

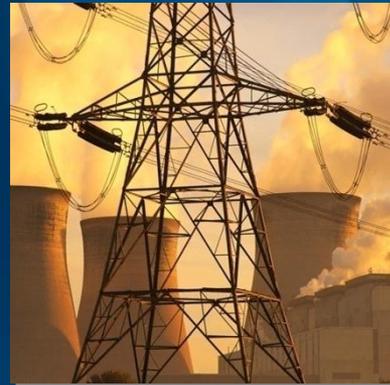
# Web Hosted Solutions Using ModelCenter as a Service

**Brant Peery**

Systems Design, Idaho National Laboratory

**Sam Alessi, PhD**

Almanac Systems LLC



# Presentation Overview

## Overall Framework

- Blending of COTS tools to provide a solution
- ModelCenter as a backend service

## Web delivered models as a service

- ModelCenter through the web
- Running a model through any interface
- Running multiple models as one system

# GEMS: Generalized Environment for Modeling Systems



Microsoft®  
**SharePoint®**

**Collaboration and Reporting**



**INL ModelCenter Web GUI**

Statistical  
Analysis

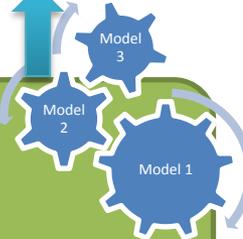
Business  
Intelligence



**Vision:  
Self Service Data &  
Model Integration  
to the Web**



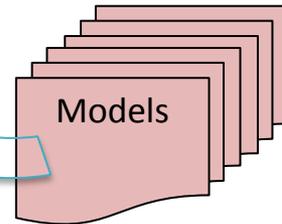
**Model  
Integration  
and Trade-Off Analysis**



Data

**INL DataCenter DataPipe**

**High  
Performance  
Computing**



Models

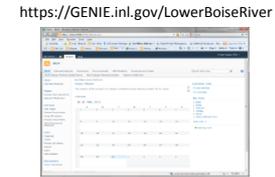
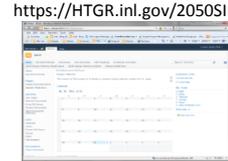
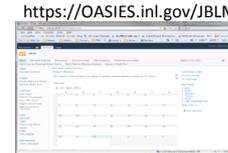
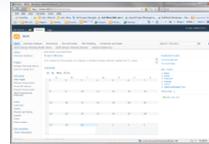
**RELAP5**



# Emerging GEMS Portfolio

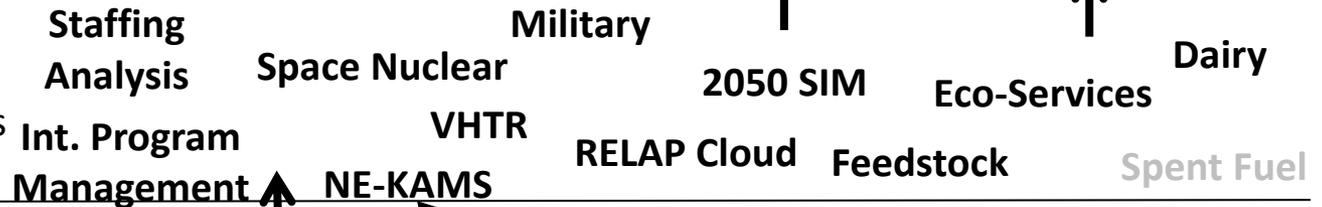
## Customer Portal:

Results, Executable Models, Data Access, Collaboration



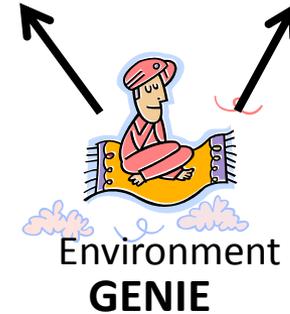
## Projects:

Specific Customer Oriented Tools, Analysis, Decision Aids



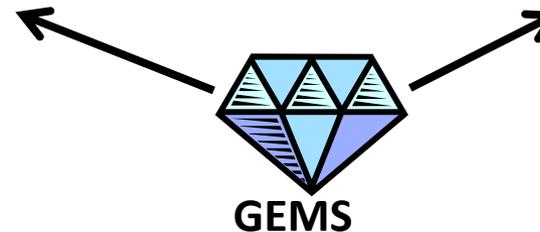
## Domain:

Energy Data, Energy Models, Preferred Modeling Tools, Decision Aids, Results, Financial Analysis, Laboratory Performance



