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Finding the Right Grid Model for Your Research in the GRID DATA Repository Using Big Data Semantic Search

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Challenges

- Increasing wind and solar generation
- Decentralization of generation
- Aging infrastructure
- Cybersecurity threats
- Severe weather events

- Need new algorithms for better **Visibility**, **Control** and **Optimization**
- Need good public datasets to test the new algorithms and compare algorithms

GRID DATA Program

Generating Realistic Information for the Development of Distribution And Transmission Algorithms

Duration	2016-2018
Projects	7
Investment	$11M

Goal:

Development of large-scale, realistic, validated, and open-access electric power system network models with the detail required for successful development and testing of new power system optimization and control algorithms.

Dataset Creation Pathways

Real Data

- Start with real data, then anonymize, perturb topologies and change sensitive infrastructure asset data as necessary.

Risks:

- Requires extremely close collaboration with ISOs such that infrastructure is not reconstructable and can be publically released.
- Datasets may no longer well represent real data.
- Real data is often messy, incomplete.

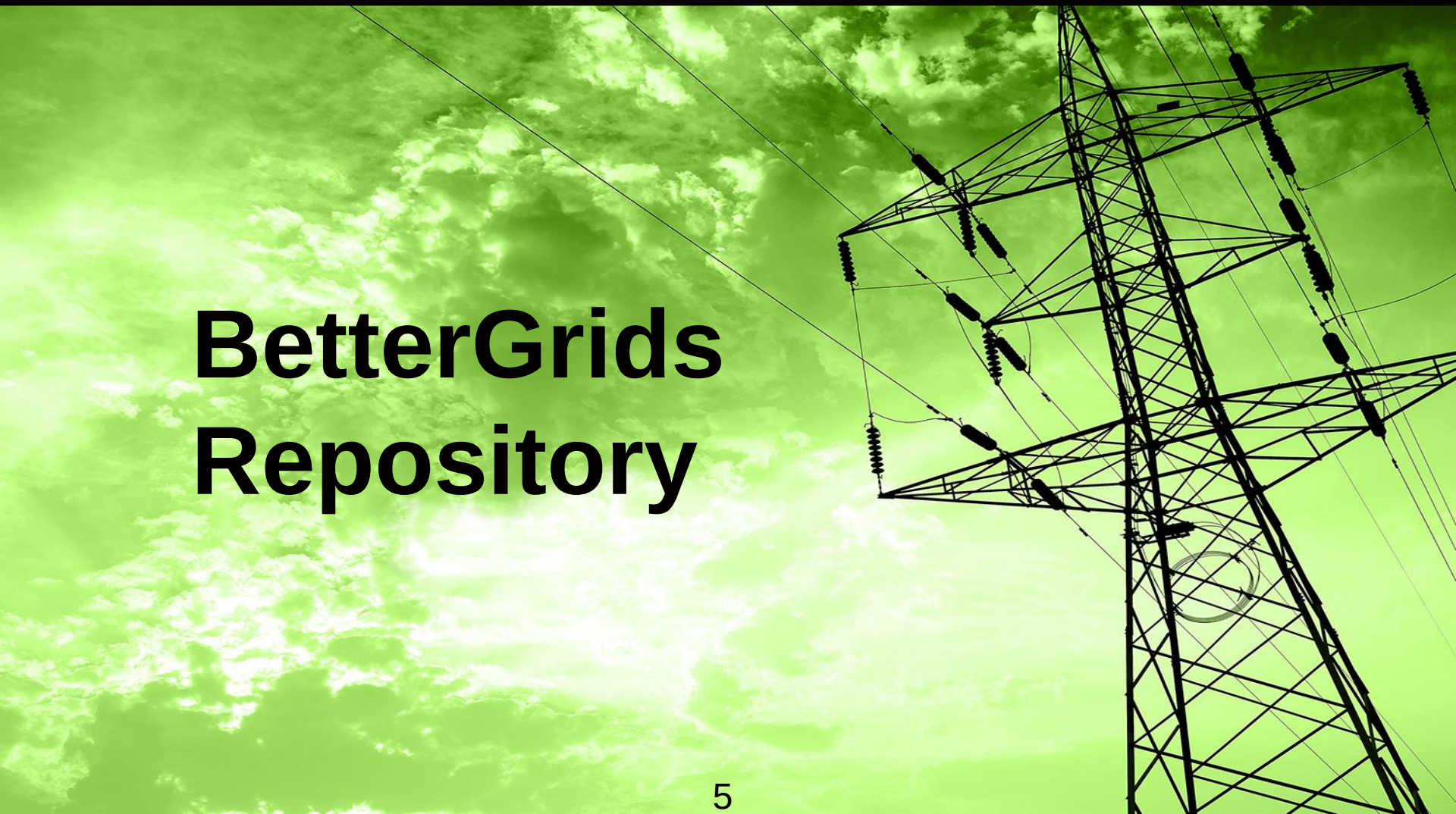
Synthetic Data

- Generate via expert input, geographic/road data and data mining.
- Generate new random graph methods for transmission networks.
- Devise statistical metrics (moments of capacity distributions, degree distributions of networks); validate against real data.

Risks:

- Validation metrics may be incomplete or misleading. (Leading to lack of realism.)

Open-access, large, realistic, validated datasets



BetterGrids Repository

BetterGrids Repository

- **A free library** of public grid model data
- **Supporting research** in grid optimization and reliability
- Enabling grid researchers to **collaborate and share data**
- Supported by a **community of volunteers** led by GridBright
