Collaborative Smart Grid Modeling and Analysis

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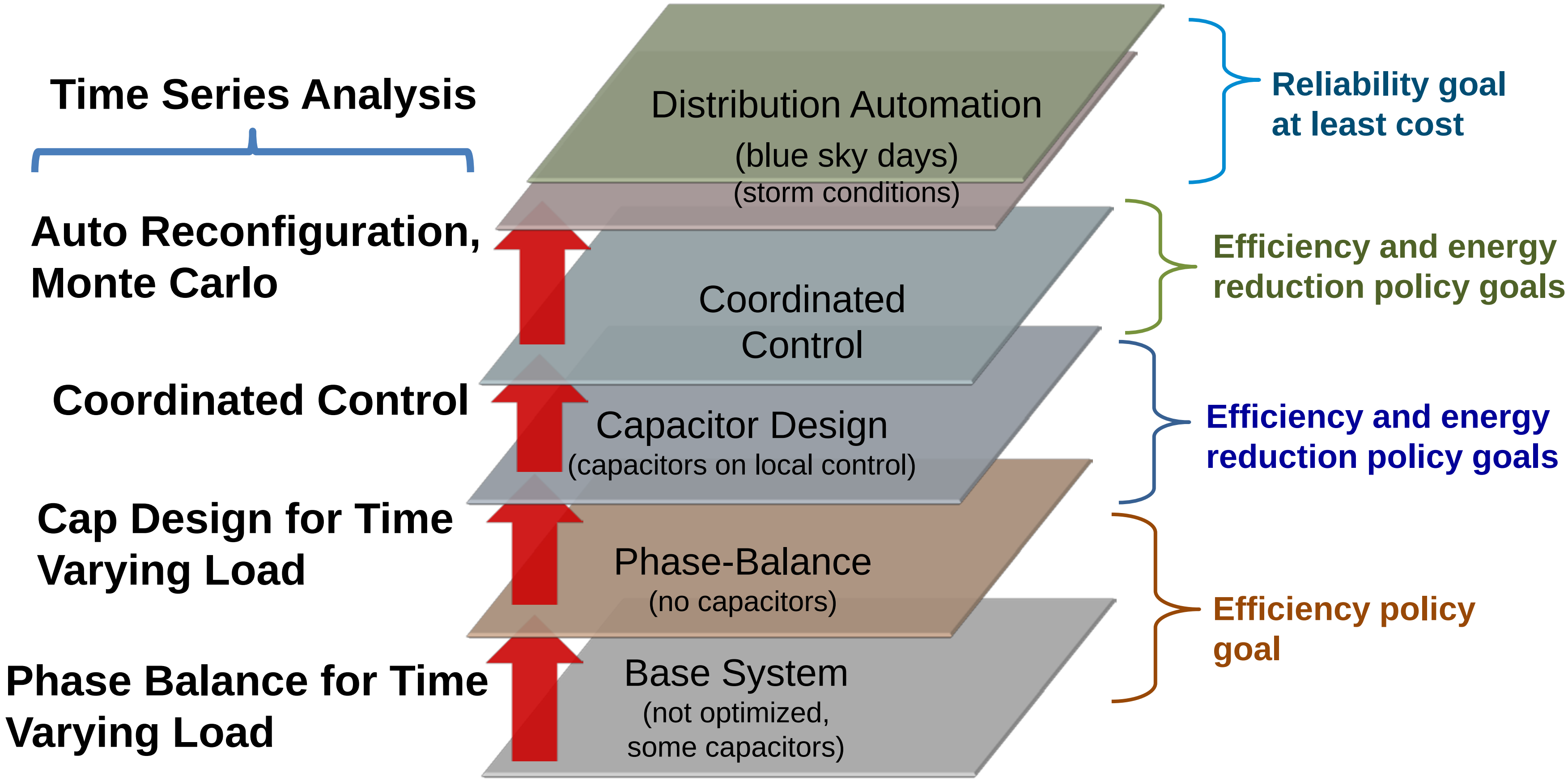
Main Goal of Collaboration

