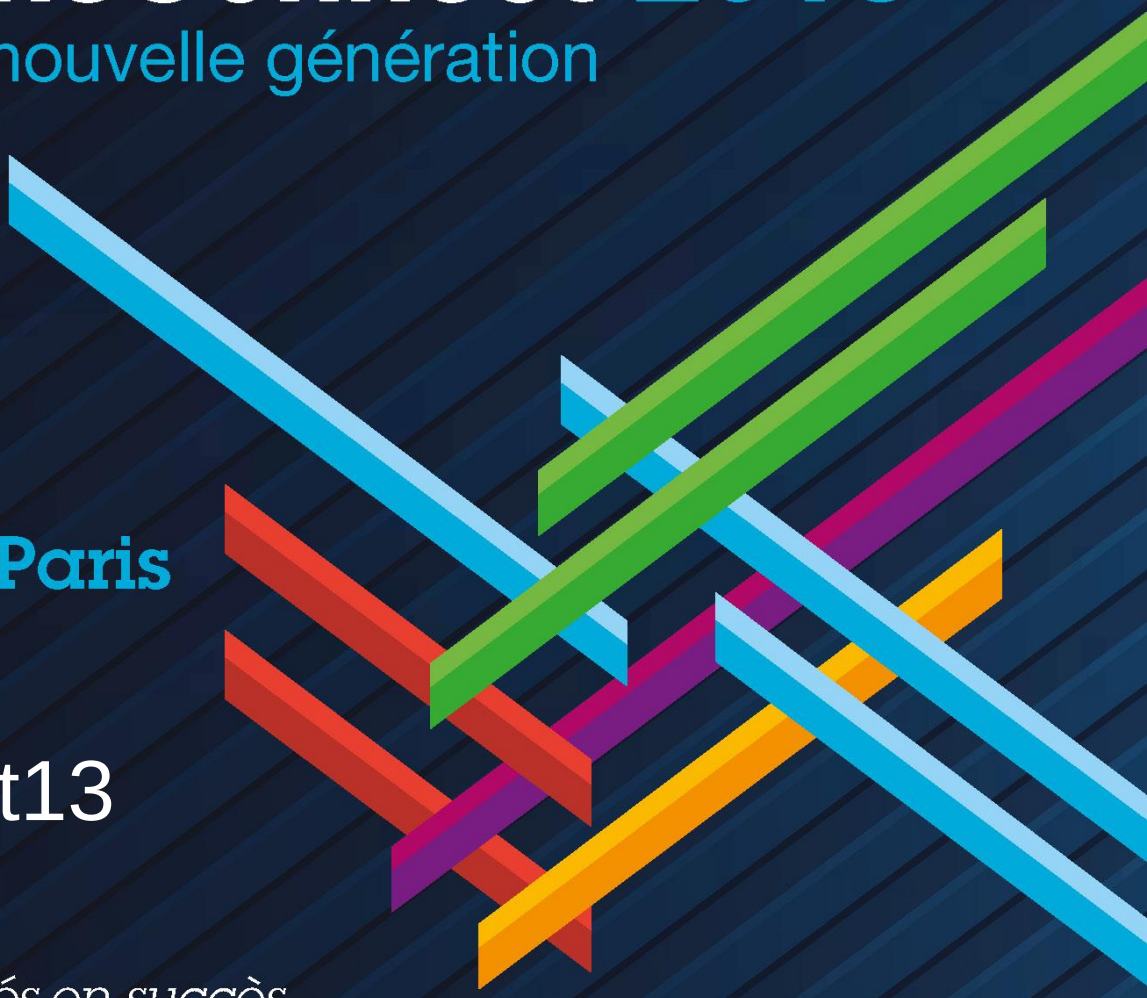
IBM SolutionsConnect 2013

L'IBM TechSoftware nouvelle génération



28, 29 et 30 août

IBM Client Center Paris

#solconnect13

Transformez vos opportunités en succès

IBM

Session IND05P1

L'innovation IBM au service du secteur E&U (*Energy & Utilities*)

Christian MOTTET – IBM E&U Industry Architect
Christian CHATEAUVIEUX – Software Architect

Agenda

- IBM's perception of the E&U Industry trends and directions
  - Problems/challenges/issues
  - Industry's answers/movements seen in the field
- Future trends and solutions
  - Overview of a few IBM Research energy projects
- Real-world implementations using readily available IBM expertise, IBM software and hardware technology
  - Incl. an introduction to ILOG Optmization solutions for E&U

We see six prevailing forces in European energy markets

Financials

Recession and energy price drops squeeze margins and impose debt and cost reduction

Assets

Aging asset performance with increased expectations on reliability

Efficiency

Increased pressure on operational efficiency and workforce productivity

Climate Change

Climate change and environmental concerns drive clean electricity, and ramp up of electric vehicles

Renewables

Growing renewable generation and distributed resources need to be incorporated on to the grid

Technology

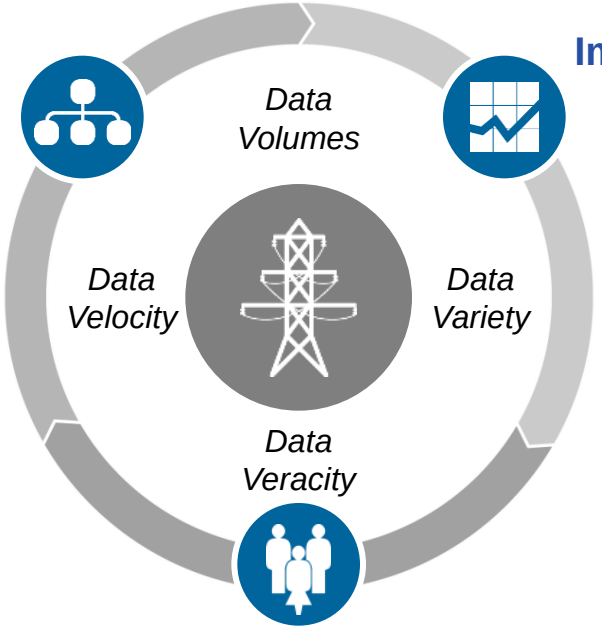
New entrants and leverage of the investments made into disruptive Smart Energy technologies

These market forces are, collectively, forcing major changes within the utility business models and the relationships between participants in the value chain

Advances in renewables technologies and the “era of smart” drive major industry change and how the incumbents run their business

Transform the Utility Network

- Distributed Generation Integration
- “New” Renewables Integration
- Microgrids
- Predictive Asset Maintenance
- Distribution Grid Monitoring
- Demand-side Response
- Mobile Workforce Optimization
- etc.