- Funded by the **DOE ARPA-E** GRID DATA Program

Repository Collections

Existing Models Curated from the Public Domain

New Models Created by Labs or Universities

Distribution Models
Public Domain

Transmission Models
Public Domain

Pacific Northwest National Lab
ARPA-E GRID DATA

University of Illinois
ARPA-E GRID DATA

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Repository Functions

Contribute Models

Describe | Describe | Upload | Verify | License | Complete

Submit: Describe this Item

Please fill further information about this submission below.

Select the keyword(s) associated with this item. Hold down the "CTRL" or "Shift" key to select more than one keyword in the list.

Subject Keywords

- Power Grids
- Smart Grids
- Generators
- Distributed power generation
- Switches
- Power Quality

Select the data format from the list.

Data Format: MatPower

Enter Version of the selected Data Format.

Data Format Version: 1

Enter Model Class of this data.

Model Class:

Enter number of buses

Buses: 1000

Enter number of generators

Generators: 200

Enter number of loads

Loads: 500

Find Models

BETTERGRIDS.ORG Browse Search Help

Search

Search: All of BetterGrids

for: Go

Current filters: Data Format | Equals | MatPower | X

Start a new search

Add filters:

Use filters to refine the search results.

Title | Equals | Add

Results/Page 10 | Sort items by Relevance In order Descending Authors/record All Update

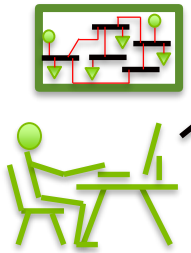
Results 1-6 of 6 (Search time: 0.001 seconds).

previous 1 next

Item hits:

Issue Date	Publisher	Title	Version	Data Format	Feeders	Loads	Buses	Generators
12-Mar-2013	*Edinburgh Test Case Archive*	39 bus New England test case with realistic cost data	*1*	*MatPower*	-	*46*	*39*	*10*

Model Curation



Model Submission

Model Submitted by Model Creator for purposes of sharing with research community

Submission Review

Submission reviewed for proper attributions, tags, description, etc.

Model Review

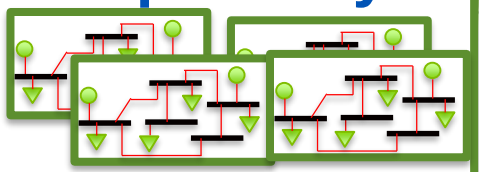
Model reviewed for usability, data content, and annotation

