EHzürich



Nexus Energy Systems Modeling Platform

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Motivation & Project Goals

Motivation: Transition of Swiss Electric Power System in 2050

Question of

- **Nuclear** phase-out Ο
- Increased shares of renewables \bigcirc
- Extensive **decentralization** of supply
- Energy efficiency Ο
- System **safety** and **resilience** Ο

Project Goals:

Focus on a scenario of high RES share in 2050

- Quantification of flexibility needs Ο
- Analyze the mutual influences of centralized and decentralized flexibility providers
 - Cost/Benefit analysis of investments alternatives
 - Optimal mix of centralized and decentralized flexibility providers





Principles of the *Nexus* modelling platform

• Transparency:

- Be a transparent and well-trusted, ready-to-access platform that is openly available to ETH researchers, industry and partners.
- Provide reproducible results and analyses: not a 'black box' and keep/capture the *know how* of existing/ongoing research projects (effectively transfer the "know-how" across disciplines) experience.
- Harmonize research viewpoints, data and modelling assumptions.

Defined interfaces:

- Identify, define and implement interfaces to capture models interdependencies
- Interconnect layers and sectors of the energy system

• Modularity:

- Integrate cross-disciplinary models through a flexible and modular structure
- Interact with existing projects to capture/keep know-how



Nexus mid-term goals and vision

- Phase 0: Preparatory work and exploration (done:2014-2015)
 - Preparatory work aimed at exploring existing methodologies, research approaches for models linkages and coupling
 - Explore the development of an interdisciplinary approach
 - Conceptual framework and proposal

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- Phase 1: Applied implementation (3 years:2016-2019)
 - Implementation of core modules and interfaces for a specific topic: "The role of flexibility providers in 2050"
 - Initial platform design (data management process and IT infrastructure design)
- Phase 2: Platform development (2019)
 - Software platform development
 - Platform openly available for researchers and partners
 - Further development (e.g. inclusion of new modules)

Nexus Platform Overview





Database

- Generic structure to abstract all Nexus data
- Scenario configuration
- Consistency, security, extendibility, platform-independency
- Phase 2 ready
- Usage of State of the art open-source databases





Results using Web interface

The Nexus Framework GEP CGE Markets SSA **GEP** Inputs Investments Show 10 v entries Search: Units production + Technology Scenario value 🔶 Unit parameters Nuclear Biogas 22374 1 FixedOPandMC -Gas Turbine 103741 2 Nuclear Showing 1 to 2 of 2 entries 1 **GEP** Results Scenario Nuclear MOC 100000 75000 Production level alue 20000 Investment 25000 0 Variable costs Biogas Gas_Turbine Technology



Energy Science

cGEP-dGEP Interface

- Step 1: Run the cGEP with determined demand gap (e.g. because of nuclear phase-out/demand increase)
- Step2: Get the initialized energy/reserve price signal from cGEP
- Step3: Run the dGEP with the total demand gap dGEP decides whether
 - a). it needs to invest
 - or b). it should import from the cGEP
- Step4: Get the optimal load ratio from dGEP
- Step5: Run the cGEP with the residual demand after the investment of dGEP



Module design includes different markets and market zones





Example results from EM





Example results from EM





An example of SSA utilization

A modified IEEE 24 bus system with Swiss load demand







Nexus mid-term goals and vision



- framework
- Modelling & defining interfaces
- Assessing and leveraging existing expertise and models



What we need – what we can offer

Needs:

- Baseline/Reference scenarios (nodal hourly loads, generator operating costs, investment costs, hydro inflows etc.)
- Input Data and sources (for CH and surrounding countries)

Offers:

- Defined and tested interfaces
- Database structure for scenario definition, input and output data
- Web-Interface

