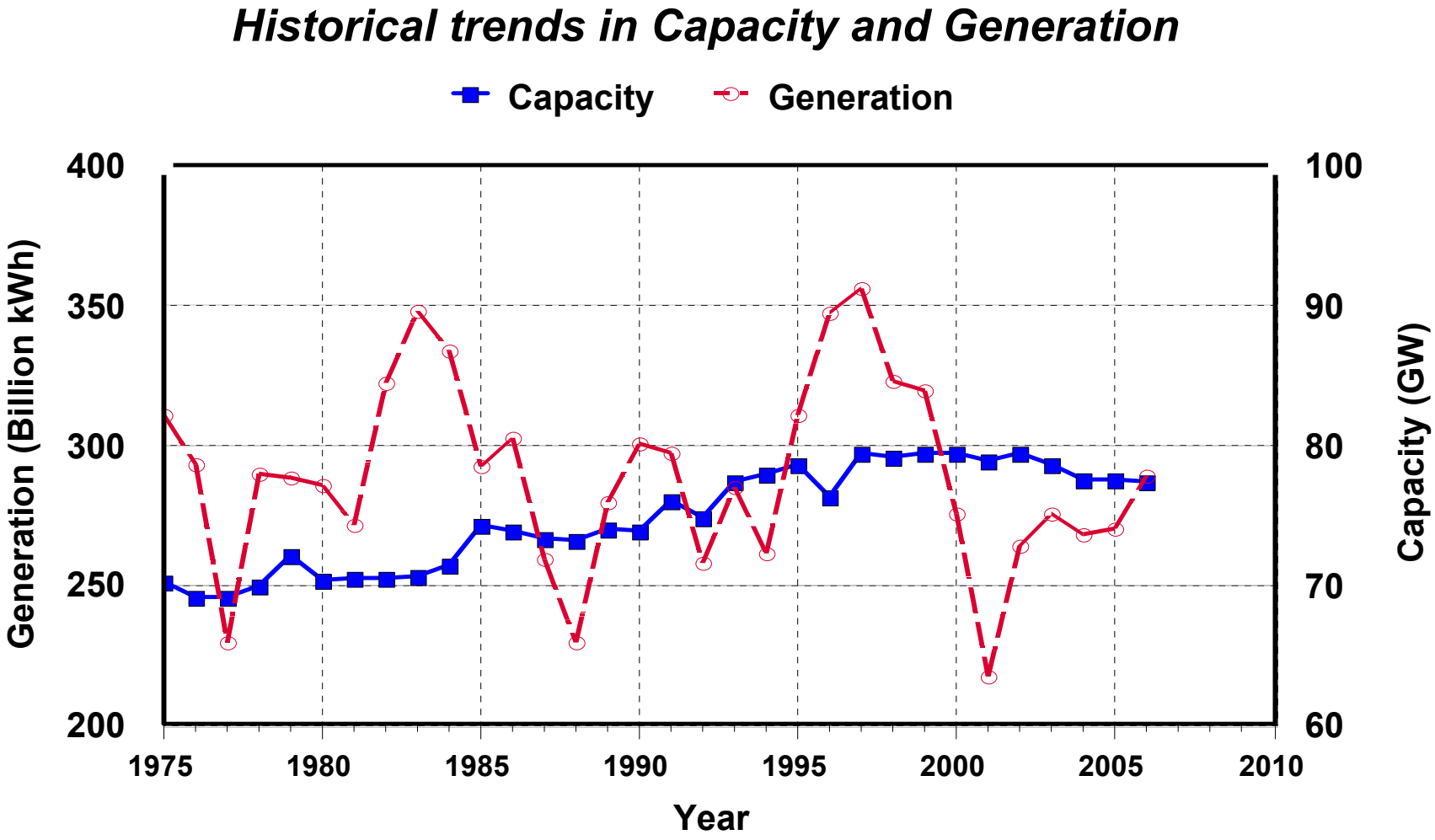

Hydropower in U.S. is a heterogeneous mix

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	Number of Projects	*Number of Units*	*Total Capacity (GW)*	*Average Project Size (MW)*	*Average Units per Project*	*Average Unit Size (MW)*
Corps of Engineers	74	350	20.4	276	4.7	58
Bureau of Reclamation	58	194	14.8	255	3.3	76
TVA	29	109	3.9	134	3.8	36
Total Federal	***161***	***653***	***39.1***	***243***	***4.1***	***60***
FERC Licenses *	1012	n/a	53.5	53	n/a	n/a
FERC Exemptions	595	n/a	0.8	1.4	n/a	n/a
Total Nonfederal *	***1607***		***54.3***	***34***		

*** Includes approximately 18 MW of pumped storage projects.**

The whole portfolio must be understood to reach a unified understanding of national trends.

