

Custom Energy
Analytics, Or
How I Stopped
Worrying and
Learned to Love
Big Data

Ethan Goldman
VEIC

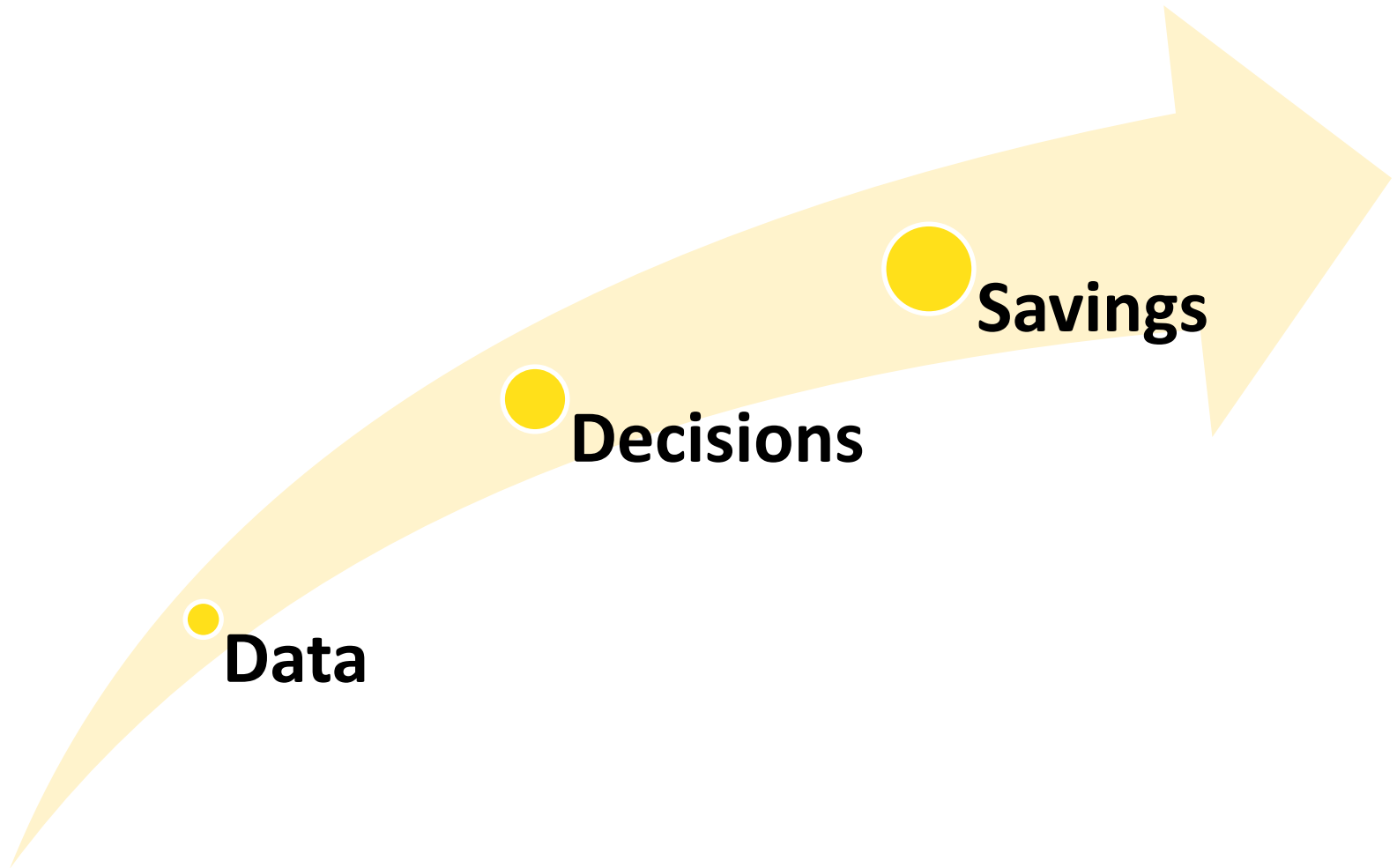


Vermont Energy Investment Corporation

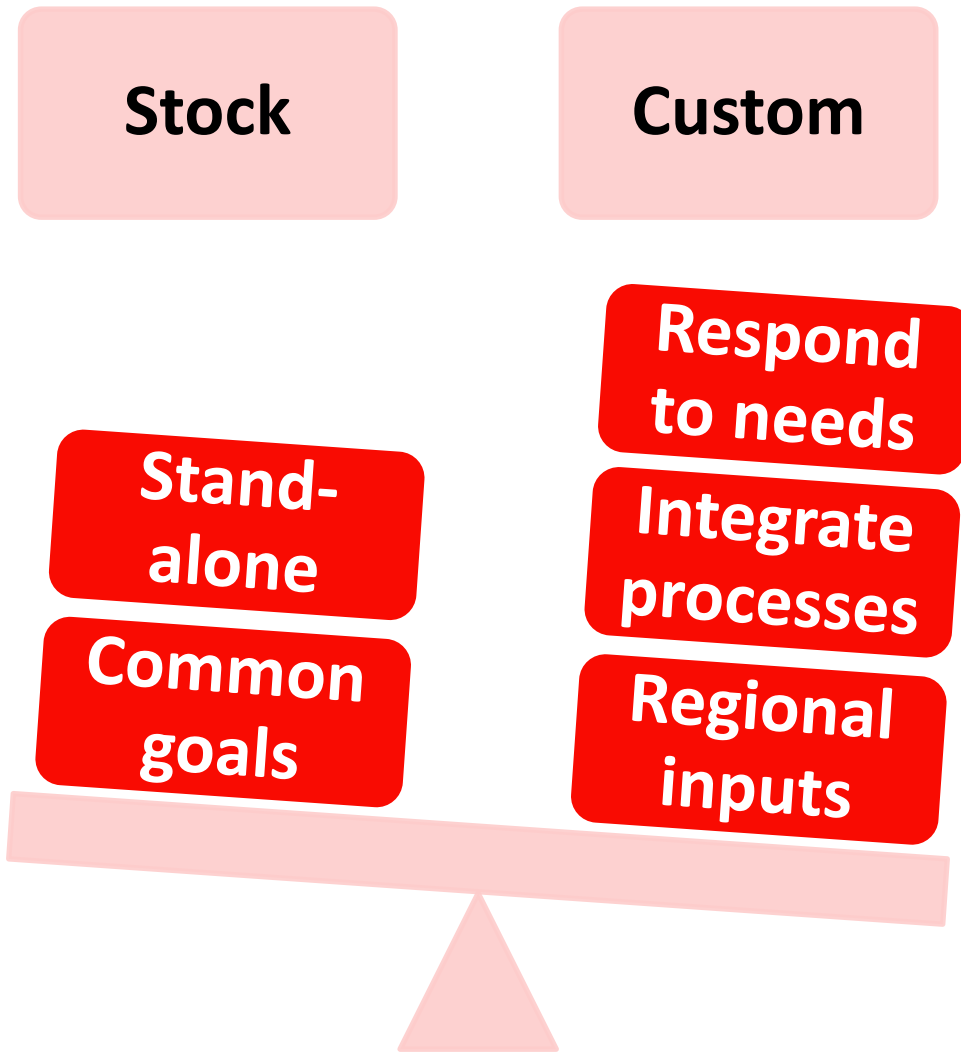
- Mission-driven nonprofit
- Over 25 years reducing economic, environmental costs of energy
- Energy efficiency, renewable energy & transportation
- Consulting & implementation
- 3 energy efficiency utilities