Improve Generation Performance

- Diverse Forecasting , e.g.
  - Weather
  - Prices
  - Demand & Supply
  - Distribution Load & Scheduling
- Intelligent Plant Lifecycle Management
- Unit Commitment & Fleet Optimization
- etc.

Transform Customer Operations

- Smart Meter Analytics
- Dynamic Pricing
- Customer Analytics & Insight (360° Customer View)
- Electric Vehicles (Usage Patterns, Charging Control , Billing etc.)
- etc.

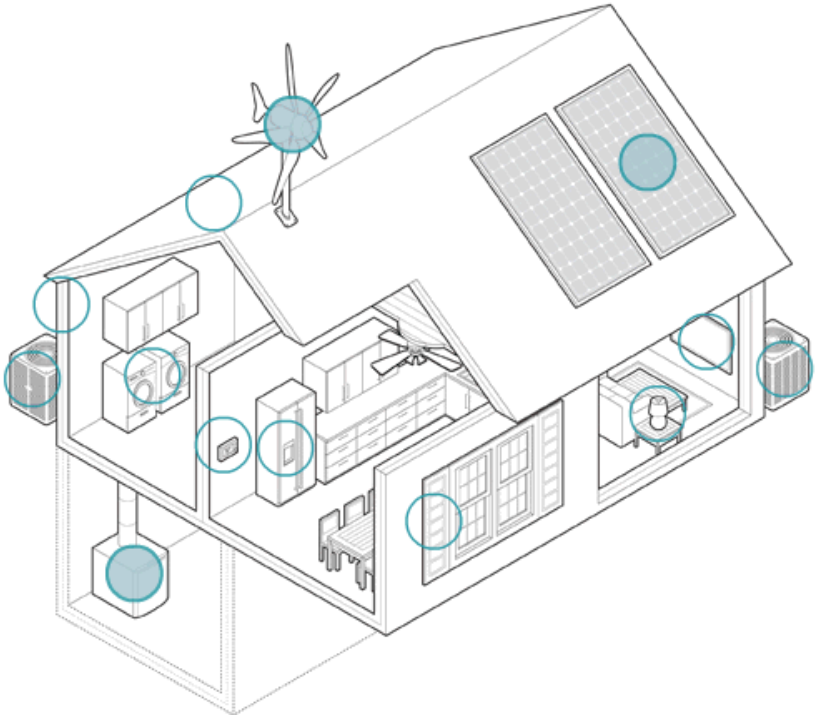
Utilities will need to excel in new disciplines adjacent to their traditional business: create business value from vast amounts of disparate data

A recent study predicts that residential energy demand from the grid could reduce as much as by 90 percent by 2020

McKinsey Quarterly

The home of the future—demanding less from the grid

By 2020, deployment of selected existing technologies in energy efficiency, microgeneration, and smart applications could potentially reduce residential energy demand from the grid by ~90 percent.



Energy needed from the grid,
baseline consumption = 100

Microgeneration

Solar photovoltaic (PV) systems—eg, crystalline wafer-based silicon panels that convert sunlight into electricity

Micro wind—very small wind turbine designed to provide electric power to a home

Mini combined heat and power (CHP)—equipment that simultaneously generates electricity and heat

Questions:

How much (bulk) generation will be needed?

How much power will the grid still have to transport?

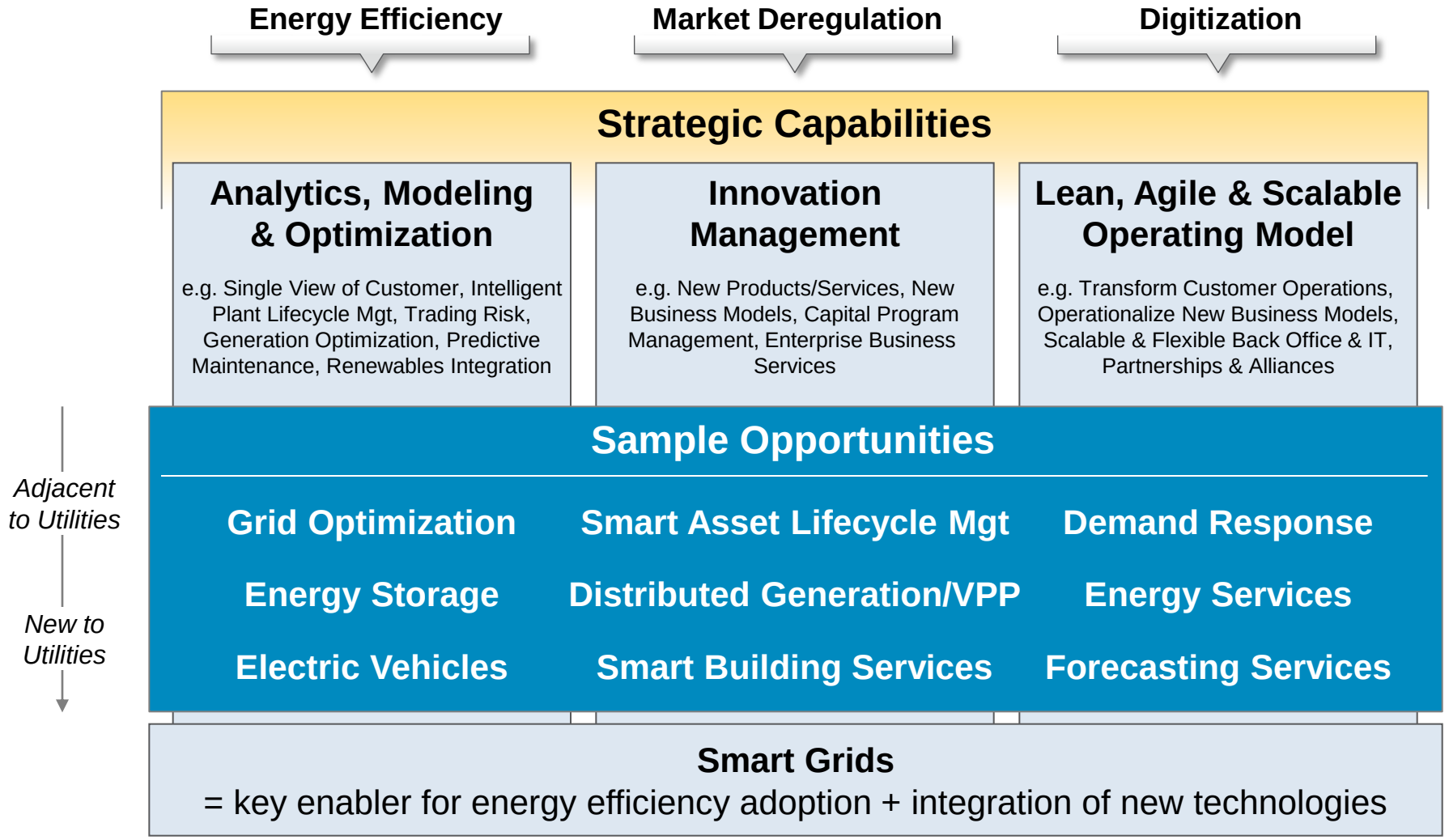
How will this affect grid prices? Who will pay for it?