Policy Review

Model reviewed for proper licensing, CIEE data, and compliance with polices

Model published

BetterGrids Repository



Semantic Search Capabilities

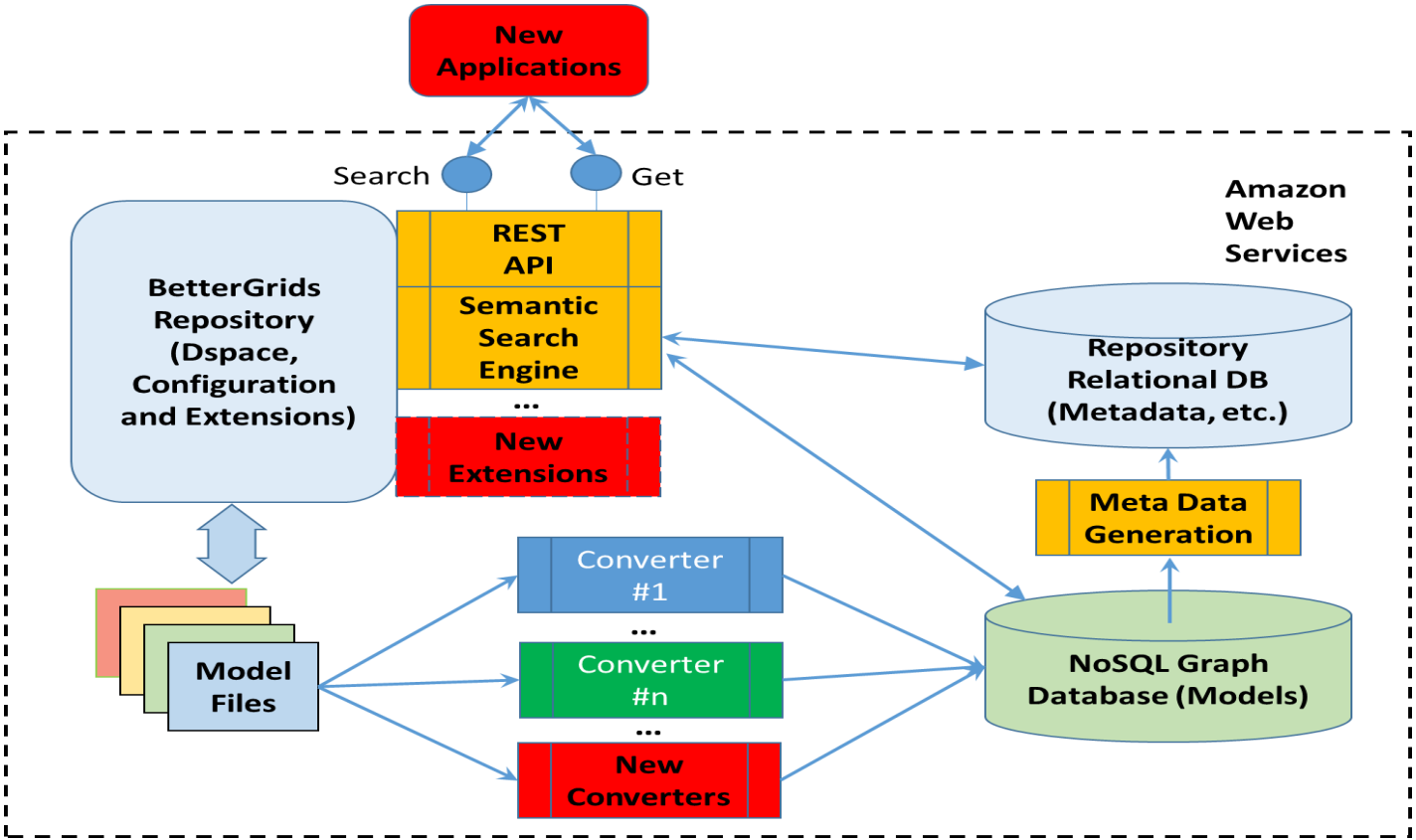
Challenge

- Researchers often look for grid models with unique electrical conditions
- With a large number of models (100s-1000s) that are very large (10,000-1,000,000 nodes/buses) manual cataloging is impossible
- Unique model conditions can't be found with traditional file/database searches