## Infrastructure:

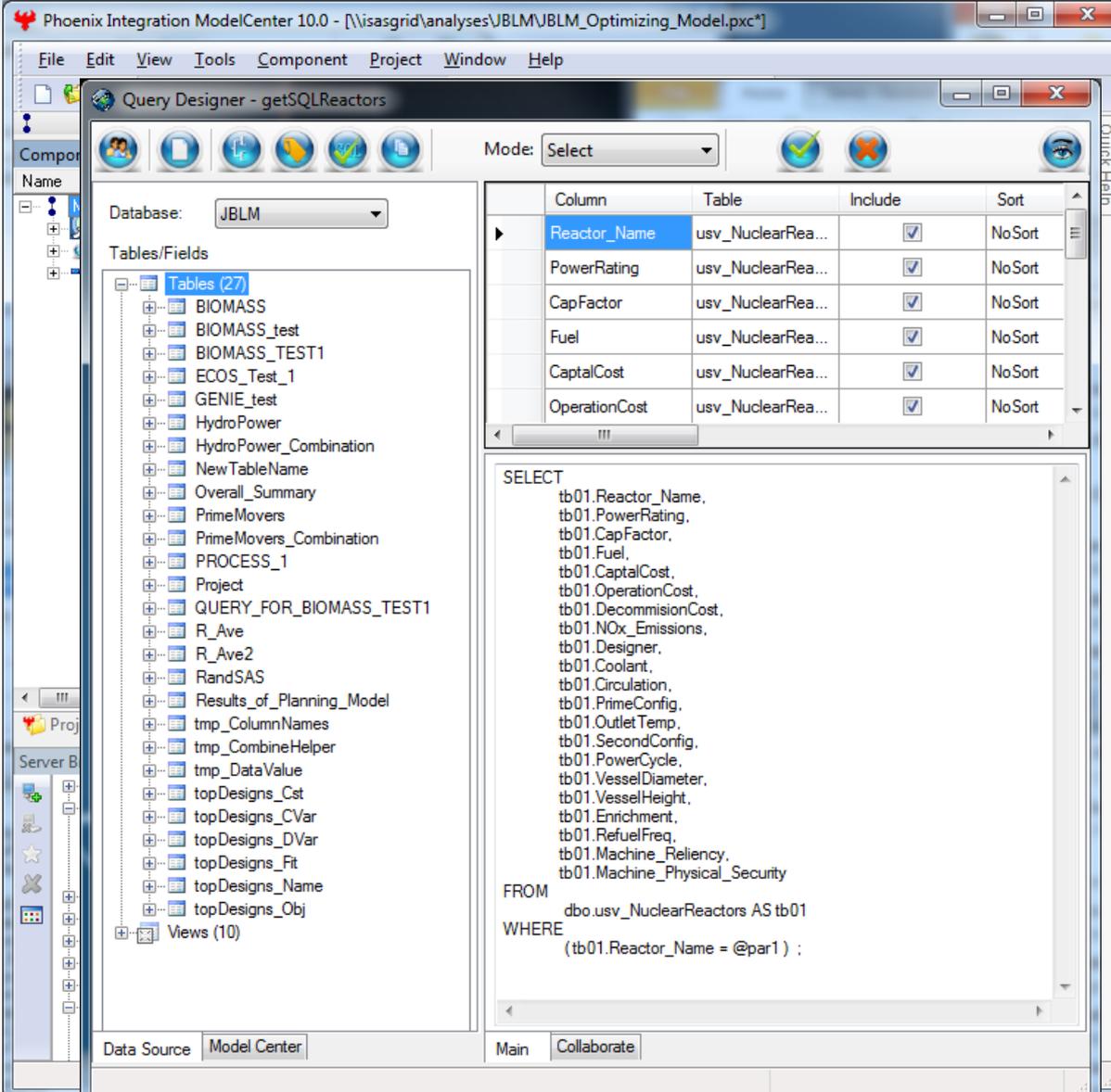
Servers, Licenses, Wrappers, Data Management, Optimizers, Visualization License/Infrastructure sharing with IM



OASIES - Optimized Analysis for Strategic Integrated Energy Systems  
 GENIE - General ENvironmental Integration Environment  
 NOMAD - Nuclear Operation Modeling Analysis & Design

# Data Management

- Original goal was “Data Provenance”
- Holding model parameters in a database would have numerous benefits:
  - Reuse of data
  - Reduced hand manipulation
  - Enterprise data management
  - Allow customer’s to select and modify model inputs
  - Allow customer’s to statistically analyze model results



Phoenix Integration ModelCenter 10.0 - [\\nasgrid\analyses\JBLM\JBLM\_Optimizing\_Model.pxc\*]

Query Designer - getSQLReactors

Mode: Select

Database: JBLM

Tables/Fields

Column	Table	Include	Sort
Reactor_Name	usv_NuclearRea...	<input checked="" type="checkbox"/>	NoSort
PowerRating	usv_NuclearRea...	<input checked="" type="checkbox"/>	NoSort
CapFactor	usv_NuclearRea...	<input checked="" type="checkbox"/>	NoSort
Fuel	usv_NuclearRea...	<input checked="" type="checkbox"/>	NoSort
CapitalCost	usv_NuclearRea...	<input checked="" type="checkbox"/>	NoSort
OperationCost	usv_NuclearRea...	<input checked="" type="checkbox"/>	NoSort