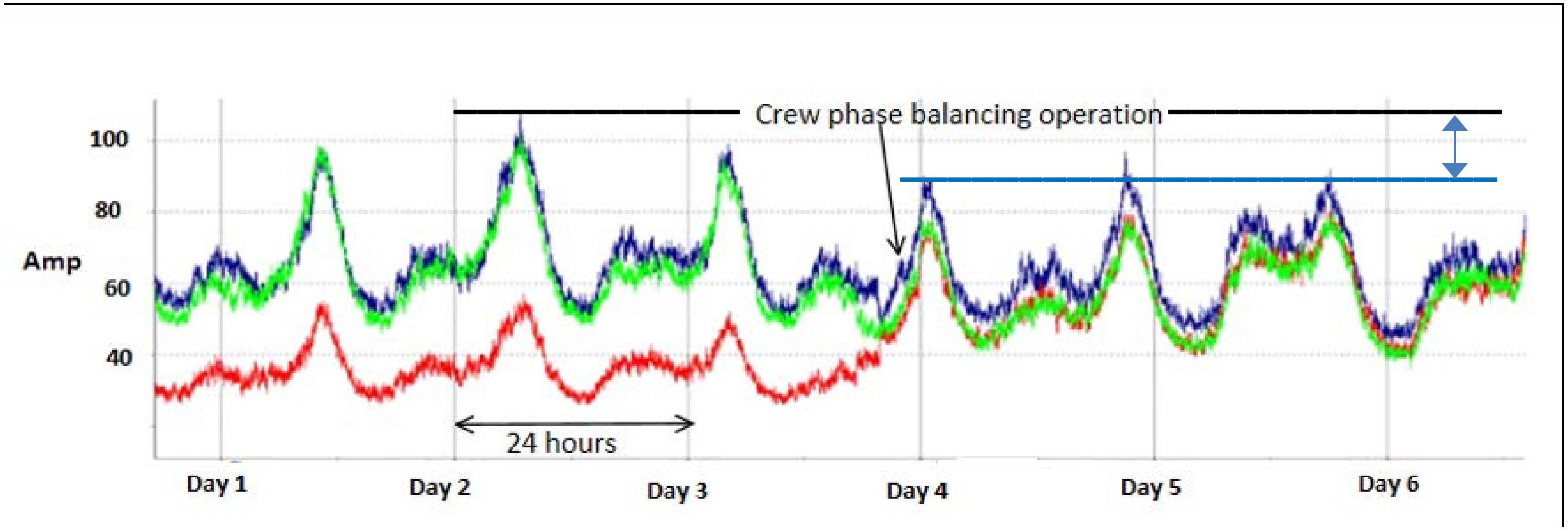
"Using models and analysis, perform comparisons of how various smart grid investments support smart grid policy goals"