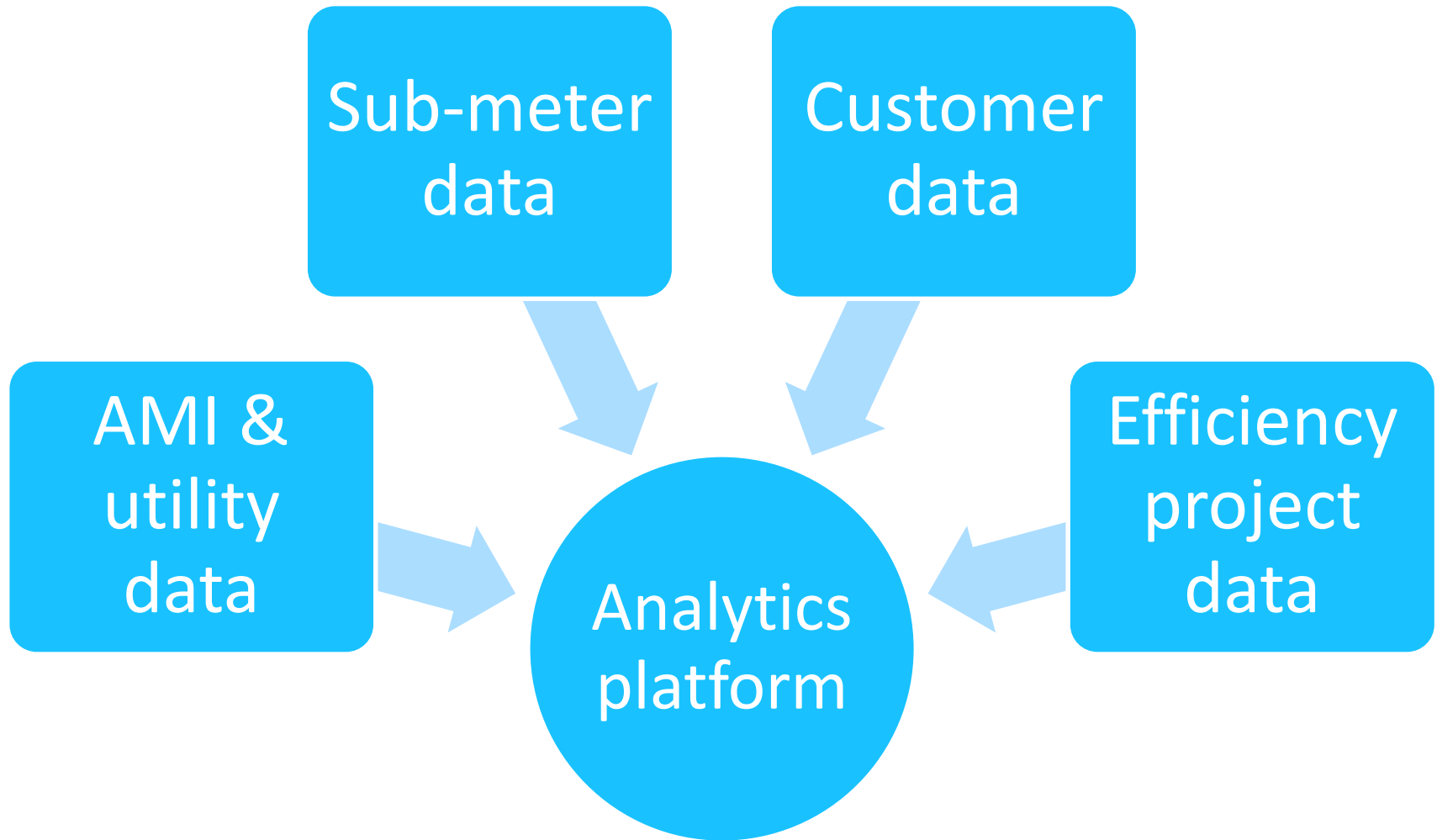
Data Strategy



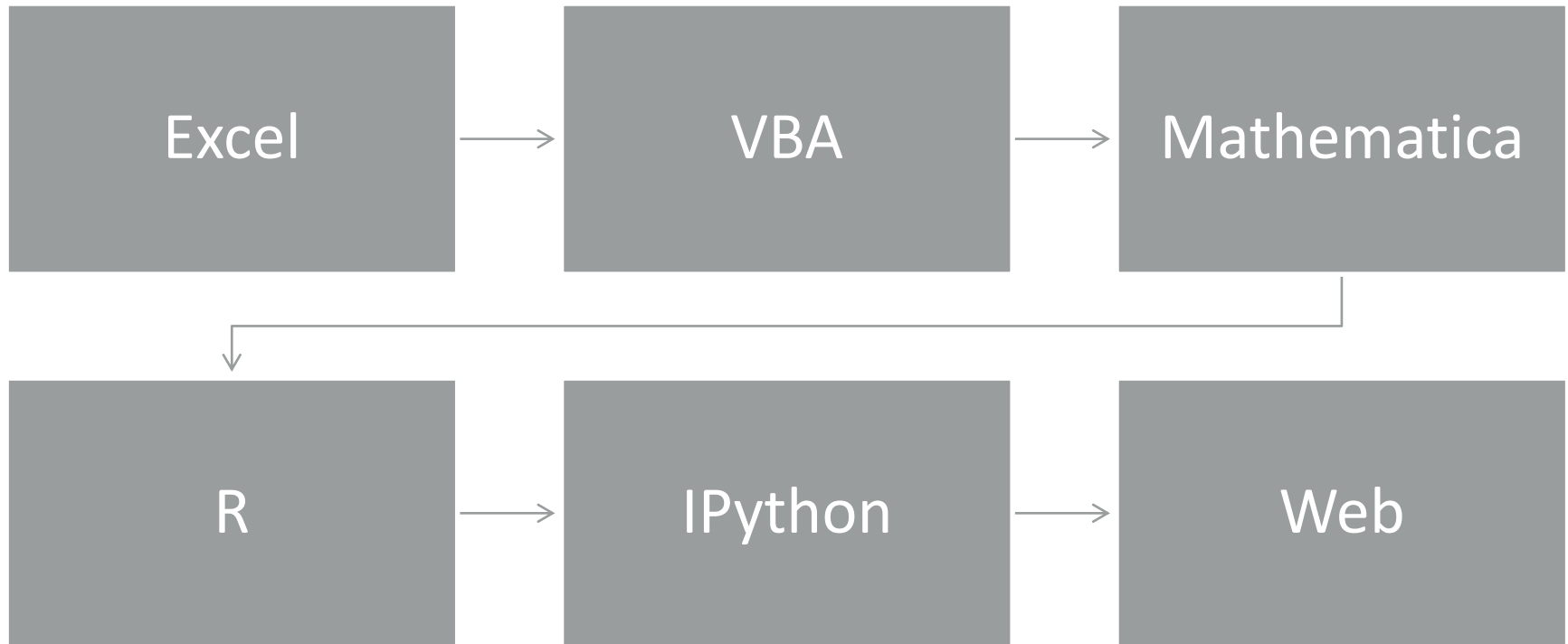
Build or Buy?



Connecting All the Data



History of VEIC Analysis Tools



What Can't Excel Do?

Boiler Savings Tool v2a.xlsx [Read-Only] - Microsoft Excel

Boiler Savings Tool

INPUT SHEET

Project Name: <<Enter Project Name>>
 Project Number: <<Enter Project Number>>
 Project Manager: <<Enter Project Manager>>
 Date Prepared: <<Enter Today's Date>>

SPACE HEAT AND DEHUMIDIFICATION REHEAT (REQ. WEATHER NORMALIZATION TOOL)

Nearest Weather Station: DC - Dulles

Building & Old Boiler Parameters		
Balance Point	65	deg F
HDD Response Coeff (Fuel Units)	6	Units/HDD
CDD Response Coeff (Fuel Units)	1	Units/CDD
Old System's Ave. Thermal Efficiency	80%	%
Fuel Thermal Content (see table at right)	0.102	MMBtu/Unit
Building's Heating Demand	20.4	MBh/ΔF
Building's Reheat Demand	3.4	MBh/ΔF

Output MBh Demanded by Building vs. OAT

Fuel Thermal Content Per Unit		
Fuel Type	Unit	MMBtu/Unit
Res. Natural Gas	therm	0.1
Res. Natural Gas	ccf	0.102
Res. Distillate	gallon	0.138
Res. High-Use LPG	gallon	0.0916
Com. Distillate	gallon	0.138
Com. LPG	gallon	0.0916
Com. Natural Gas	therm	0.1
Kerosene	gallon	0.1366
Wood	cord	22

REALITY CHECKS

- MBh is thousand-Btus-per-hour and MMBtu is million-Btus. 1 MMBtu = 1000 MBtu.
- When you convert from MMBtu to MBtu, MULTIPLY by 1000.
- When you convert from MBtu to MMBtu, DIVIDE by 1000.

What Can't Excel Do?