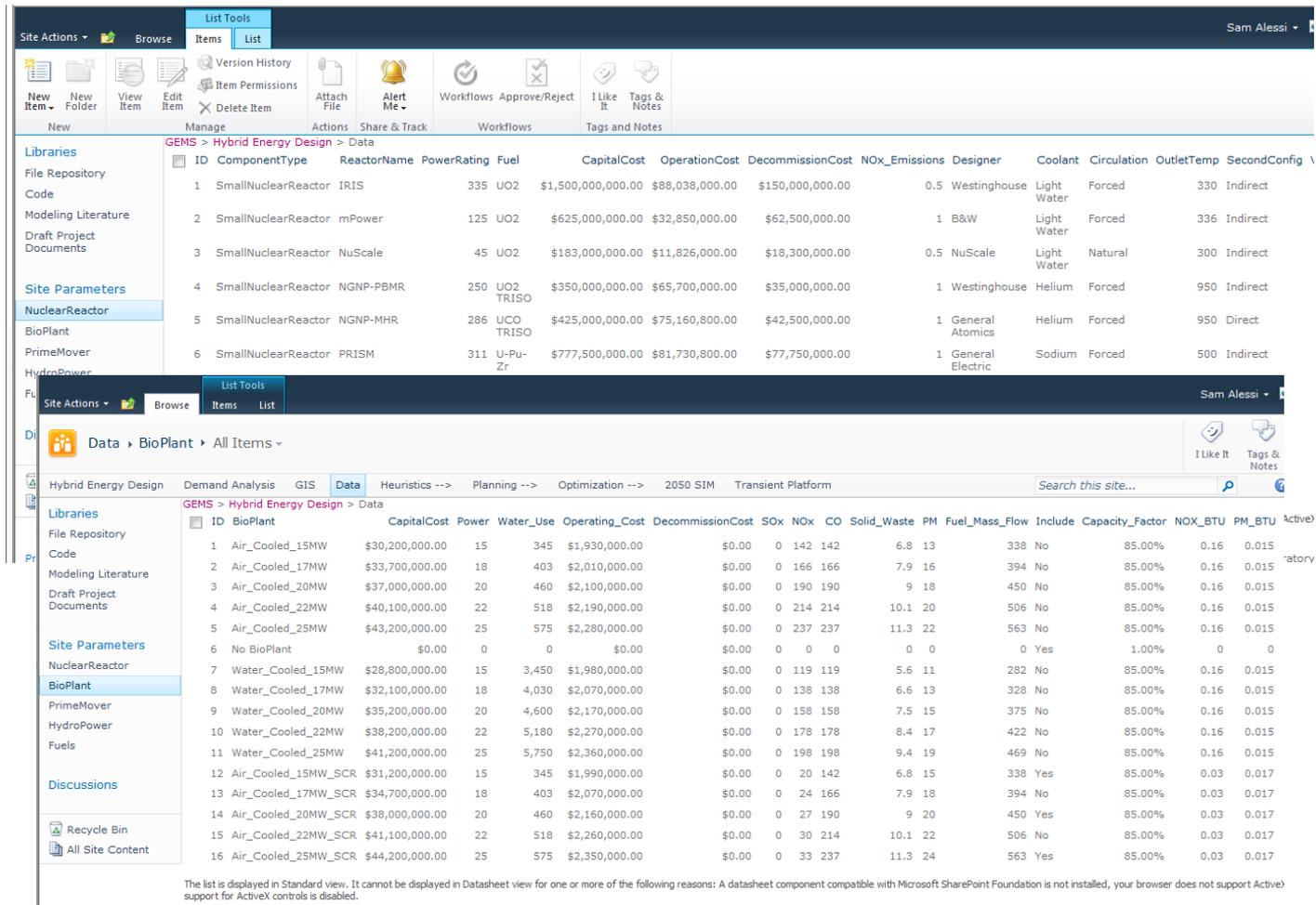
```

SELECT
  tb01.Reactor_Name,
  tb01.PowerRating,
  tb01.CapFactor,
  tb01.Fuel,
  tb01.CapitalCost,
  tb01.OperationCost,
  tb01.DecommissionCost,
  tb01.NOx_Emissions,
  tb01.Designer,
  tb01.Coolant,
  tb01.Circulation,
  tb01.PrimeConfig,
  tb01.OutletTemp,
  tb01.SecondConfig,
  tb01.PowerCycle,
  tb01.VesselDiameter,
  tb01.VesselHeight,
  tb01.Enrichment,
  tb01.RefuelFreq,
  tb01.Machine_Reliency,
  tb01.Machine_Physical_Security
FROM
  dbo.usv_NuclearReactors AS tb01
WHERE
  (tb01.Reactor_Name = @par1) ;
  
```

Data Source: Model Center | Main | Collaborate

# Web Data Access

- Database values can be exposed to the web site for user selection prior to a ModelCenter run.



The screenshot displays two data tables from a web application. The top table, titled 'GEMS > Hybrid Energy Design > Data', lists nuclear reactor components. The bottom table, titled 'GEMS > Hybrid Energy Design > Data', lists bio-plant components. Both tables are displayed in a standard view within a web browser interface.

ID	ComponentType	ReactorName	PowerRating	Fuel	CapitalCost	OperationCost	DecommissionCost	NOx_Emissions	Designer	Coolant	Circulation	OutletTemp	SecondConfig
1	SmallNuclearReactor	IRIS	335	UO2	\$1,500,000,000.00	\$88,038,000.00	\$150,000,000.00	0.5	Westinghouse	Light Water	Forced	330	Indirect
2	SmallNuclearReactor	mPower	125	UO2	\$625,000,000.00	\$32,850,000.00	\$62,500,000.00	1	B&W	Light Water	Forced	336	Indirect
3	SmallNuclearReactor	NuScale	45	UO2	\$183,000,000.00	\$11,826,000.00	\$18,300,000.00	0.5	NuScale	Light Water	Natural	300	Indirect
4	SmallNuclearReactor	NGNP-PBMR	250	UO2 TRISO	\$350,000,000.00	\$65,700,000.00	\$35,000,000.00	1	Westinghouse	Helium	Forced	950	Indirect
5	SmallNuclearReactor	NGNP-MHR	286	UCO TRISO	\$425,000,000.00	\$75,160,800.00	\$42,500,000.00	1	General Atomics	Helium	Forced	950	Direct
6	SmallNuclearReactor	PRISM	311	U-Pu- Zr	\$777,500,000.00	\$81,730,800.00	\$77,750,000.00	1	General Electric	Sodium	Forced	500	Indirect