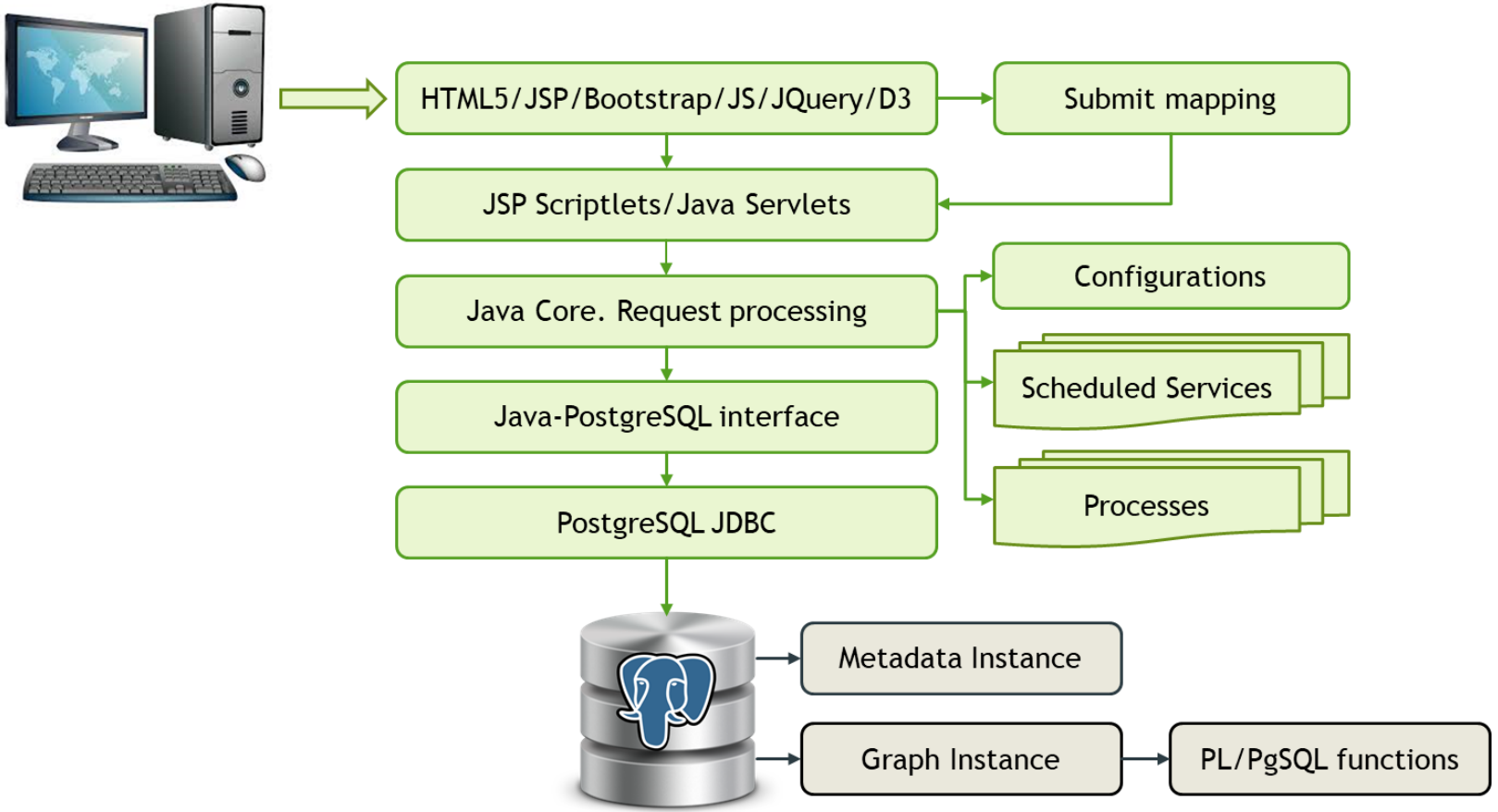
Solution

- Construct a database of the models that "understands" the equipment & organization of the models so that it can be intelligently searched
- Achievable by translating & pre-processing the data, storing it in a NOSQL/graph database, and searching using big data techniques