Pattern
detection

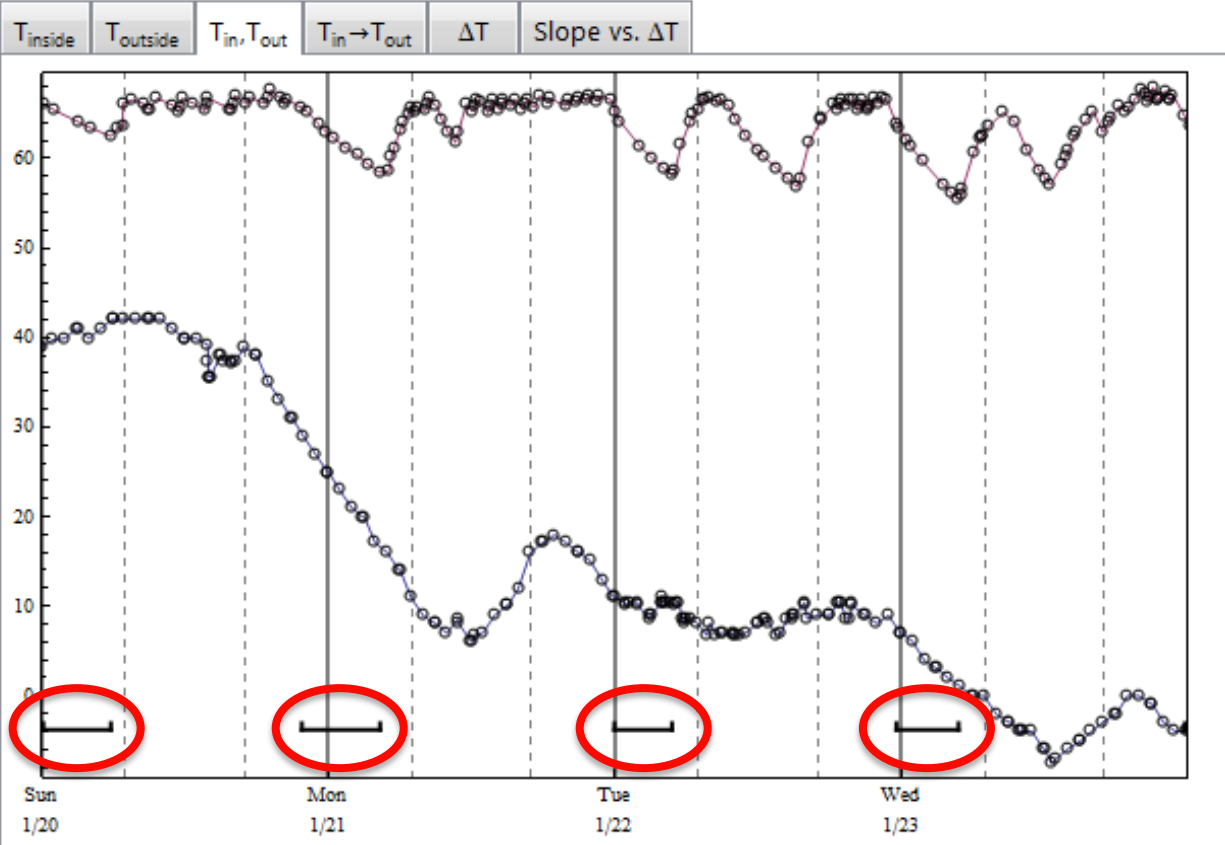
Repeatable
tasks – data
flow integration

Modular code

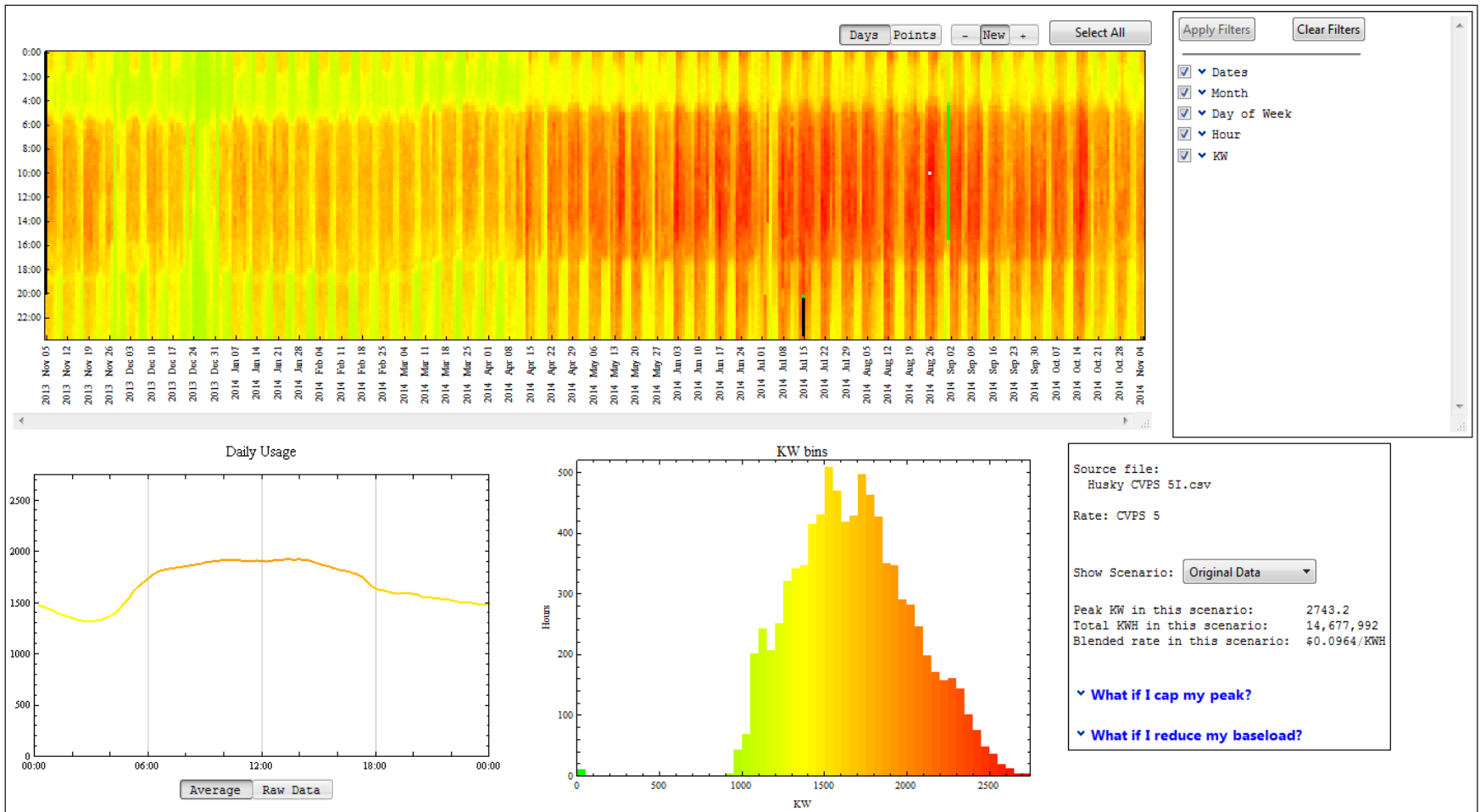
Usable
interfaces



Pattern Detection



Mathematica and the Great Leap Forward



IPython Notebooks

IP[y]: Notebook

Data Warehouse chart export Last Checkpoint: Jul 02 14:42 (unsaved changes)