ID	BioPlant	CapitalCost	Power	Water_Use	Operating_Cost	DecommissionCost	SOx	NOx	CO	Solid_Waste	PM	Fuel_Mass_Flow	Include	Capacity_Factor	NOX_BTU	PM_BTU	Active
1	Air_Cooled_15MW	\$30,200,000.00	15	345	\$1,930,000.00	\$0.00	0	142	142	6.8	13	338	No	85.00%	0.16	0.015	
2	Air_Cooled_17MW	\$33,700,000.00	18	403	\$2,010,000.00	\$0.00	0	166	166	7.9	16	394	No	85.00%	0.16	0.015	
3	Air_Cooled_20MW	\$37,000,000.00	20	460	\$2,100,000.00	\$0.00	0	190	190	9	18	450	No	85.00%	0.16	0.015	
4	Air_Cooled_22MW	\$40,100,000.00	22	518	\$2,190,000.00	\$0.00	0	214	214	10.1	20	506	No	85.00%	0.16	0.015	
5	Air_Cooled_25MW	\$43,200,000.00	25	575	\$2,280,000.00	\$0.00	0	237	237	11.3	22	563	No	85.00%	0.16	0.015	
6	No BioPlant	\$0.00	0	0	\$0.00	\$0.00	0	0	0	0	0	0	Yes	1.00%	0	0	
7	Water_Cooled_15MW	\$28,800,000.00	15	3,450	\$1,980,000.00	\$0.00	0	119	119	5.6	11	282	No	85.00%	0.16	0.015	
8	Water_Cooled_17MW	\$32,100,000.00	18	4,030	\$2,070,000.00	\$0.00	0	138	138	6.6	13	328	No	85.00%	0.16	0.015	
9	Water_Cooled_20MW	\$35,200,000.00	20	4,600	\$2,170,000.00	\$0.00	0	158	158	7.5	15	375	No	85.00%	0.16	0.015	
10	Water_Cooled_22MW	\$38,200,000.00	22	5,180	\$2,270,000.00	\$0.00	0	178	178	8.4	17	422	No	85.00%	0.16	0.015	
11	Water_Cooled_25MW	\$41,200,000.00	25	5,750	\$2,360,000.00	\$0.00	0	198	198	9.4	19	469	No	85.00%	0.16	0.015	
12	Air_Cooled_15MW_SCR	\$31,200,000.00	15	345	\$1,990,000.00	\$0.00	0	20	142	6.8	15	338	Yes	85.00%	0.03	0.017	
13	Air_Cooled_17MW_SCR	\$34,700,000.00	18	403	\$2,070,000.00	\$0.00	0	24	166	7.9	18	394	No	85.00%	0.03	0.017	
14	Air_Cooled_20MW_SCR	\$38,000,000.00	20	460	\$2,160,000.00	\$0.00	0	27	190	9	20	450	Yes	85.00%	0.03	0.017	
15	Air_Cooled_22MW_SCR	\$41,100,000.00	22	518	\$2,260,000.00	\$0.00	0	30	214	10.1	22	506	No	85.00%	0.03	0.017	
16	Air_Cooled_25MW_SCR	\$44,200,000.00	25	575	\$2,350,000.00	\$0.00	0	33	237	11.3	24	563	Yes	85.00%	0.03	0.017	

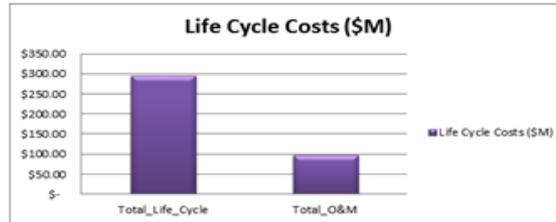
The list is displayed in Standard view. It cannot be displayed in Datasheet view for one or more of the following reasons: A datasheet component compatible with Microsoft SharePoint Foundation is not installed, your browser does not support ActiveX support for ActiveX controls is disabled.

# ModelCenter SharePoint Webpart

<b>Variables</b> Input	<b>Scenario</b> Input	<b>Summary</b> Assumption Report	<b>Costs</b> Output	<b>Power</b> Output	<b>Fuel</b> Output	<b>Emissions</b> Output	<b>Resilience</b> Output
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- Ex: SharePoint customer interface
- SAS provided means to run data centric statistical models
- ModelCenter supports legacy codes and code integration
- Both systems are usable by non programmers

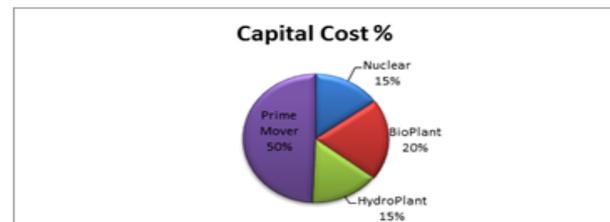
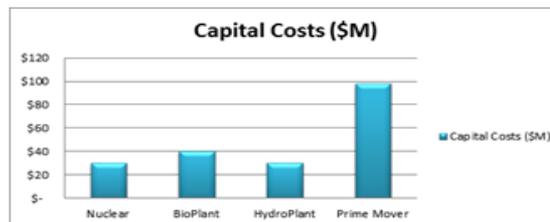
Power Generation Type	Life Cycle Costs (\$M)
Total_Life_Cycle	\$295.86 M
Total_O&M	\$97.24 M
O&M_PctOf_LCC	32.9%