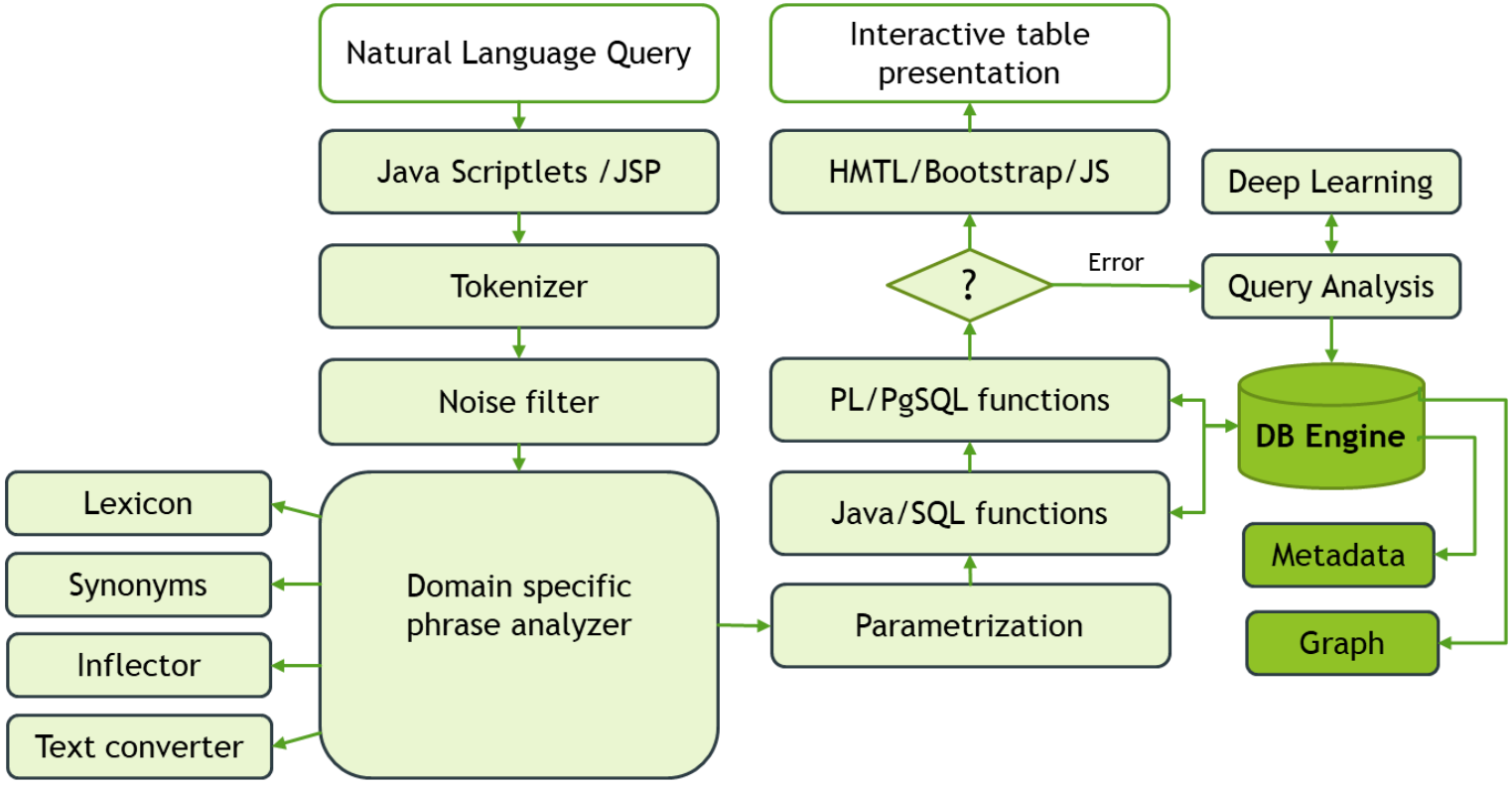
Repository Model Converters



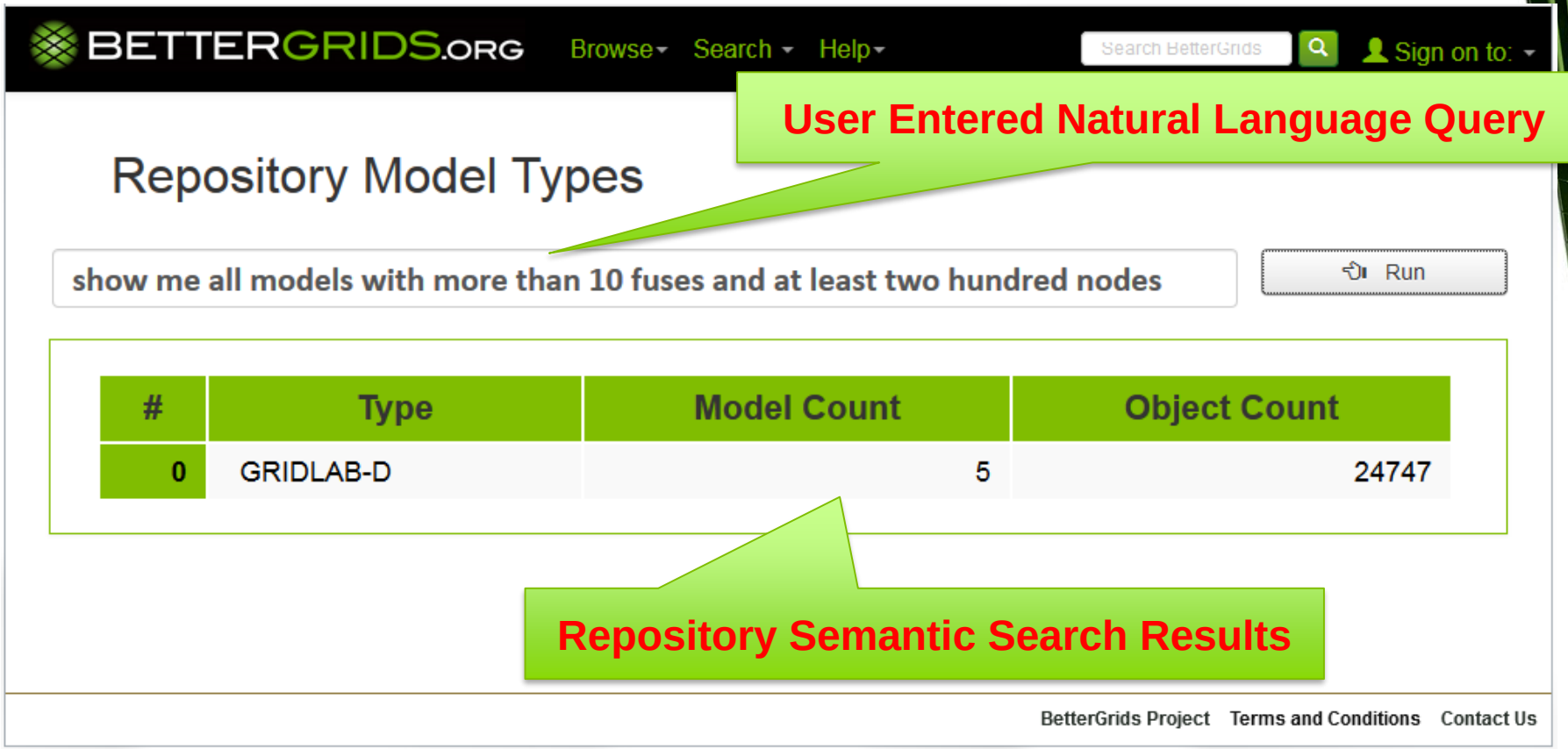
Repository Architecture



Semantic Search Engine



Semantic Search Example



Example Queries

Query
Search for models with greater than 5,000 buses with over 10,000 miles of total line length of 69kV and greater
Search for models that have over 100 PV loads
Search for models that have over 10 PV loads on a single 4KV circuit
Search for models with 10 or more feeders fed from the same substation that have more than one voltage regulator per circuit
Search for models with more than 100 wind plants and solar plants connected at 34kV or lower
Search for models with the sum of distributed generation total kW capacity of PV plants over 100kW is 100mW or greater

The Support Community

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About BetterGrids

BetterGrids Foundation, Inc.

- Is a nonprofit public charity (501 (C) (3)) dedicated to research and education in smart grid.
- Vision for grid researchers have the essential data they need to develop better grid solutions.