Will we afford a grid in the future?

Will the current Utility business model survive?

Source: McKinsey Quarterly, Winning the battle for the home of the future

Therefore, Utilities must rethink their business models and develop a set of strategic capabilities to take advantage of arising opportunities



Our approach focuses on three foundational capabilities to deliver end-to-end solutions

SOLUTION DEVELOPMENT AND DELIVERY

Solution Development

IBM Research

- First of a Kind projects
- Smarter Energy Research Institute

Global IUN Coalition

GIUNC Global Intelligent Utility Network Coalition

Solution Delivery

Partner Ecosystem

POLICY AND REGULATION

GRIDWISE

GSGF Global Smart Grid Federation

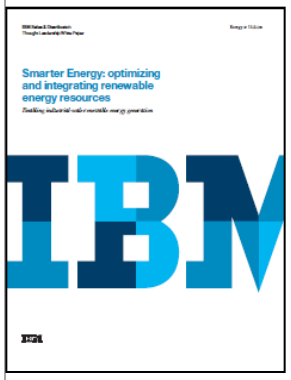
eurelectric ELECTRICITY FOR EUROPE

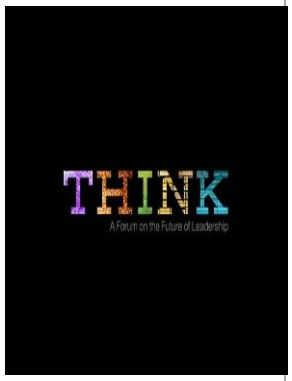
CLEAN ENERGY MINISTERIAL

NATIONAL ASSOCIATION OF REGULATORY UTILITY COMMISSIONERS DEDICATED TO PUBLIC SERVICE 1889

QUÉBEC 2012 WORLD FORUM ON ENERGY REGULATION V

INDUSTRY THOUGHT LEADERHSIP





@IBMSmartrEnergy

GIUNC membership

Duke Energy
Charlotte, NC USA
Optimized energy value chain minimizing need for new fossil generation units, AMR-to-AMI strategic transition, advanced feeder modeling

ONCOR
Dallas, TX USA
Advanced metering system implementation, integration and PMO, MDM, Business Analytics, Security, Smart Meter Texas

Pepco Holdings Inc
Washington, DC USA
IUN blueprint, outage management, notification, AMI

SDGE / Sempra Energy utility
San Diego, CA USA
Renewables and electric vehicle integration, distribution automation, microgrids, condition based maintenance, GIS, OMS/DMS

CenterPoint Energy
Houston, TX USA
Advanced metering system and intelligent grid implementation, outage management, notification, integration and PMO, MDM and HAN, Smart Meter Texas

CPFL ENERGIA
Campinas, Brazil
Intelligent network, metering center, loss reduction, mobile workforce management, communications

eRDF
Paris, France
Sensing & control, asset optimization for fault prevention, smart grid for Co2 reduction, AMM & communications network

DONG energy
Copenhagen, Denmark
Power Hub (VPP), DMS integration, eFlex project, Flexible consumption

TATA POWER-DDL
New Delhi, India
Defined Smart grid roadmap, AMI Pilot initiated, Enterprise service bus, Business Intelligence, Field Force Automation, Integrated Communication network, ESB

alliander
Arnhem, The Netherlands
Organization-wide smart grid vision, strategy and implementation

e·on
Düsseldorf, Germany
Efficiency, Renewables Integration, Grid Quality, Intelligent Substation

KEPCO
Seoul, South Korea
Nuclear generation, Jeju test bed, Renewable integration, EVs, Grid automation

TEPCO
Tokyo, Japan
Low-carbon generation, EVs, Rooftop PV, Efficient buildings, AMI, Storage, Grid reliability

essential energy
Queanbeyan, Australia
IN strategy and customized IN blueprint, organizational impact of smart grid, IN Research & Demonstration Center

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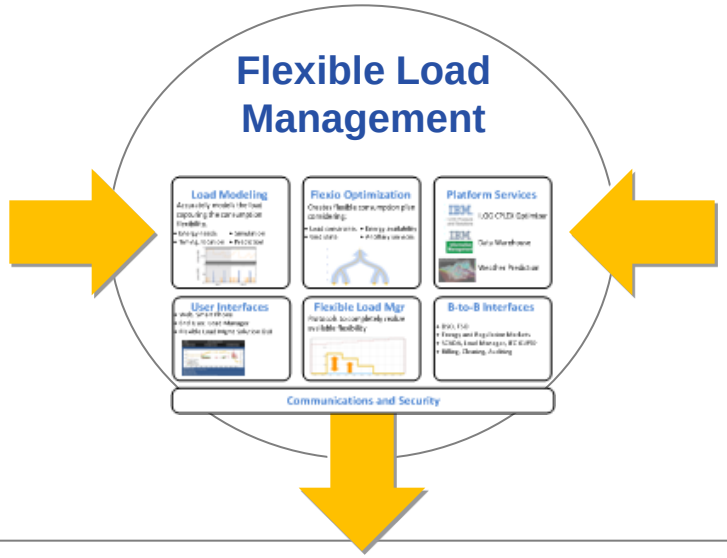
IBM Research puts a strong focus on Flexible Load Management, as the share of volatile, yet not controllable, renewables increases