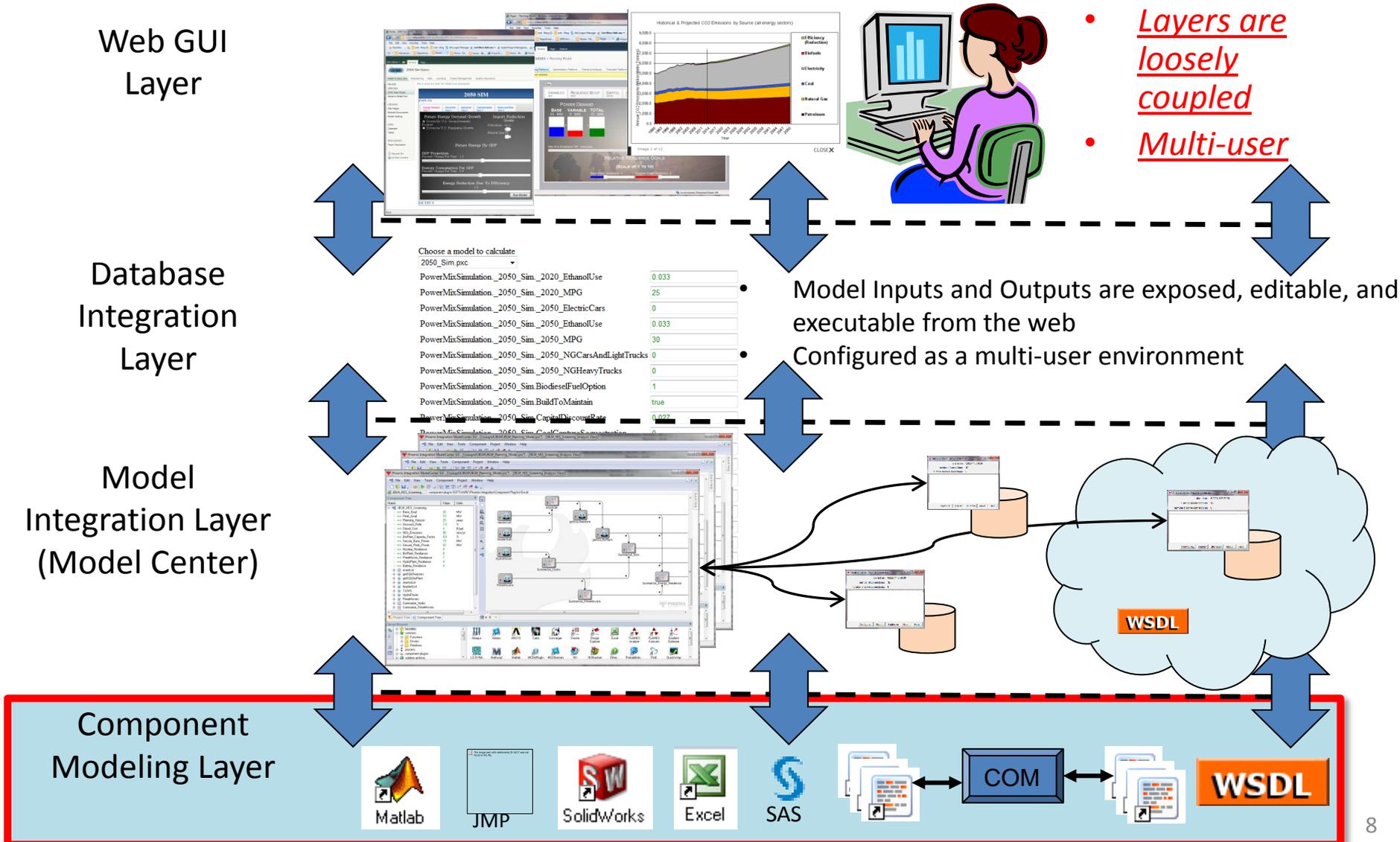
Description	Costs per kW (\$/kW)
\$/kW Per Capital Costs	\$3,099.933
\$/kW Per Operation Cost not Including Fuel	\$0.010



Power Generation Type	Capital Costs (\$M)	Capital Cost %
Nuclear	\$30.00 M	15.1%
BioPlant	\$40.32 M	20.3%
HydroPlant	\$30.38 M	15.3%
Prime Mover	\$97.92 M	49.3%
<b>Total Capital Cost</b>	<b>\$198.62 M</b>	<b>100.0%</b>



# ModelCenter-based Web GUI



# Energy Policy Model

- Allows users to set an energy mix (% Nuclear, % Coal, etc.)
- Model determines outcomes to the year 2050