Smart Grid Analysis of Policy Goals



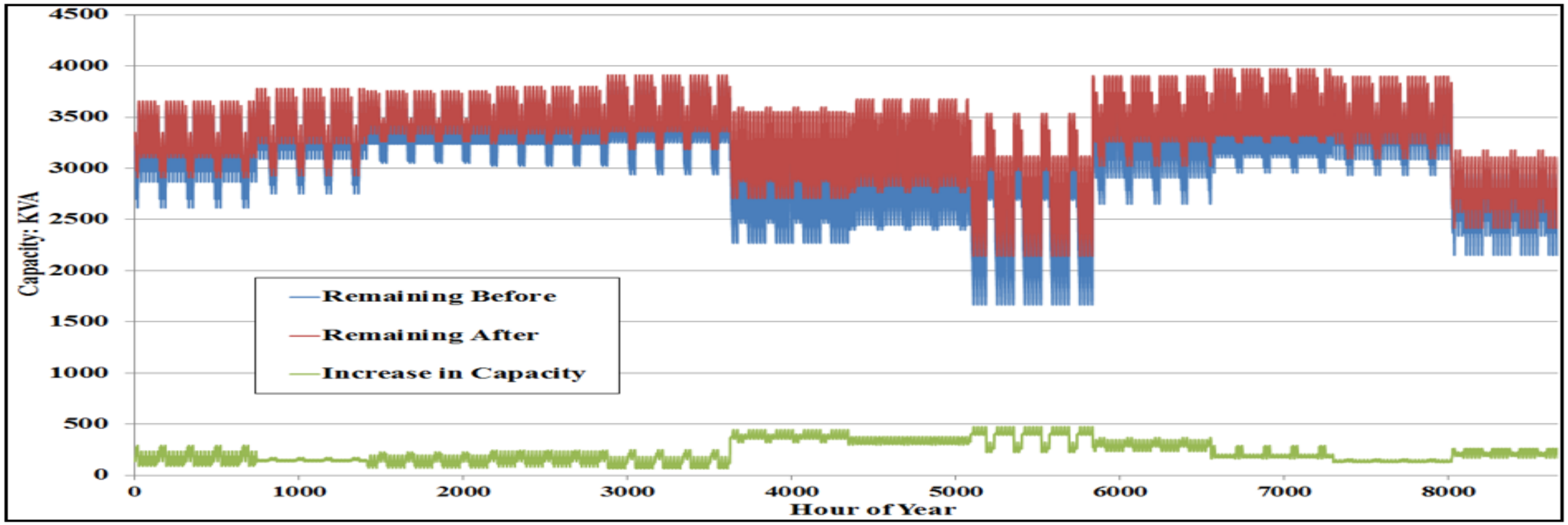
Develop Diagrams to Support Policy Goals