Renewable & Distributed Sources of Electric Power
(Variability, Volatility)

Forecasting ✓ Control ✗

Flexible Load Management



Flexible Loads of Electricity Consumption
(Single vs. Aggregated)


Industrial


E-Vehicles


Homes


Buildings

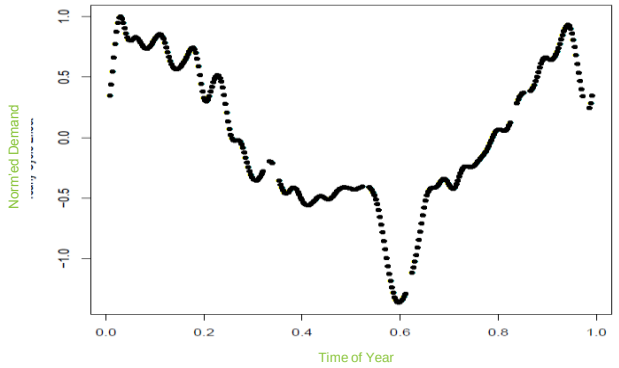
Balanced Power Grid

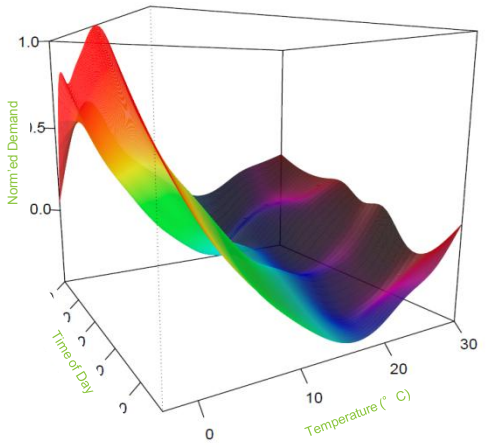
- Improved network stability
- Reduced infrastructure investment – for generation & grid operators
- Reduced use of expensive stand-by generation resources
- Distributed network balancing to balance distributed generation
- New business model opportunities, e.g. Energy Procurement, Demand Side Operators

Technology enabled demand-side balancing can be a very cost effective addition to the energy management portfolio – and creates new business opportunities

Understand demand: Energy demand modeling and forecasting

- Accurately forecasting energy load is key for operators to ensure grid stability. Current practice is:
  - Forecasting applied to few, highly aggregated series
  - Models are manually inspected and optimized over time
  - Limited test data, no systematic method to generate
- Challenges:
  - Large-scale, accurate forecast in real-time on low level of locality
  - Large number of forecasting models, almost automatically updated
  - Incorporate local, diverse information (local weather, events, …)
  - Huge amounts of real data; simulation for test and what-if analysis
- FOAK research collaboration with EDF to develop platform for large-scale monitoring, simulating and forecasting energy load
  - Scales to very large amount of streaming SCADA, Smart Meter data
  - Automates learning of very accurate energy demand models





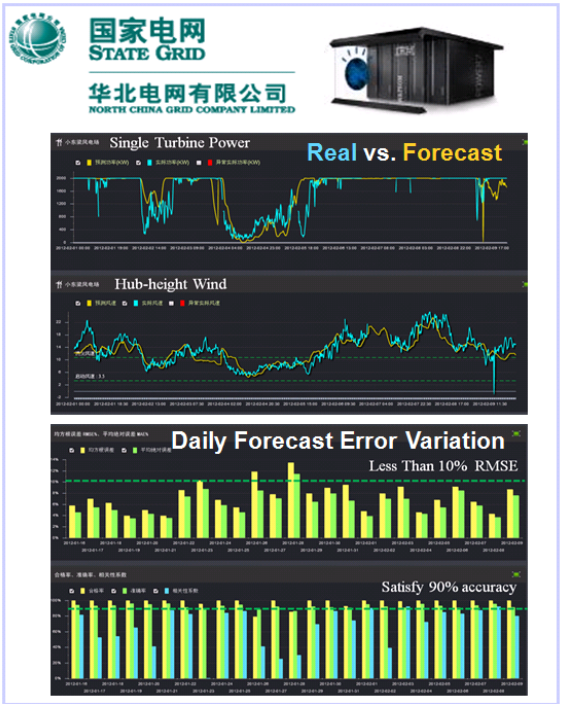
- Accuracy: 1.63% Mean Absolute Percentage Error (MAPE)
- 20% improvement over industry and academic state of the art (validated on real data from EDF)
- Key feature: Explicitly factors in domain expertise

Predict renewable power generation: **H**ybrid (Data Assimilation-based) **R**enewable **E**nergy **F**orecasting **S**olution (HyREF)

- Business Challenges:
  - renewable power: intermittent, random, anti-peaking
  - Lack of high accuracy power forecasting
  - As a result, a large quantity of the produced electricity is not integrated/wasted (ex: from 25 up to 60 % in China)

– Solution: HyREF is a advanced power and weather modeling technology that brings together weather prediction and analytics to help utilities gain significant benefits that include:

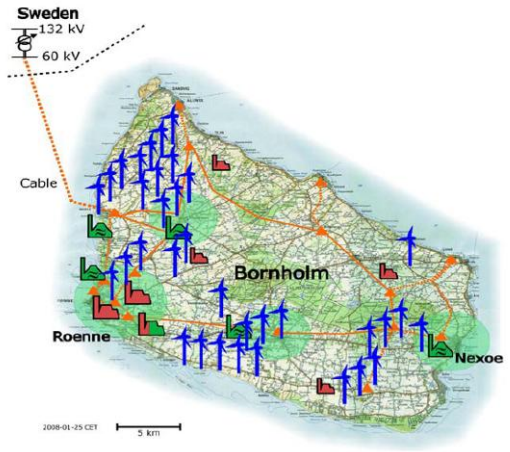
  - More accurate forecasting of the expected output of wind power and solar energy generation
  - Integration of more renewable energy onto power grids
  - Helping to reduce emissions of harmful gasses
  - Providing "cleaner" energy output for consumers and businesses