Basic problem: old data used to predict future directions

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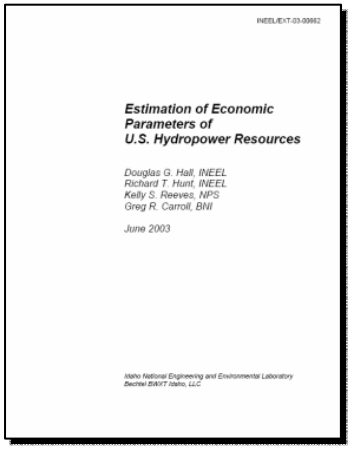
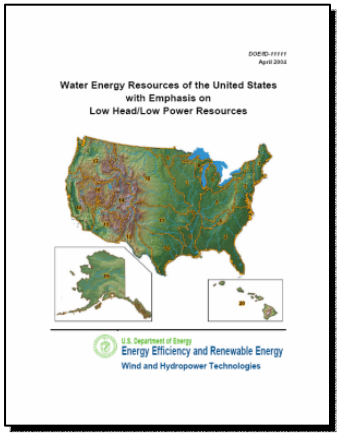
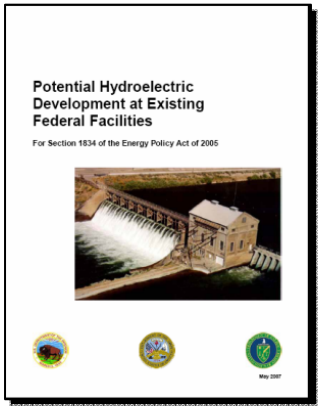
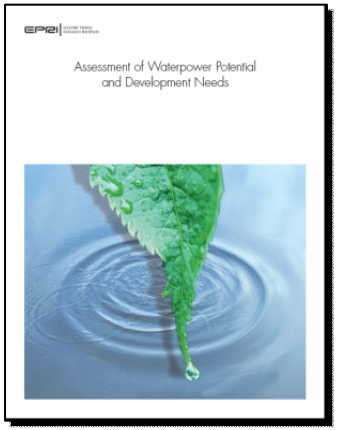
- EPRI studies of potential resources fall back to studies from early 2000s, which are based on FERC HPRA and NPS data of 1990s
- NREL carbon abatement study and new NHA/Navigant study rely on cost data from 2003
- EPAct Section needs to be updated









New understanding will require a new database

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Initial scope: Describe all existing federal and nonfederal facilities

- Project characteristics
  - *Power plants and equipment*
  - *Dams, diversions and reservoirs*
  - *Connectivity in river basins*
- Generation patterns for at least 10 years
- Water availability and competing water uses

Expanded scope in FY09

- Add pumped storage projects
- Add cost of development data
- Link to Regional Energy Deployment Systems Model (ReEDS) at NREL
- Import new resource data collected in FOA-2009

Analysis Team:

EnergyWorks, ORNL, NREL, other private sector advisors and contractors, plus agencies

NHAAP can be the basis for additional studies

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- **Hydroelectric Power Assessment required by the Omnibus Public Lands**
  - H.R. 146, Sec. 9505, signed March 30, 2009
  - Effect of global climate change on water supplies for hydropower and power supplies from PMAs
  - Report due April 2011 and every 5 years thereafter
  - DOE to lead, in consultation with PMAs, USGS, NOAA, and states
- **Value of hydropower to interconnection of renewables to the grid**

Initial results will be available in December 2009

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- Get beyond the cycle of planning future on outdated information
- Build new basis for answering key questions:
  - What are markets for new technology?
  - What will it cost to develop new resources?
  - How does generation respond to
    - water availability
    - competing uses
    - climate variability and change


Now let's get to work !