Mission

Operating the **Grid Data Repository** in a self-funding manner

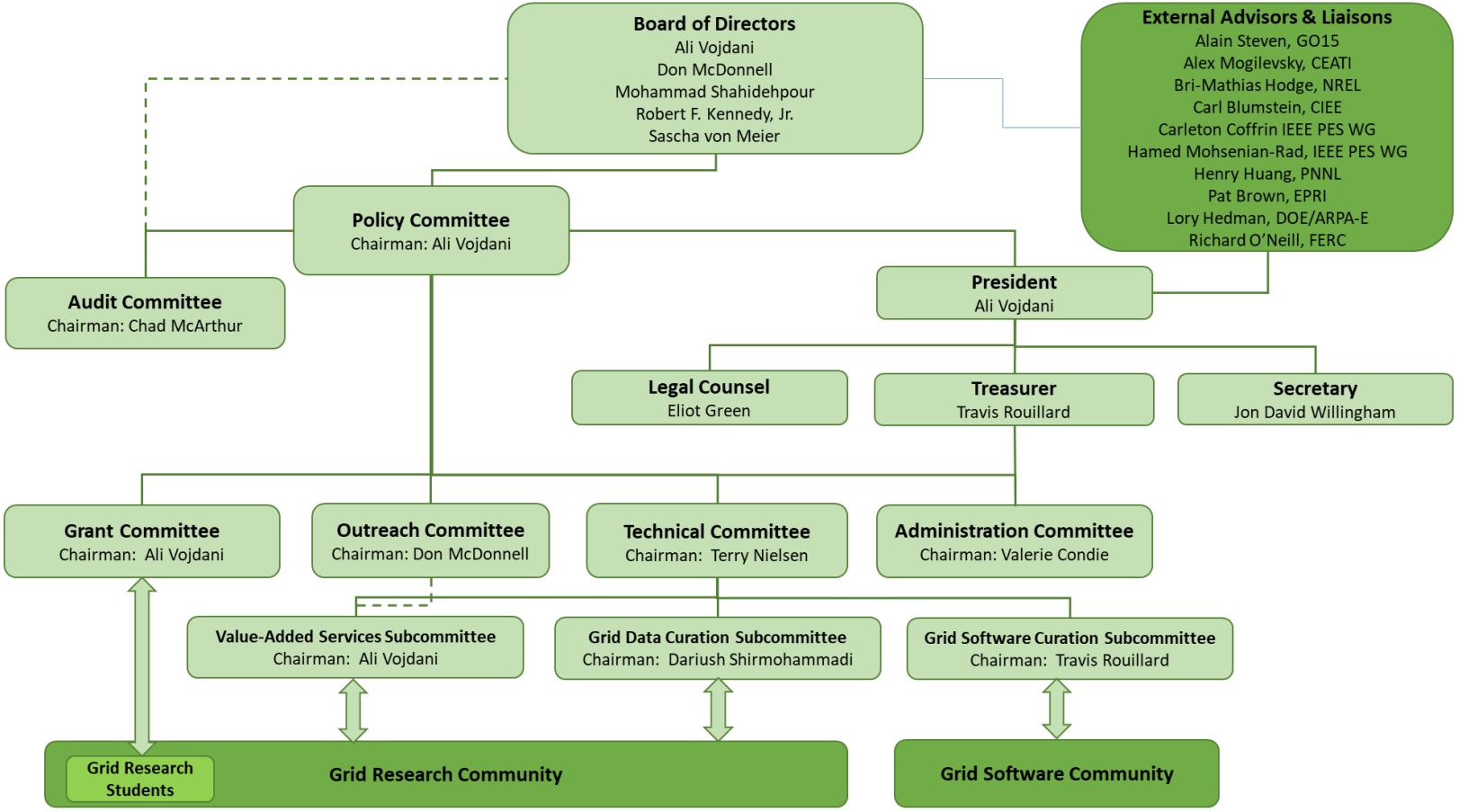
Self-Funding Strategy

1. Engaging a community of volunteers to operate the Repository and govern BetterGrids.
2. Creating value-added grid research solutions under a Freemium pricing model.
3. Connecting grid research students with experienced entrepreneurs to improve Tech-to-Market.
4. Fundraising from charitable donors.
5. Making grants to research students developing better grid solutions.

Unique Differentiation

The only organization exclusively dedicated to availability of data for smart grid

BetterGrids Leadership Team



Organizations Engaged*

*Organizations that are participating in various BetterGrids committees and/or have provided valuable input to creation of the GRID DATA Repository.

Join the Community

- Visit www.bettergrids.org
- Join our Mailing List for Newsletters and Updates
- Follow us on LinkedIn (BetterGrids)
- Follow us on Twitter (@BetterGridsOrg)
- Contact us at info@BetterGrids.org
- Volunteer, contribute data, or propose new services
- Learn more about our services for Researchers
- Ask about our free Repositories for Univerisities
- Spread the word
- Make donations