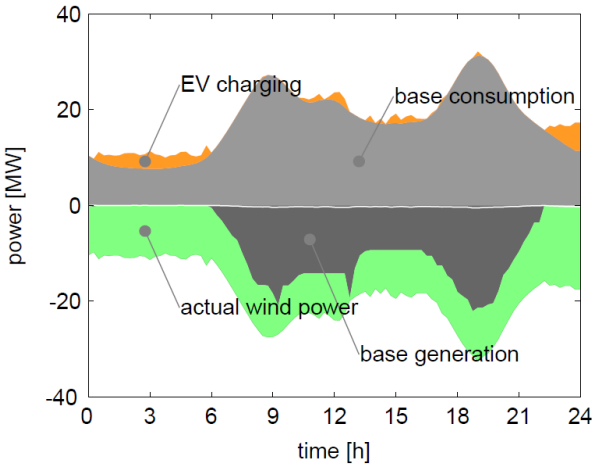


- At NCGC (sub-company of China State Grid (SGCC)) HyREF provided day-ahead Forecast with 8 % error on average, which allowed an increase wind/solar power integration by 10%
- Guohua (one of the top 3 China wind farm company) used HyREF on 6 wind farms and significantly increased penetration of renewable energy, with direct societal, regulatory & operational impacts, while reducing risk of grid overload & increasing grid stability

Storage with Electric Vehicles: Project EDISON
Symbiosis of Generation, Electric Vehicles and Grid

- Research project on grid behavior and control when integrating volatile renewables (wind) and high number of electric vehicles
- Vision is to leverage batteries to stabilize the entire eco-system
- Creates charging plans for all subscribed vehicles based on:
  – trip forecasts (simulation)
  – battery state of charge / state of health
  – grid state (DSO input)
  – energy availability & price
  – ancillary services requests
- Developed Management System for active control of e-vehicle charging by correlating forecasts and real-time data (grid load, power generated from wind, car battery charge etc.)

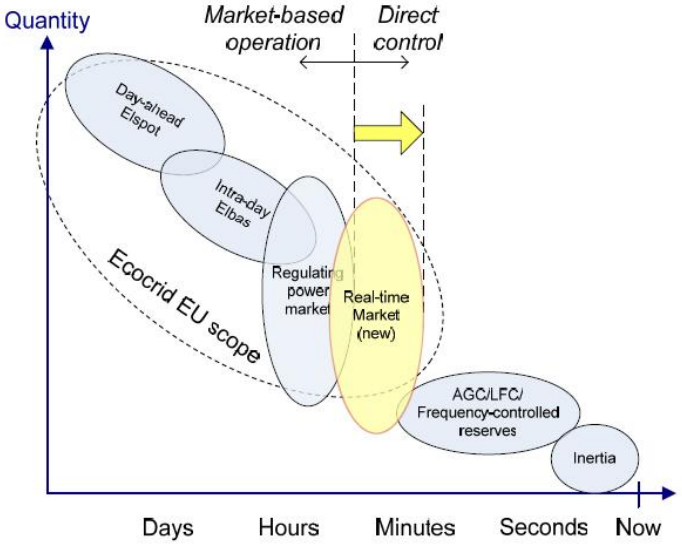


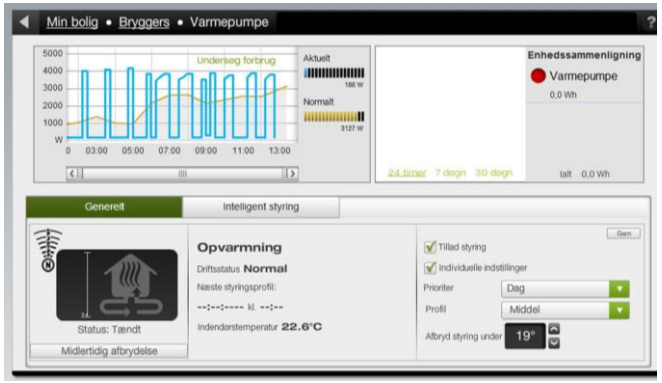


- Storage of excess wind energy in e-vehicle batteries (buffer)
- Reduced fossil-based power generation to charge e-vehicles
- Leverage e-vehicles as a buffer to balance out grid, and to to supply (balancing) power during supply shortages (V2G)

Residential Demand Response Example: Real-time Market to Balance Supply vs. Demand

- Demonstrate an energy grid that uses at least 50% renewable energy sources (wind, solar, biomass/biogas)
- Price-based distributed planning based on real time conditions:
  - Automated end-user “smart controllers” for select appliances (dishwashers, heat pumps, water heaters)
  - Smart Meters manage “real-time” price signals
  - Consumers schedule online when/at what price to buy electricity using smart meters and a web-based app
  - Utilities manage pricing based on (renewable) supply, demand and available storage capacity





- Increased use of renewable energy
- Balanced grid load and reduces failures
- Accommodation of consumer preferences and their desire to reduce energy consumption