File Edit View Insert Cell Kernel Help

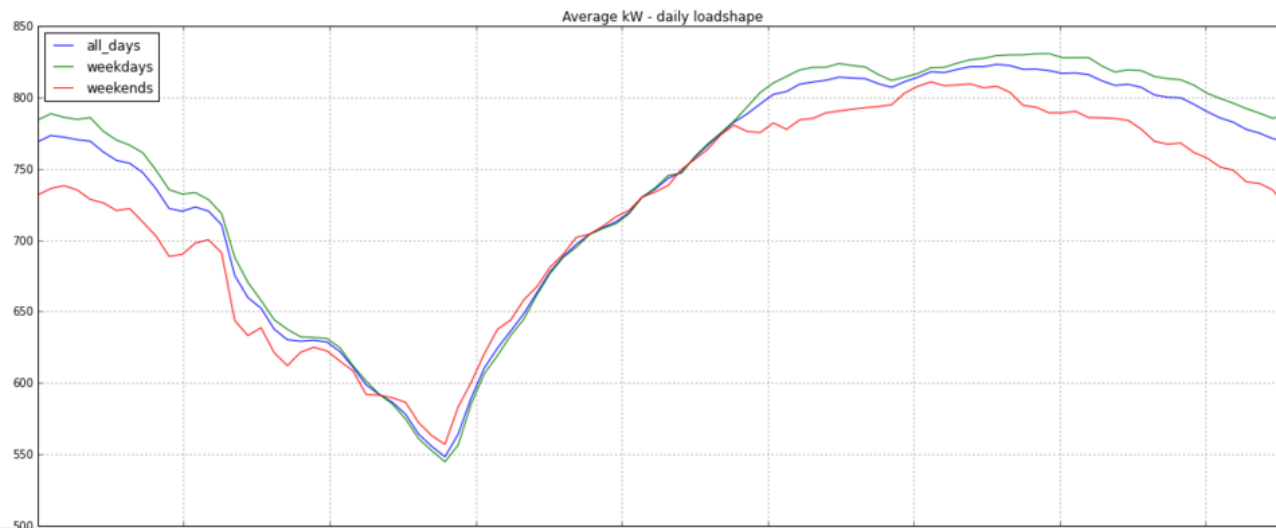
Code Cell Toolbar: None

In [43]: `usage_list.head()`

Out[43]:

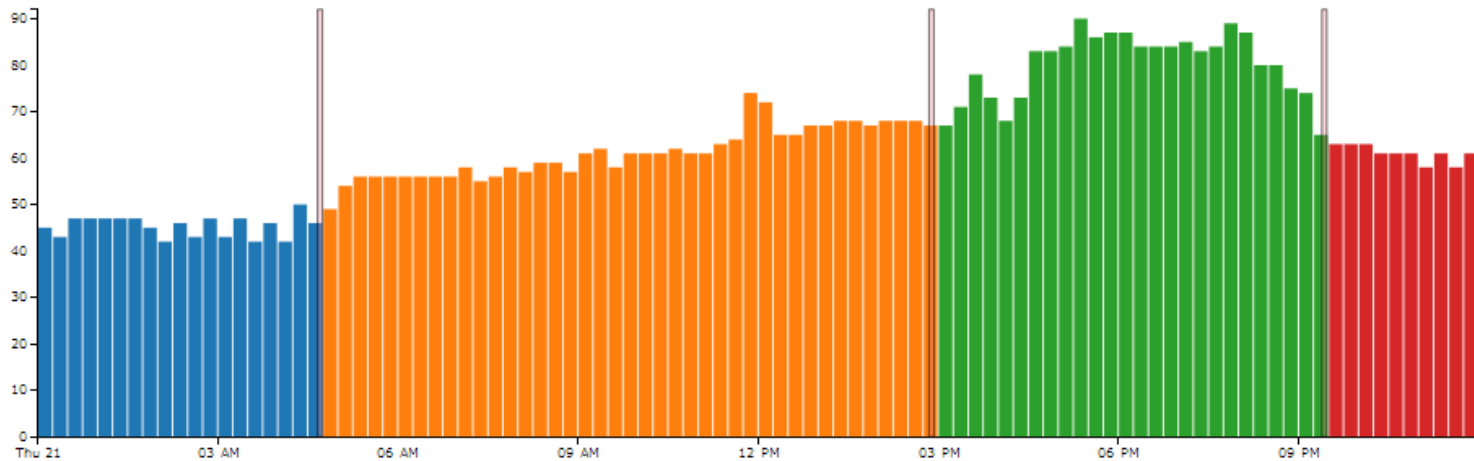
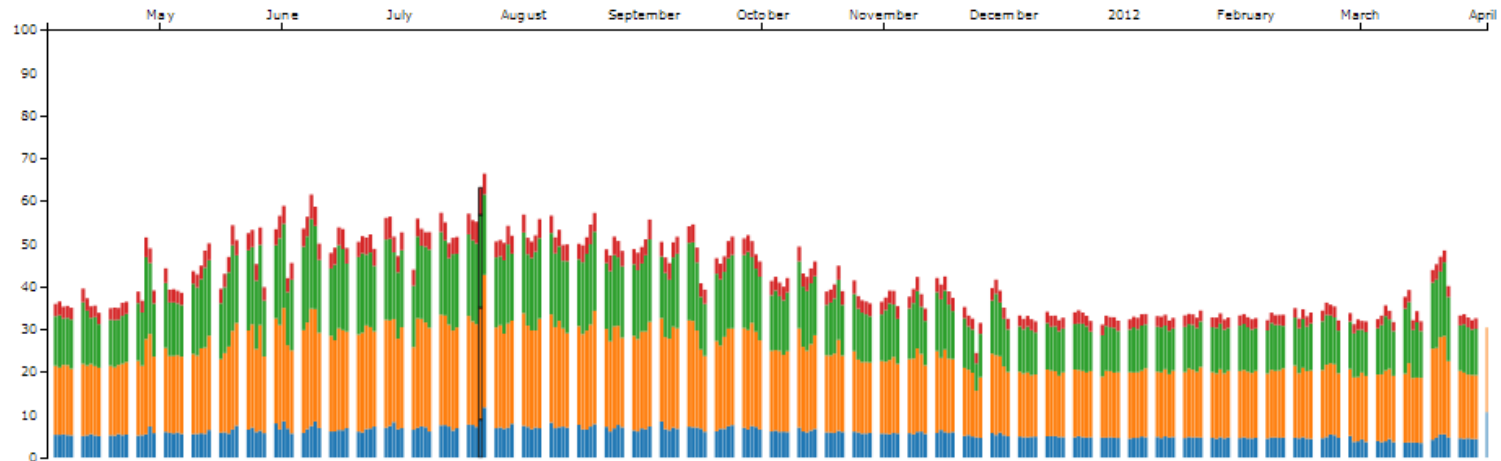
		kWh	weekday_val	beginning_datetime	avg_kW
date_value					
2015-02-07	23:45:00	137.97	5	2015-02-07 23:45:00	551.88
2015-02-08	00:00:00	140.85	6	2015-02-08 00:00:00	563.40
	00:15:00	142.56	6	2015-02-08 00:15:00	570.24
	00:30:00	143.01	6	2015-02-08 00:30:00	572.04
	00:45:00	145.44	6	2015-02-08 00:45:00	581.76