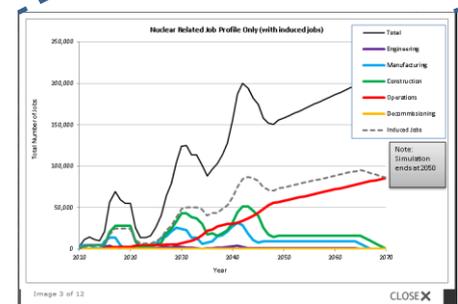
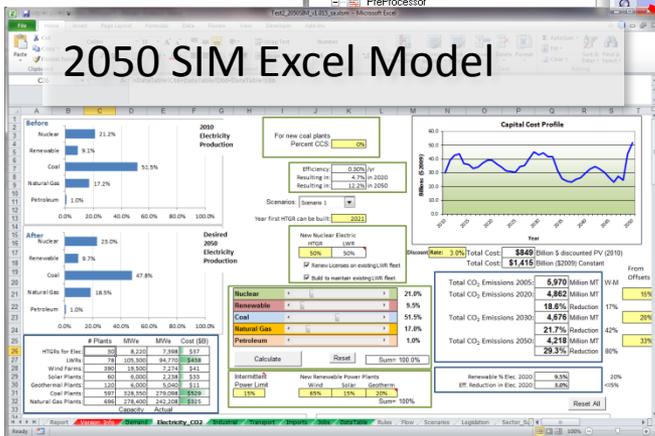
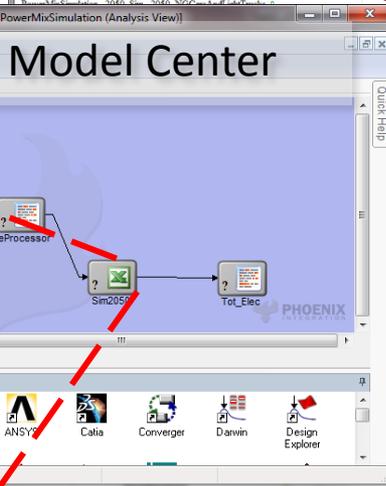
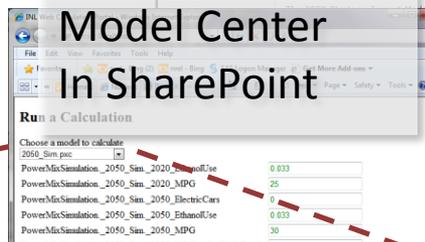
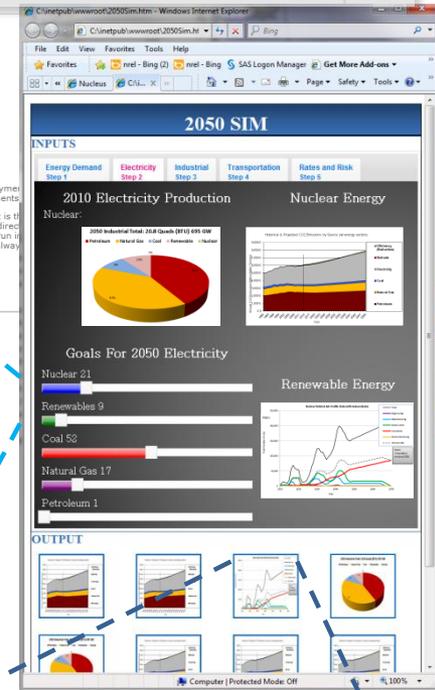
## To Run the Model

1. Go to SharePoint Site
2. Adjust inputs
3. Click Run
4. View Results

## User Web Site



## ModelCenter Controller (GUI)



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# Web Interfaces for Old Code

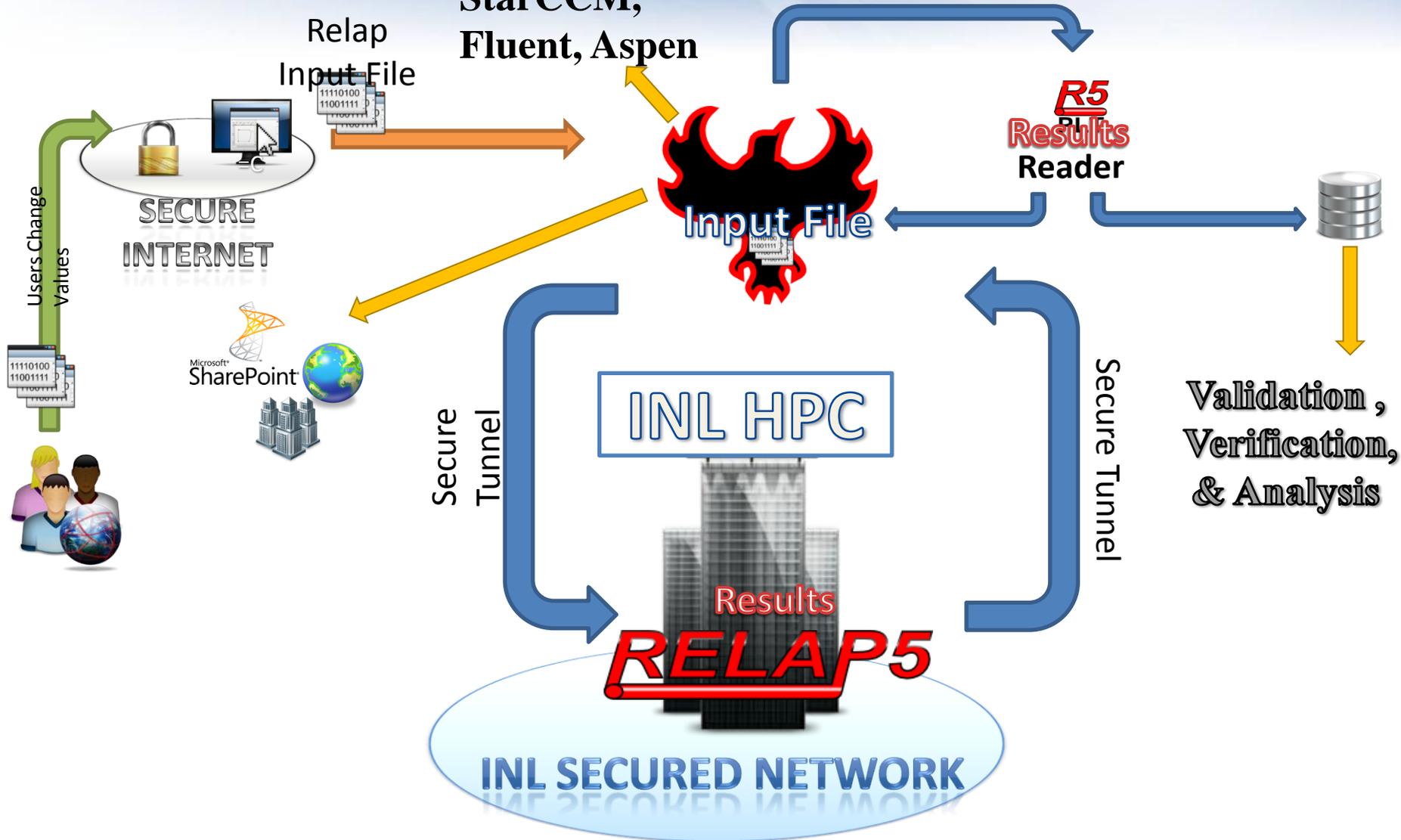
- Legacy applications need web interfaces too
  - Usually costly
  - Usually time consuming
  - Usually wrong (HARD to get 100%)
- Avoid rewriting algorithms
  - Original developer still owns maintenance
  - Updates are as easy as copying new release to server

