



Developing sectorial indicators

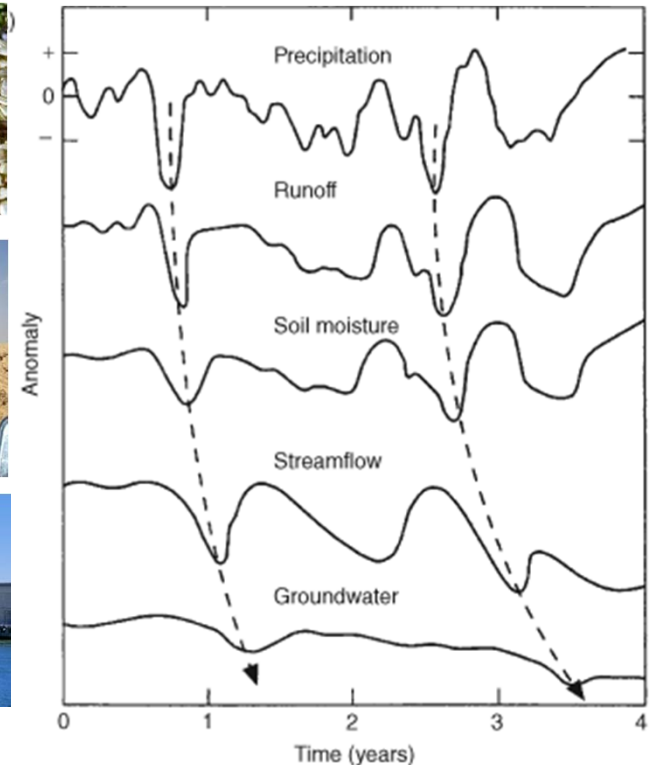
The case of energy production

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Drought Risk

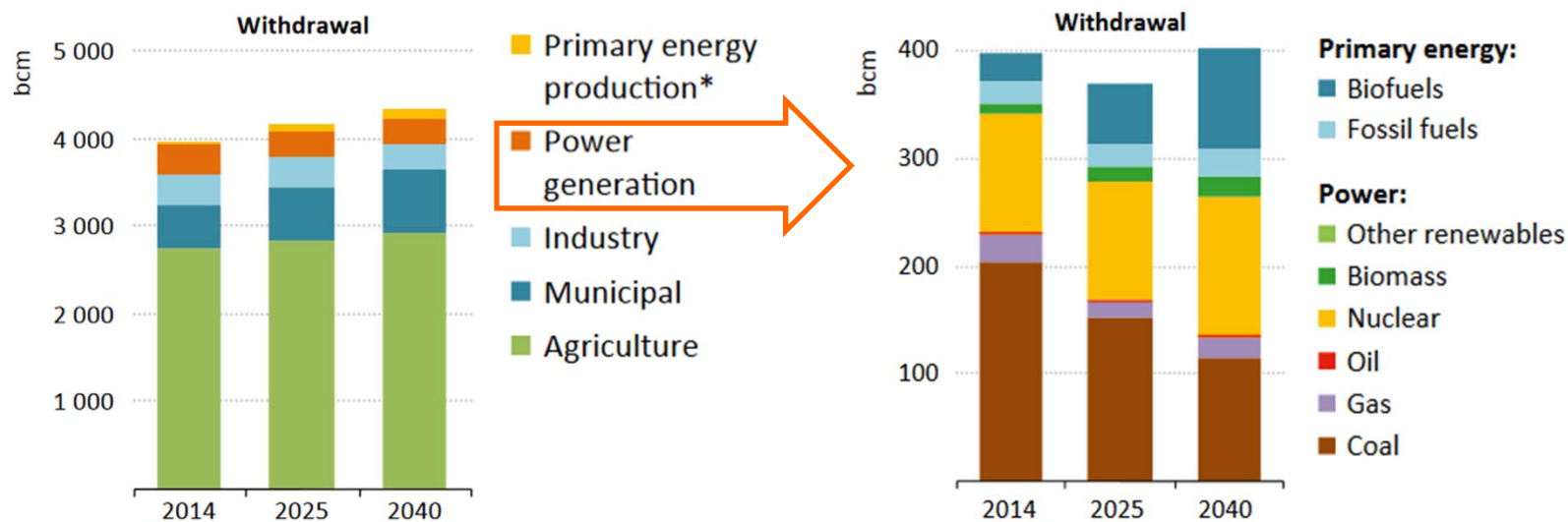
$$\text{Risk} = \text{Hazard} \times \text{Exposure} \times \text{Vulnerability}$$

