Coupling of energy system and hydrology models for improved representation and sector integration

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Design and Operations of Energy Systems

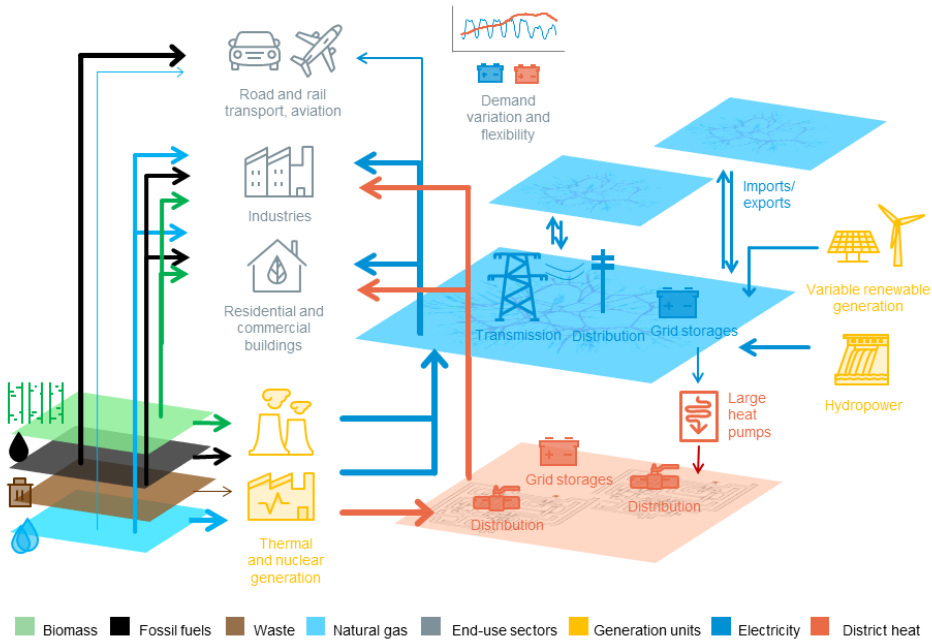
The challenges…

- Hydrological models are very specific and considers basin by basin interactions without a full picture view
- Energy system models are, by definition, sytem oriented and must neglect hydrological details
- Rapid changes in water flow, water level heights, intensity of floods, decrease in glaciers availbility are example of environmental impacts
- Integration of hydropower depends on the data availability (river basins based), come from at best on daily average basis. If no data are available, then the hydrological part is neglected and hydropower operates based on their operating details

FlexTool modelling approach – what can you study?

IRENA FlexTool

https://irena-flextool.github.io/flextool/



Cost-optimization
bottom-up
for multiple energy sectors
in local, national and regional scales.

INVEST PLANNING / CAPACITY EXPANSION

What would be the most cost-optimal investments for a certain system in a certain future setting?

OPERATIONAL PLANNING / SCHEDULING

How a certain future system would operate with given investments according to least-cost unit commitment?

VTT solutions

ModSnow

With daily resolution

Glacier and snow data with daily resolution

CWatM

With daily resolution

Rainfall and evaporation

Lakes and natural resevoirs

End-use of water in households, industry, livestock and agriculture

Groundwater

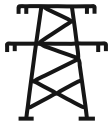
IRENA FlexTool

With hourly resolution

Simulation, daily	Reservoirs	Optimization, hourly
Cubic meters of reservoir size		MWh of reservoir size
Cubic meters of outflow	 Hydropower	MWh of electricity output
Cubic meters of water for irrigation + losses	 Pumping	MWh of energy used for pumping by energy source
		Demand response
		Optimized investments in solar pumps
	 Cooling water in thermal plants?	

Power generation

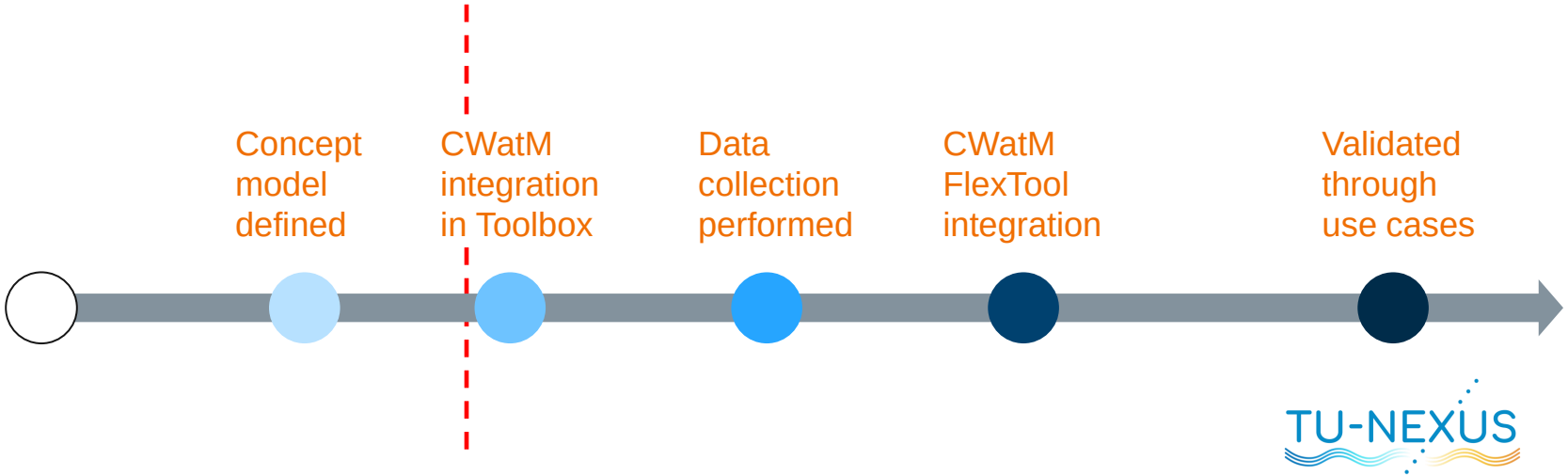
Variable renewable generation



Power transmission

End-use in households and industry

Where are we at?



VTT

TU-NEXUS

beyond the obvious

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