In [38]: `loadshapes.plot(figsize=[20,8], title = 'Average kW - daily loadshape')`
`plt.savefig(output_path + 'kw_loadshape_plot.png')`



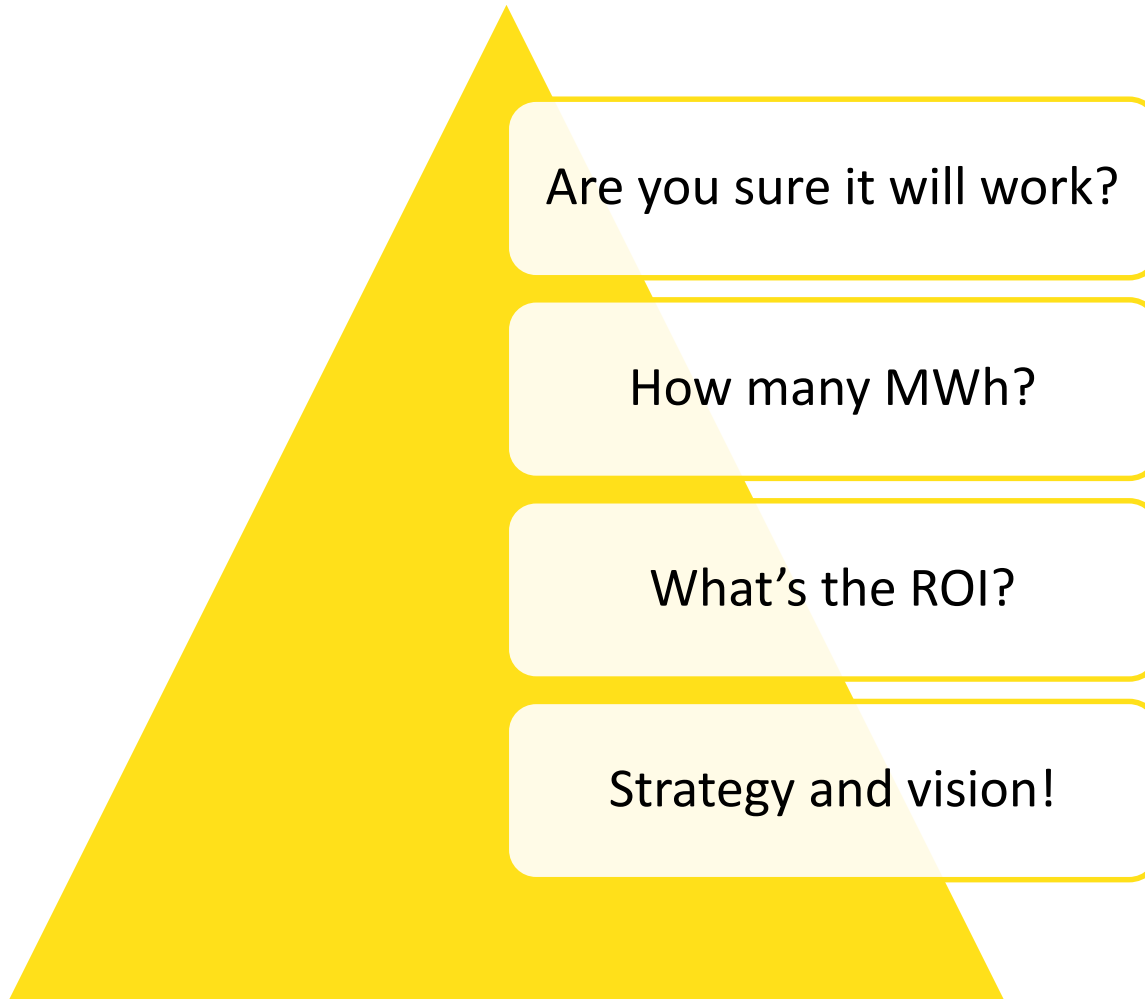
Taking Python to the Web

Weekdays Weekends Both [Interface 2](#) [Interface 3](#)