- Different sectors, different droughts, different impacts.
- Indices: seek for sensitivity, robustness, ease of use.
- Monitoring: regular/frequent updates, completeness.
- Must avoid sectorial overlaps/double counting



Changnon Jr SA. Detecting drought conditions in Illinois. Illinois State Water Survey Champaign, Circular 169, 1987.

Energy water nexus



Sources: Luck, et al. (2015); Bijl, et al. (2016); Wada, et al. (2016); IEA analysis.

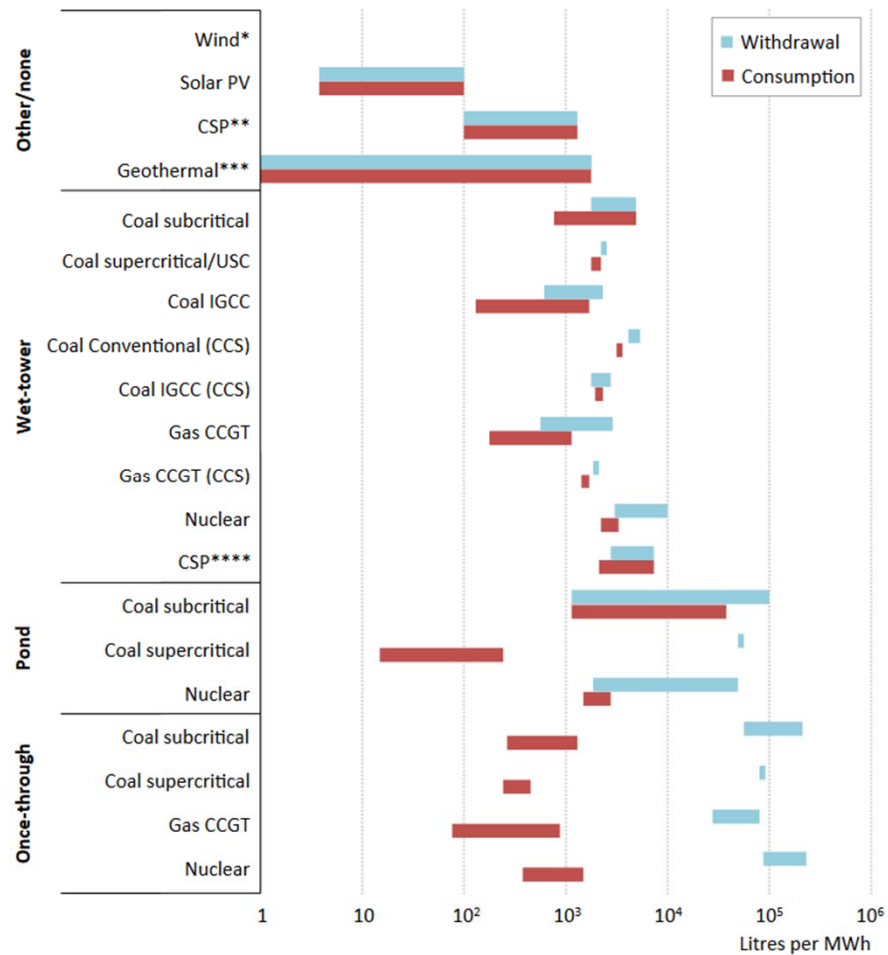
Wet-cooling systems at power plants account for 41% of all fresh water withdrawals in the U.S.