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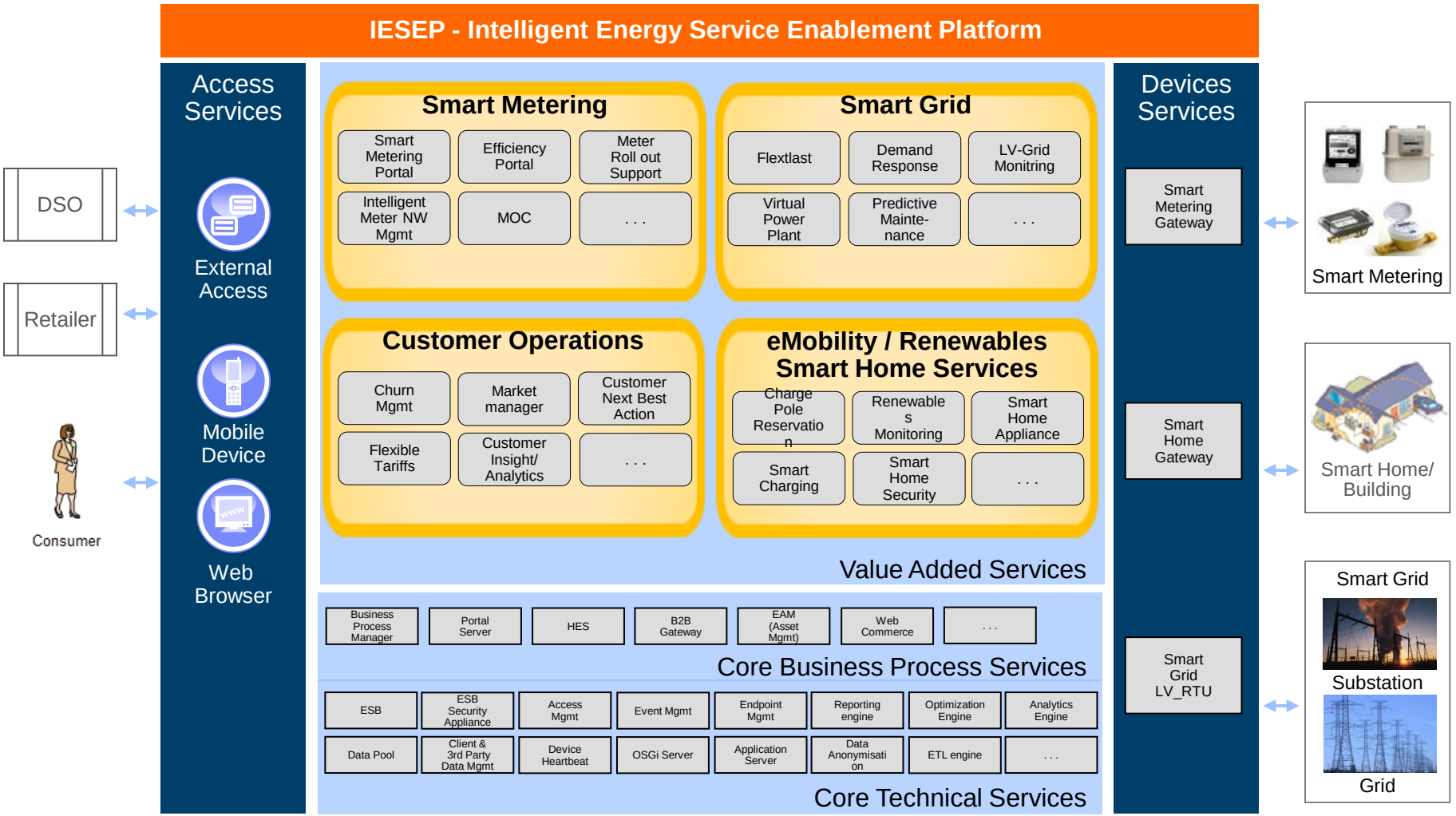
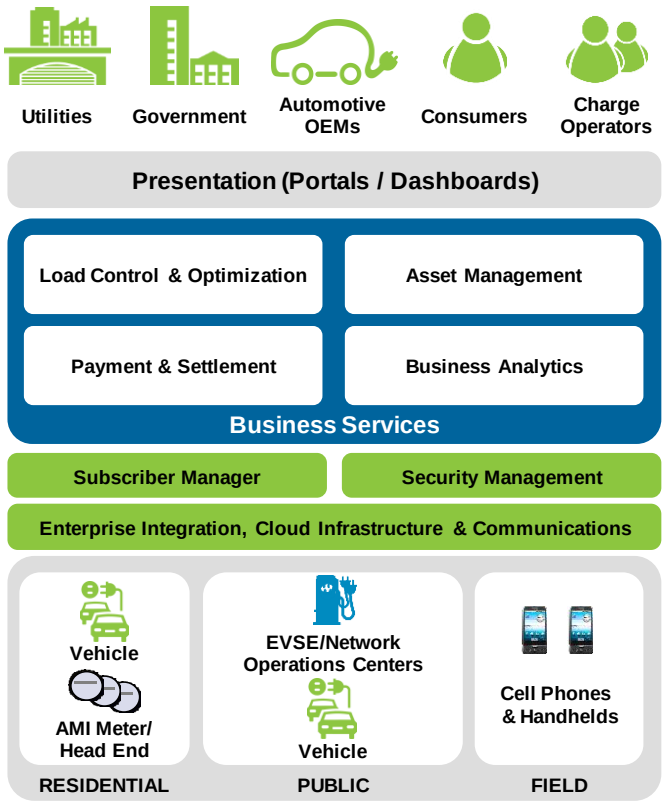
Smarter Energy Example:
IBM Integrated Enablement Platform for Smart Services



Electric Vehicles Example: Mobility as a Service (MaaS) Backbone

ecars Leading the charge

- Cloud based EV platform to give users an integrated and seamless experience when plugging into any of the 1'000 charging-points anywhere in Ireland
- Financial Services: rate/price management, metering, fee calculation, payments, multi-party settlement
- Asset Management: remote monitoring & diagnostic systems for EV service equipment & supporting devices
- Optimization & Control Services: calculation of dynamic rate tariffs, charge schedules, demand response signals
- Integration & Transaction Management: foundational capabilities to securely & reliably deliver above services

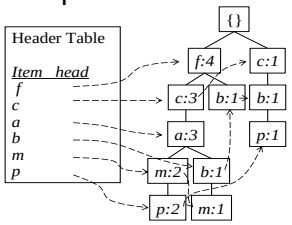


- Financial: support of current and emerging financial and settlement requirements
- Interoperability: integrates different devices and market roles into a seamless network
- Grid Integration: proper management and control to minimize impact on grid operations

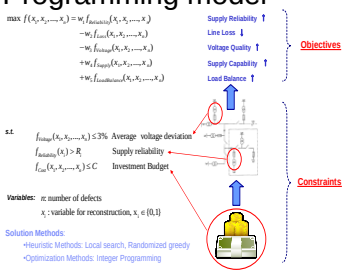
Understanding the Grid: Intelligent grid assessment and planning (iGAP)