# ModelCenter As A Service to the Rescue

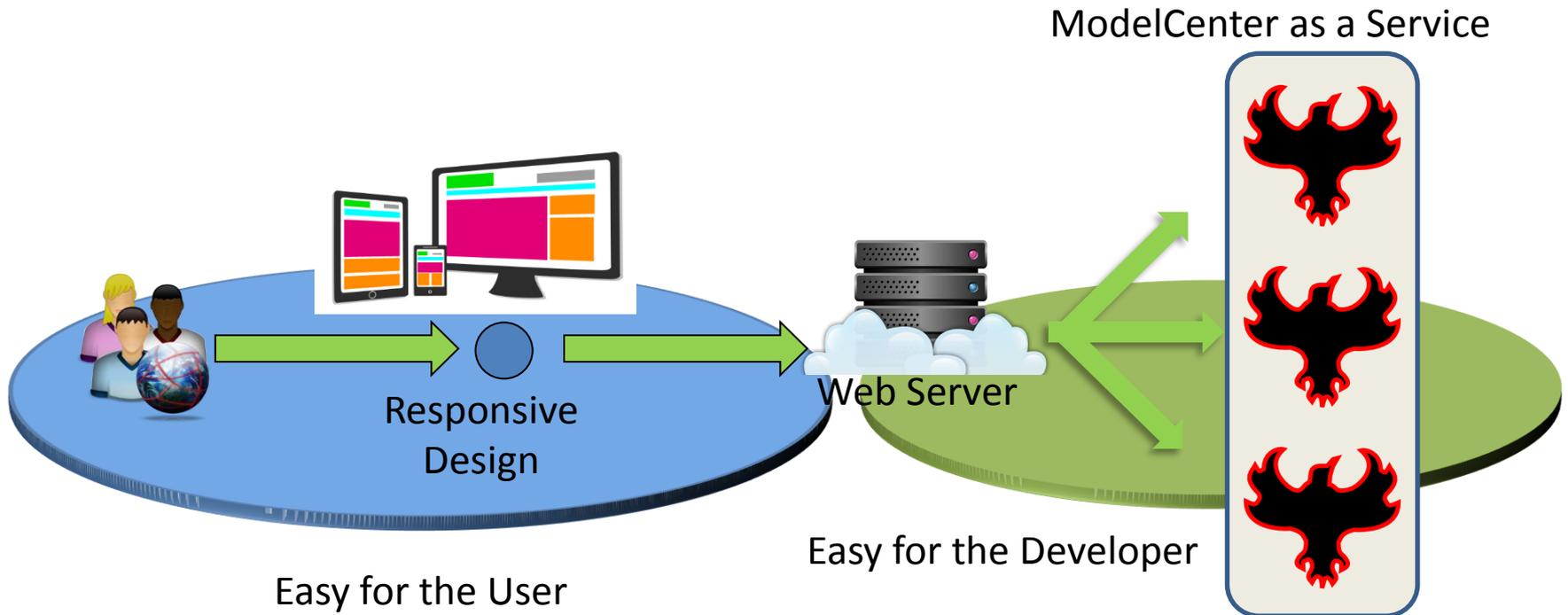
- No need to rewrite or translate code
- Wrapped code IS the original code
- Trade studies can be conducted
- Model chaining
- ModelCenter used as a backend service only