Power plant water requirements

As "fuel":



As coolant:



Drought-related risk for power production

Approach:

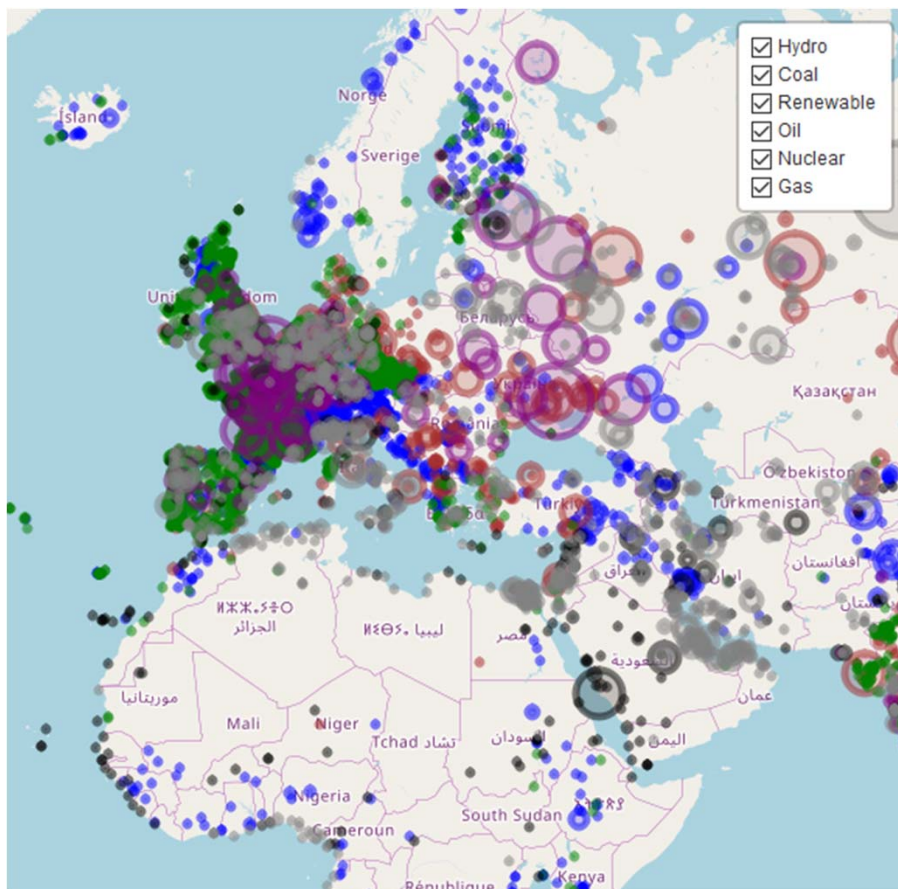
- Assessed at individual plant level (-> fully scalable)
- Simple metrics (-> less data required -> higher spatial coverage)
- Incorporate only sector specific indicators (-> can be combined with other sectorial without overlaps/double counting)

Conceptually:

Exposure: demand (MWh, or load in MW)

Vulnerability: water withdrawal per MWh, accounting for physical conditions and reservoir actual storage.

Hazard: in-flow water volume anomaly



Many data sources:

- WEPP (commercial, no geoinfo)
- IAEA PRIS (only nuclear)
- PowerWatch (open but embargo)
- Global Energy Observatory (relatively small)
- Enipedia, CARMA, ...
- Many local/business/national providers (pulverized information)
- GRanD reservoirs and dams

Currently 5k installations considered

Full and consistent data available for nuclear power only.



Actually:

Exposure: power capacity (MW)

Vulnerability: class of water withdrawal per MWh

Hazard: a proxy for low flow anomalies (long term SPI, CDI, Palmer's, ...?)

Monitoring: interesting resources from Europe (ENTSO) and US.

Tradeoffs:

- global coverage
- major events



Impacts?

Environmental Research Letters

LETTER • OPEN ACCESS

Impacts of recent drought and warm years on water resources and electricity supply worldwide

Michelle T H van Vliet^{1,2,3} , Justin Sheffield², David Wiberg³ and Eric F Wood²

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Letter

Power-generation system vulnerability and adaptation to changes in climate and water resources

Michelle T. H. van Vliet , David Wiberg, Sylvain Leduc & Keywan Riahi

Nature Climate Change **6**, 375–380 (2016)

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Joint
Research
Centre



- Sectorial indicators link impacts
- Sectorial indicators are data hungry (lots of “local” information)
- Data exist, but hard to get (hidden, fragmented and closed-source)
- Incremental improvements
- Other sectors, comparable issues

Next:

- Low flow anomaly
- More data gathering/polishing
- Put online
- Other sectors

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