Non-Existent Capacity Policy Goal



Increase in three-phase capacity has also occurred due to phase balancing

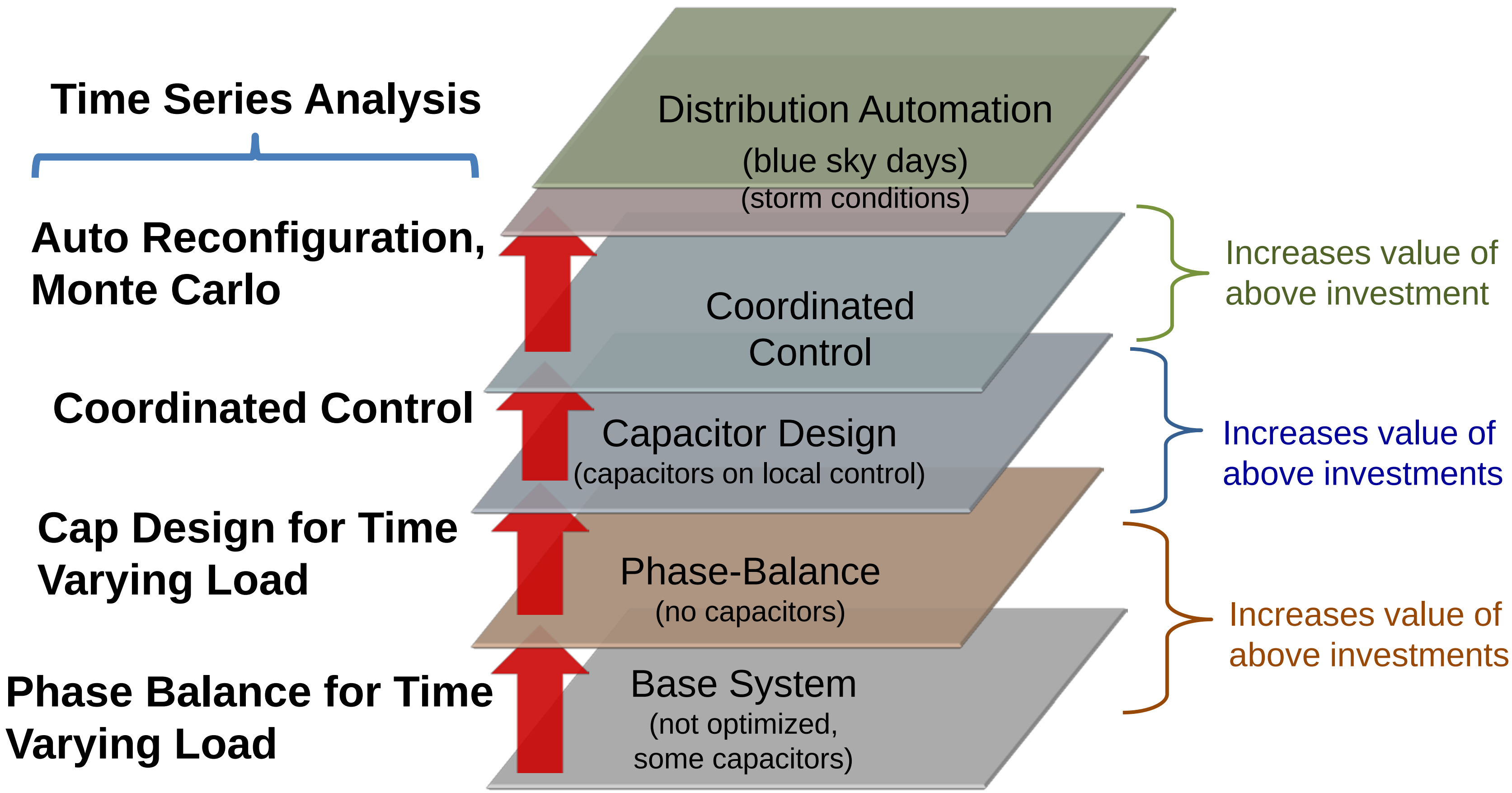
Increase in Capacity



Remaining capacity and increase capacity

Should analysis also drive policy goals?

How Investments Are Ordered Affect Cost of Reaching Goals



Algorithms Used in ORU Smart Grid Investment Analysis

- Time series Performance Analysis
- Time series Economic Analysis
- Time series power flow
- Phase balancing over time varying load
- Capacitor placement over time varying load
- Reconfiguration for restoration
- Storm simulation
- Monte Carlo analysis
- Coordinated control for CVR
- Analysis Automation

Programming Collaboration Environments

- Graph Trace Analysis based algorithms
- Dew graphical environment using API
- Dew analysis engine
- Dew remote analysis engine for cloud environment
  - Offer to use the NRECA cloud environment

Collaboration on Models and Analysis Algorithms

- New US model shared that illustrates PV generation in various secondary system configurations and for various primary system connection points
- DER Adoption Analysis Impact Program
- 3-phase dynamic simulation of integrated transmission and distribution systems

Slides Presented at May 7, 2015 Meeting Follow

Model-Centric Smart Grid

Model is reused and continuously improved in all phases

Performance Analysis **+**

Economic Analysis **+**

Lab Testing **+**

Field Validation **=**

Model-Centric Smart Grid

U.S. – CPRI Interactions

- Web interactions involving U.S. and India Ph.D. students are planned for May and June
- A collaborative paper is planned for the 2015 IEEE IAS Joint Industrial and Commercial Power Systems conference in Hyderabad, India, November 2015
- Students are using Distributed Engineering Workstation software in modeling and software development collaboration