# Remote Use of RELAP5

StarCCM,  
Fluent, Aspen



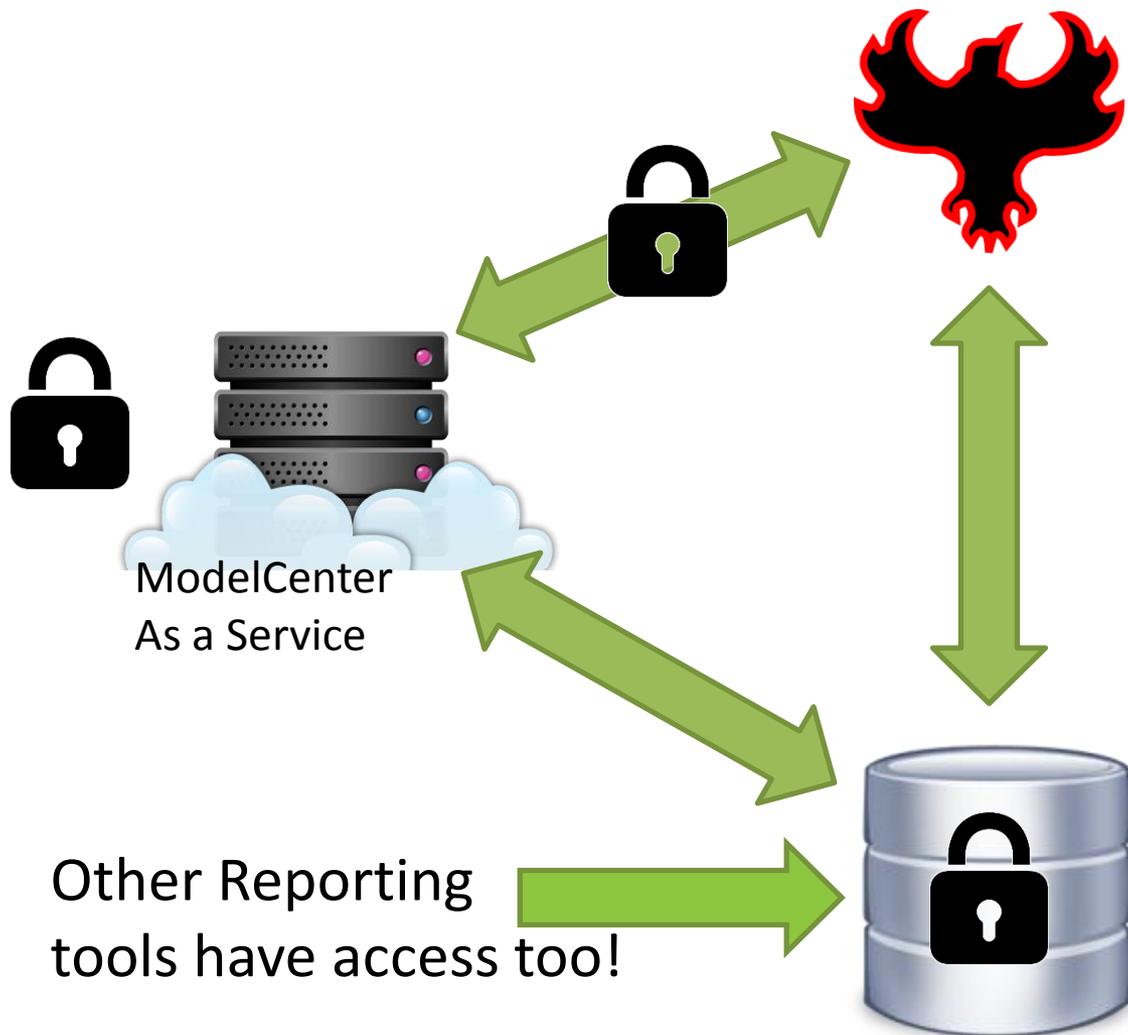
# Web User Interaction with ModelCenter



# Advantages

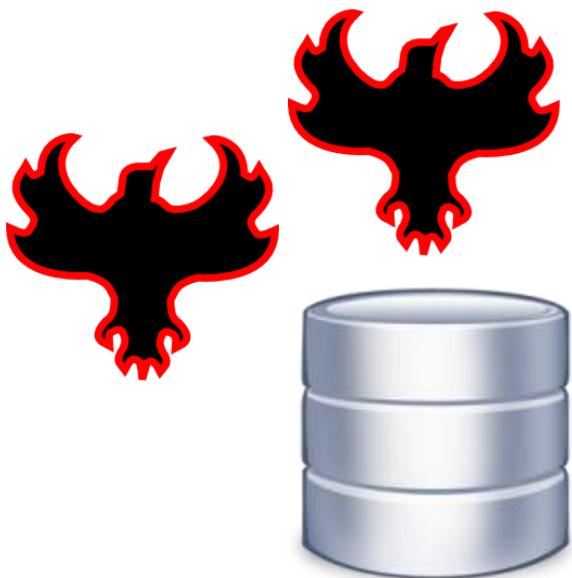
- Interface completely decoupled from the Model
- Model is now scalable (like the internet)
- Distributed computing
- Load Balanced
- Easy for the User
- Easy to distribute use of the model
- Easy to maintain

# Database Driven Models



- User Specific Data
- Model Specific Data
- Cached Runs
- Automated Cache Generation
- FAST RESULTS
- Audit Trail
- Trend Tracking

# Common Systems Can Play Together



Model Run Database



User Variables Value  
and Preferences Database



Variable Definition Database

# Data Playground

- Multiple models have access to the same data
- Model run order doesn't matter
- Very Turbo Tax like
- User can get reports at will
- User uses a web interface (familiar)
- More models can be added at will (easy growth)

# ModelCenter as a Service

- ModelCenter used as a backend service
- Runs on C#
  - Windows
  - Mono Project
  - Soon to be released cross platform .NET 5
- Uses runner licenses
- Uses a common variables database
  - Multi model preferences and unit conversion

# ModelCente as a Service

- Uses JSON messaging (ODATA)
- Can be talked to by
  - Web pages
  - Custom Phone Apps
  - Tablets
  - System to System
  - Anything web enabled
- Models executed by non-technical end users

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**Brant Peery**  
**Idaho National Laboratory**  
(208) 526-3666

**Sam Alessi, Ph.D.**  
**Almanac Systems LLC**  
(208) 569-3437