Hydropower is showing signs of deterioration

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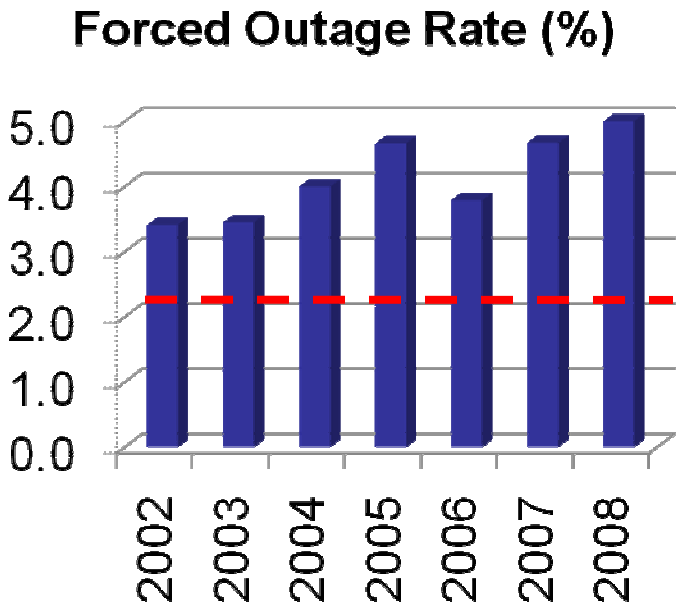
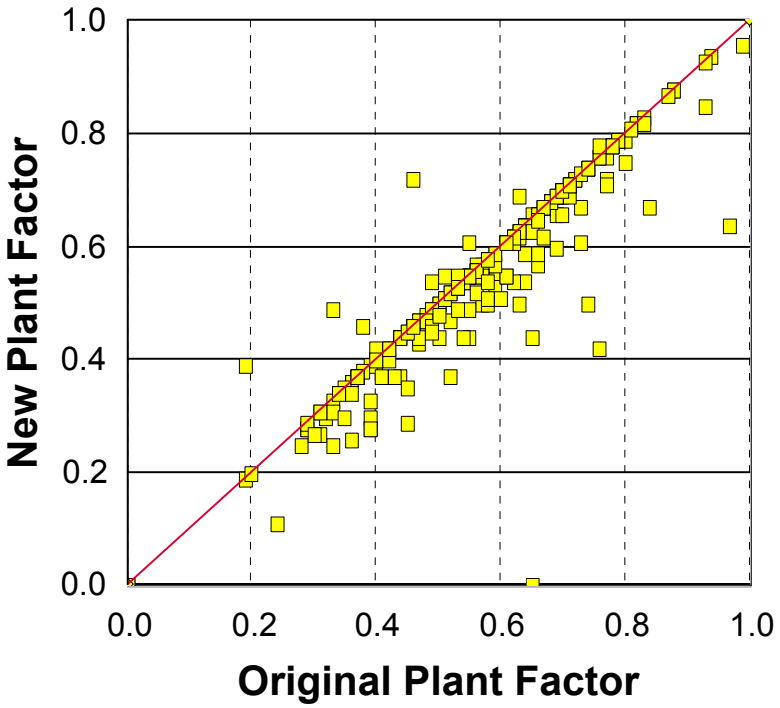
Corps projects are progressively less available for generation



Industry average and Corps Goal is 2.0% (red dashed line)

Nonfederal projects have lower capacity factors after relicensing



Lack of investment drives these trends.

EPRI estimates large blocks of new water power by 2025

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Water Power type	Most-Likely Scenario	Aggressive Scenario *
New, Large Hydro	500	2,500
Small, Low-Power Hydro	3,375	5,400
Capacity Gains at Existing Plants	2,875	3,000
New Hydro at Existing Dams	7,000	8,000
In-River Hydrokinetic Projects	3,000	3,000
Tidal-Current Hydrokinetic Projects	3,000	3,000
Ocean Wave Projects	10,000	12,000
Pumped Storage Projects	10,000	12,500
TOTALS	**39,750**	**49,400**

* Aggressive scenario involves strong policy and investment strategies at federal and state levels.

Source: *Updated Edition of Assessment of Waterpower Potential and Development Needs. EPRI, Palo Alto, CA: 2009.*

Myths persist about Hydro

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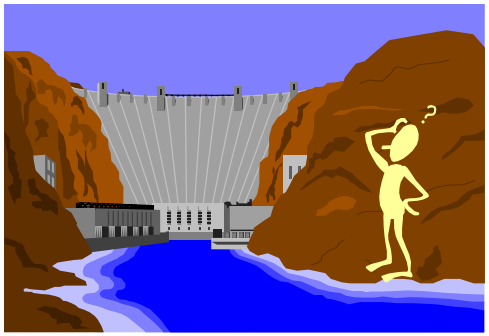