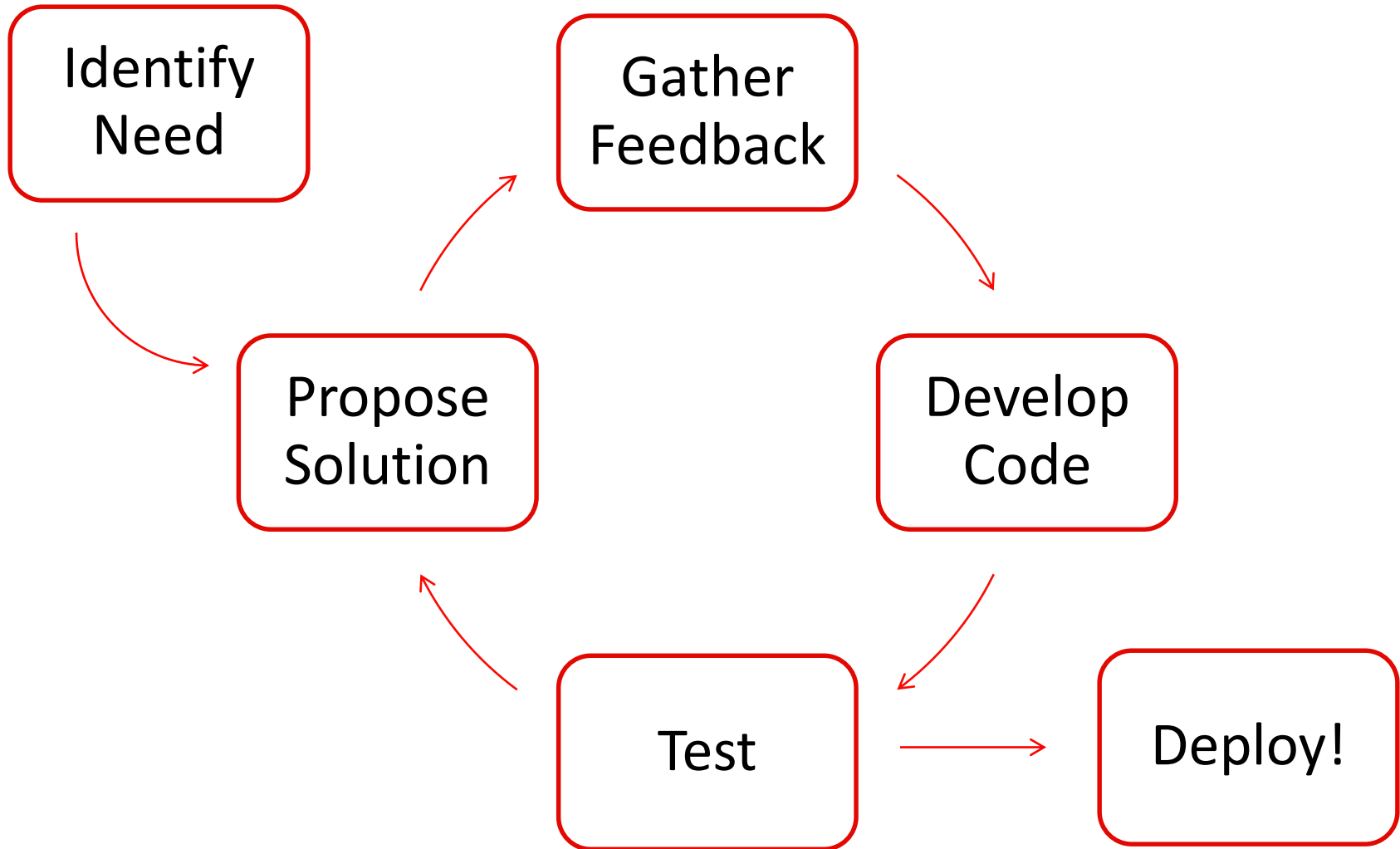


[reset](#)