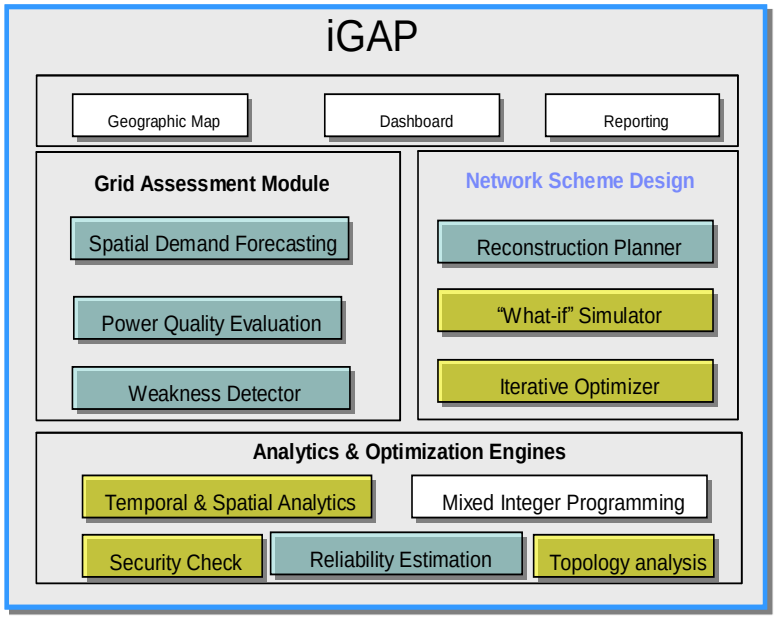
国家电网公司 STATE GRID CORPORATION OF CHINA

1 - Family defects mining with Frequent Pattern Mining

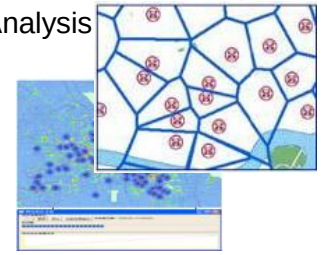


2 - Investment optimization with Mixed Integer Programming model





3 - Optimized power supply path design with Topology Analysis



4 - System flexibility with business rule

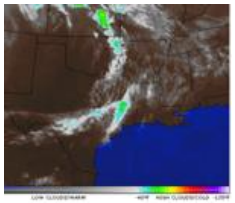
- Determined where the most urgent grid segment to be upgraded is
- Determined where construction can make the most revenue
- Achieved annual savings of about $40M for the same operational Key Performance Indicator.

Understanding the grid: Analytics & Optimization Mgt System for outage decision response transformation

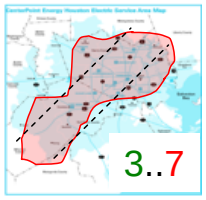
conEdison, inc.

Business as usual

Weather Feeds



Aggregated damage estimates



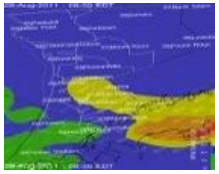
Job	Crew	Start	End
32	XB	4:0	5:0
33	XA	4:0	6:0

Human judgment to forecast crew needs based on weather data feeds. **Requires significant experience.**

Crew Dispatch Decision + Plan
Suffers from inaccurate weather prediction and best-guess damage estimation

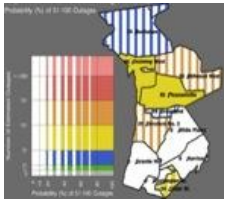
Prescriptive Analytics

Fine-Grained Weather Model

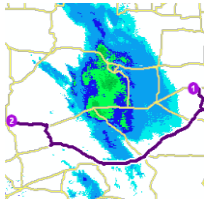


Predictive Damage and Outage Model

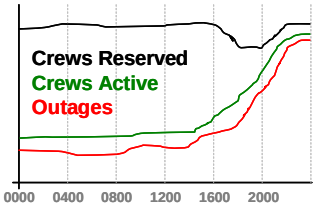
Probabilistic Restoration Effort Prediction



Optimized Crew Reservation



Transform decision process by adding advanced modeling, prescriptive analytics, and optimization



User receives fine grained prediction with spatial and temporal specificity.
Historical knowledge is built into weather, damage, and outage models

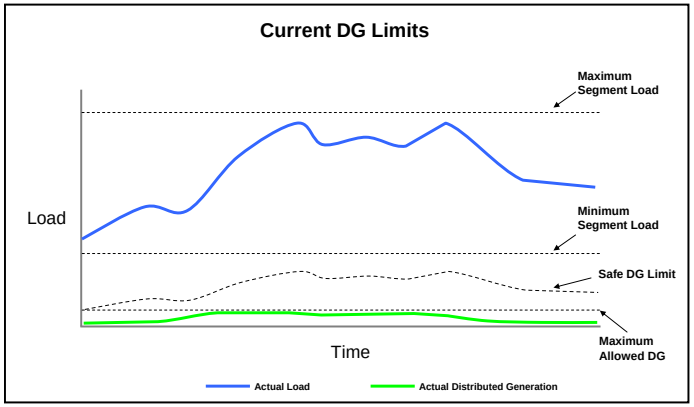
24-48hrs before event

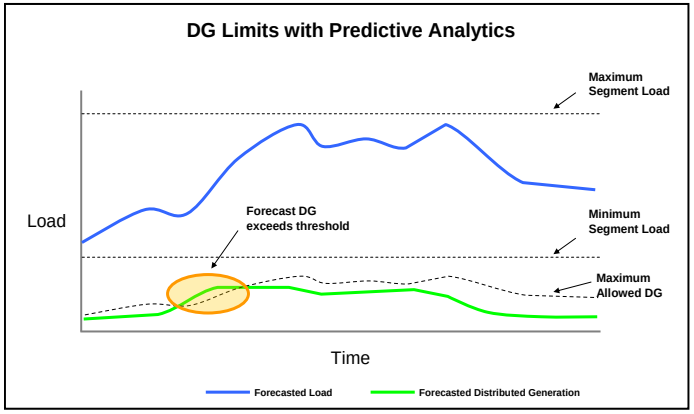
Crew Dispatch Decision + Plan:
Improved weather model, predictive damage model and optimized crew dispatch drives decisions