- ***Myth:*** Hydro technology is mature and well understood
  - **Fact:** *DOE-led R&D improved generation at Wanapum Dam by 14%*
- ***Myth:*** Hydro is cheap
  - **Fact:** *Hydro is now the most expensive renewable; new development costs are more than $3,000/kW*
- ***Myth:*** All Hydro is bad for the environment
  - **Fact:** *Many large projects have been certified as "Green Hydro" by environmental NGOs via LIHI*
- ***Myth:*** Hydro industry does not need federal investments
  - **Fact:** *Available industry funding is consumed in regulatory compliance and competitive markets*
- ***Myth:*** There are no new sites for development
  - **Fact:** *EPRI conservatively estimates 10GW new by 2025*

Loss of hydropower negates gains in other renewables

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- Examples:
  - Loss in hydro capacity since 2000 (-2.5 GW) is equal to all existing geothermal capacity
  - Annual variability in hydro generation (± 70 TWh) exceeds total generation from other renewables
- Other troubling trends in Hydropower:
  - Availability of Corps projects is steadly dropping
  - Capacity factors drop in relicensing
- Bottom line: when we need more, we are getting less, because of neglect of the sector

Hydropower is no longer the cheapest renewable

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	Capacity (GW) by Scenario			*Cost ($/kW or kWh)*		
Development Type	***Low***	***Medium***	***High***	***cost now***	***2030 cost***	***life time***
New small hydro at new dams	0	5	12	3,125	2,900	50
New hydro at existing dams	8	15	21	2,010	1,810	30
Capacity upgrades	5	5	5	1,340	1,205	25
Efficiency upgrades	3.5	5.7	7.1	0.042	0.038	25
	16.5	30.7	45.1			

Source: McKinsey/NREL carbon abatement study, 2009

Decrease in hydropower affects total GHG emissions

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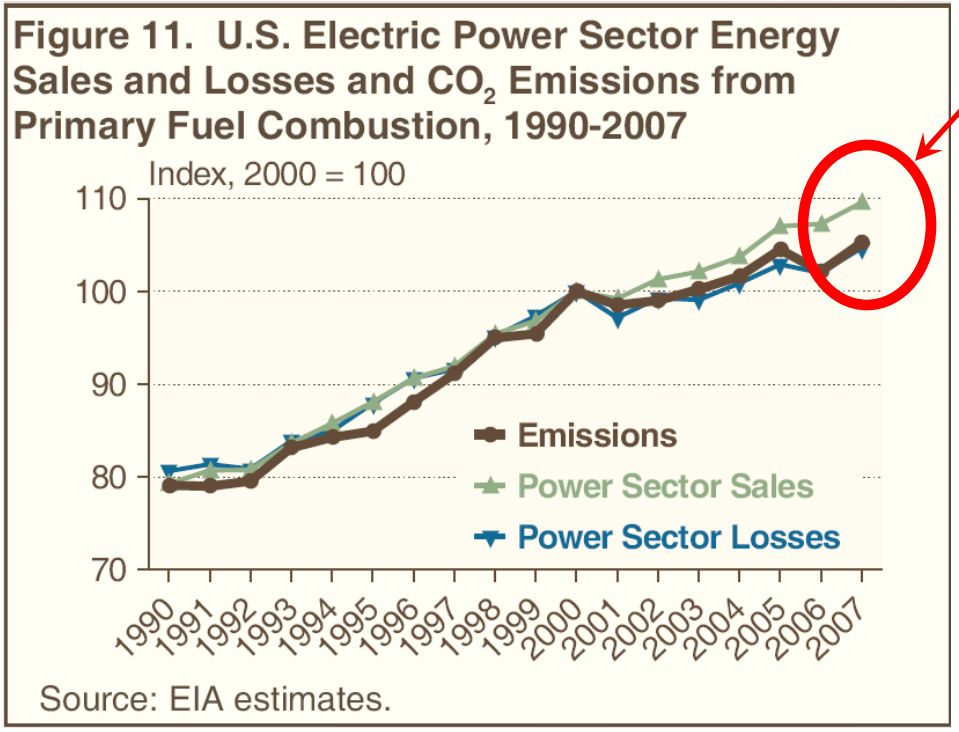

0.4% increase in carbon intensity in 2007 was due to a 40-TWh drop in hydropower generation, which offset increases in wind and nuclear

EIA 2008

***Source: Emissions of Greenhouse Gases in the U.S. 2007*, DOE-EIA-0573(2007), December 2008.**