DEW Academic Version

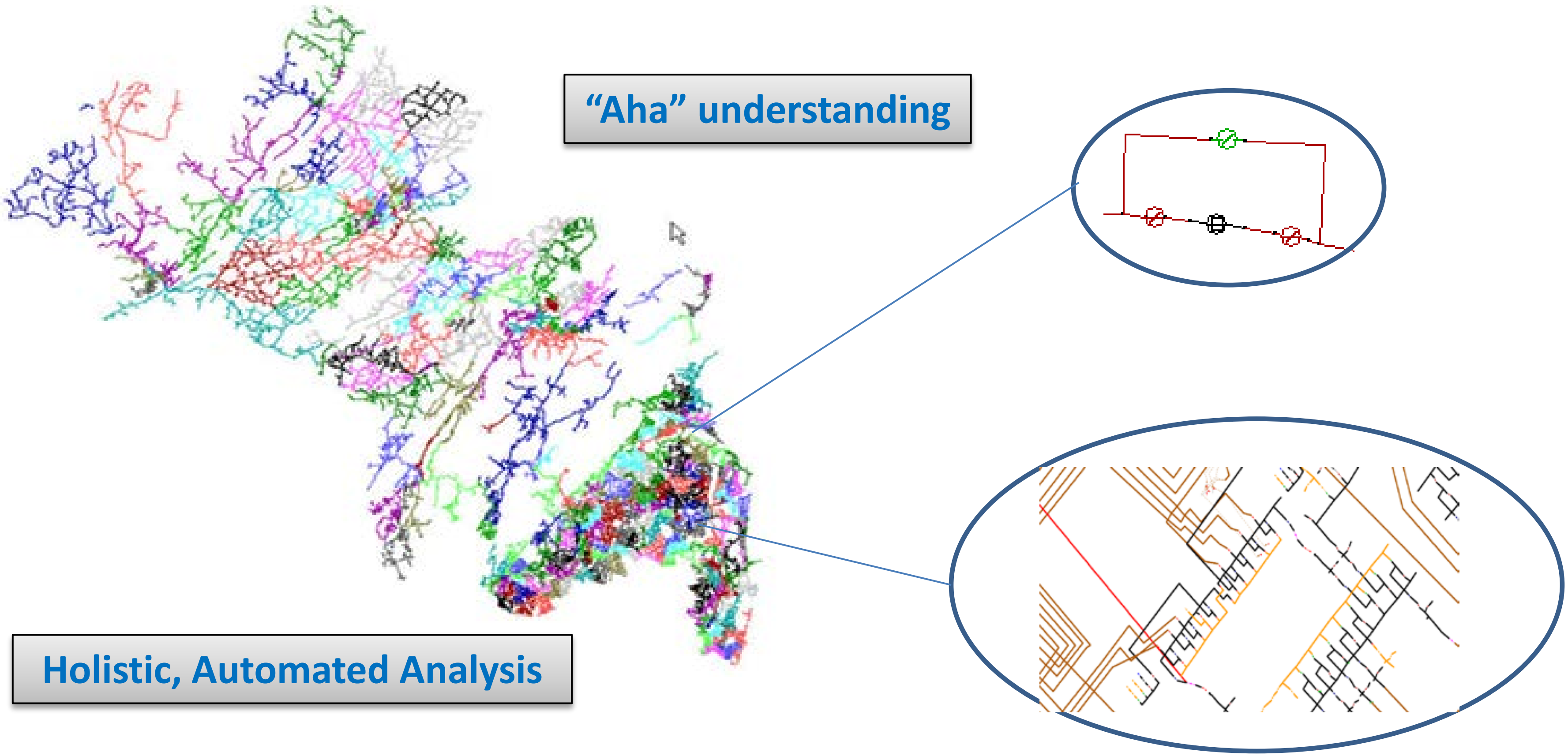
- Circuit Server for sharing of models
- A number of smart grid analysis programs
- Programming interfaces
  - Remote, distributed programming interface
- Source code examples, such as DER Adoption
- Journal references

Example U.S. Case Study

Integrated System Model

Merge all construction models together, relating all measurements

"Aha" understanding



Holistic, Automated Analysis

Use one, detailed, root model for all analysis, from planning to testing to training to real-time analysis and control, maintained in synch with construction models…

Present Value Savings for 10 Years

Case	Cost (Inc/Total) ($000)	Savings Type					Case Savings ($000)	$ Saved / $ Invested (Inc/Total)
		Efficiency (Inc/Total) ($000)	Energy (Inc/Total) ($000)	Capital ($000)	Operation ($000)	CI ($000)		
CBA1	163/163	94/94	29/29	NA	NA	NA	123	0.75/0.75
CBA2	564/727	227/321	2,234/2,263	NA	NA	NA	2461	4.36/3.55
CBA3	68/795	88/409	2,064/4,328	NA	NA	NA	2,132	31.65/5.74
CBA4	1,953/2,748	NA	NA	7,014	7,646	9,566	24,226	12.4/10.54

Estimated CO_2 reduction = 76,330 tons

Societal Benefits

$1.4 ~ Residential
$230 ~ Commercial
$650 ~ Industrial