Selling It



Getting It Done

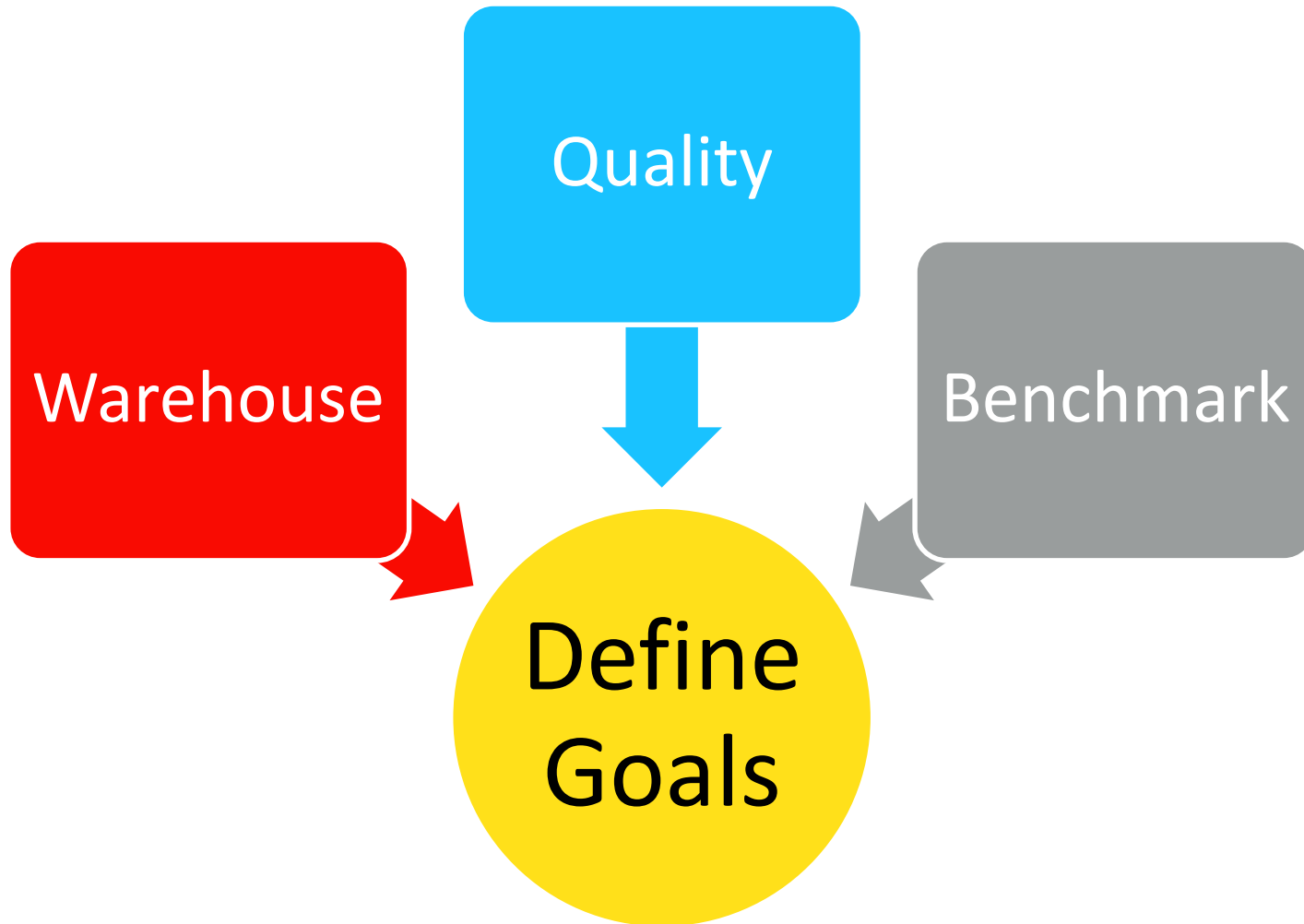


How to Deal With Big Data

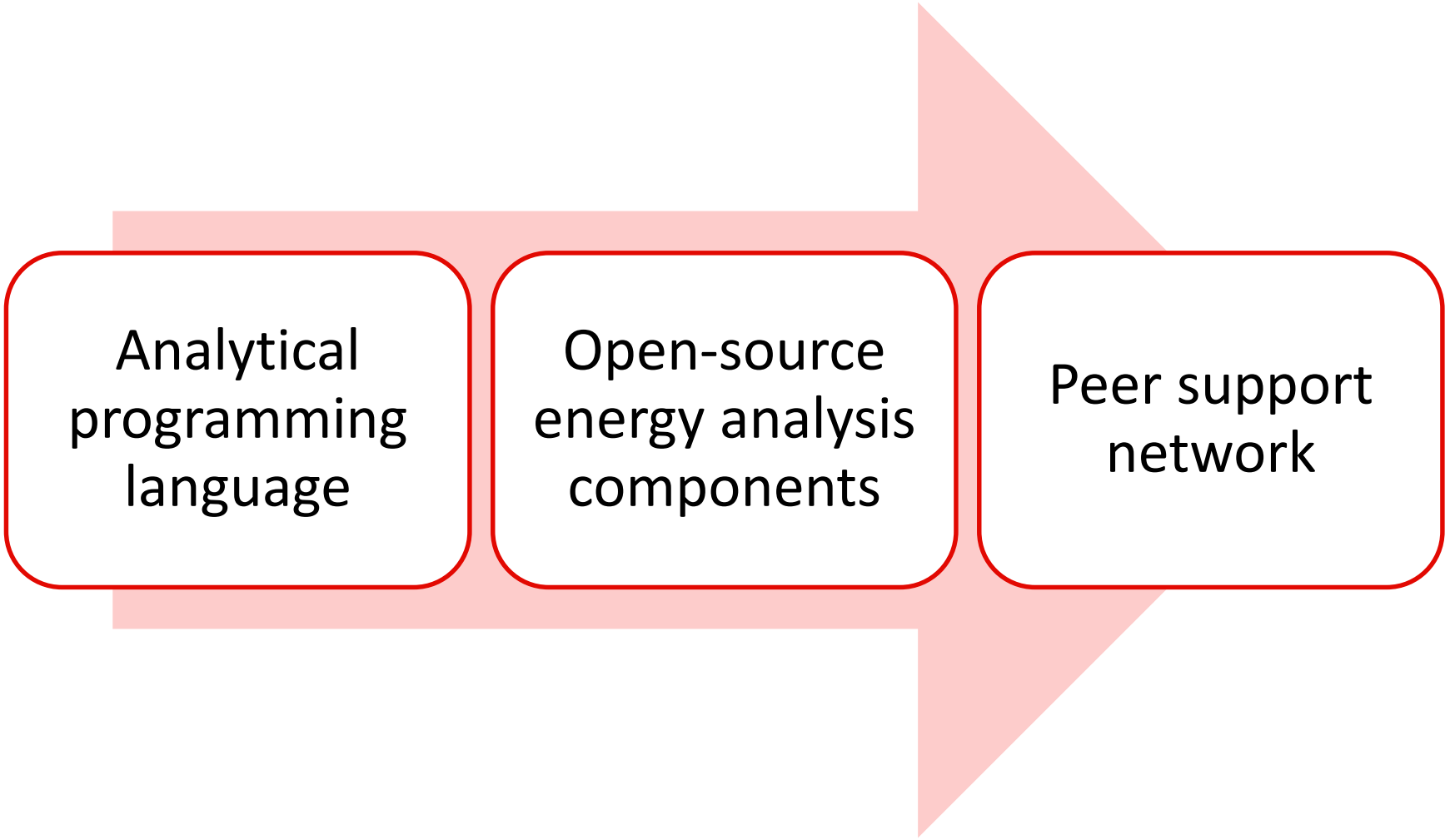


**You don't have
big data!**

How to Deal With Medium-sized Data



Your New Toolbox



Analytical
programming
language

Open-source
energy analysis
components

Peer support
network





Energy Data Geeks
of the World, Unite!

You have nothing to
lose but your chains!

egoldman@veic.org