1

Controlling the grid: Devolving control of distributed generation and integration of new renewables

- Significant number of distributed generation is being connected to Hydro One's Low Voltage distribution network as mandated by Ontario Green Energy Act
- Distributed generation predictive and optimization analytics engine developed in order to:
  - Balance supply vs. demand locally by identifying excessive generation and shed generation prior to predicted interval, and restore after
  - Forecast load and generation at the feeder level based on predictors, e.g. weather forecast, type of day, season, diversity of load, smart metering etc



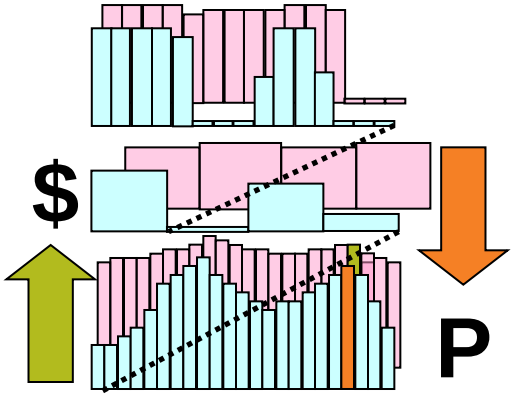


- Distributed Generation Predictive & Optimization Analytics, has provided Hydro One the ability to securely optimize distributed generation versus load in their network on an hourly basis
- Hydro one is now working on automating the process at the feeder level

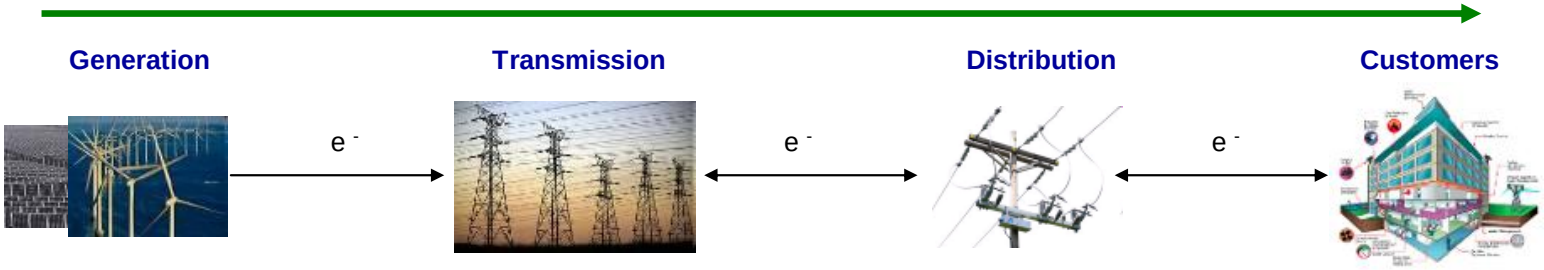
Controlling the grid: Optimized demand response and transactive energy control

- A highly distributed overlay approach utilizing a cost-based economic signal as a distributed control system signal.
- All business and operational objectives and constraints can be monetized and thereby incorporated into the signal.

Signals forecast several days



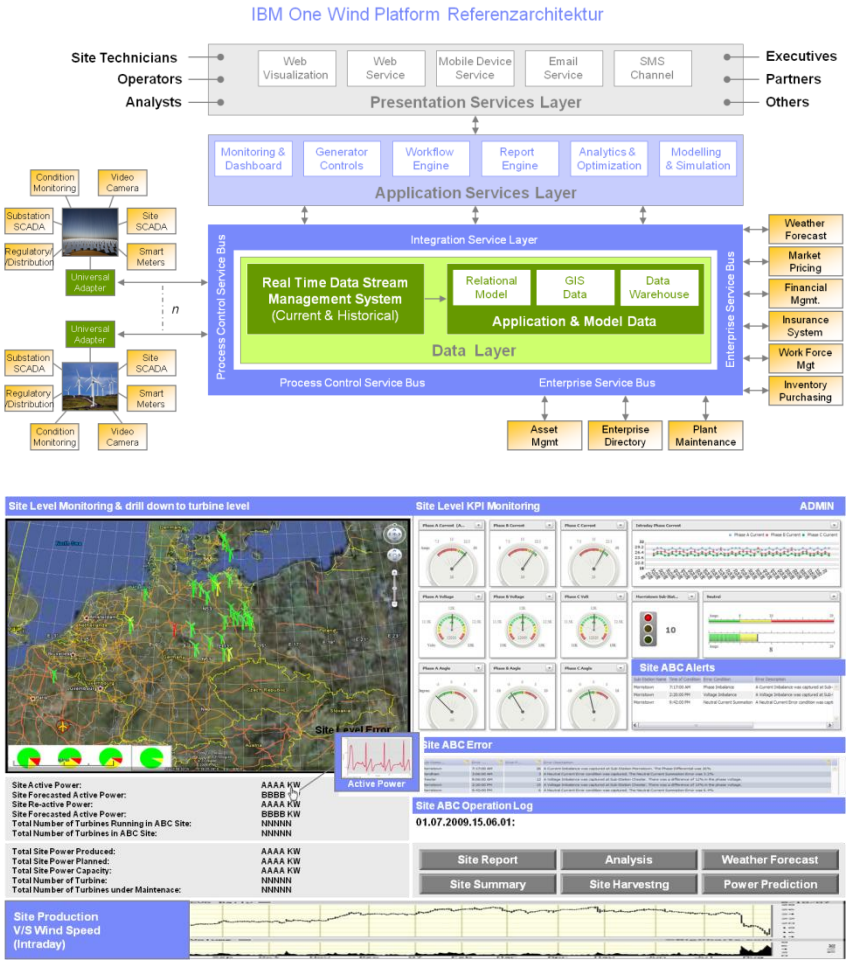
Transactive Incentive Signal (TIS): reflects true *cost* of electricity at any given point



Transactive Feedback Signal (TFS): reflects anticipated consumption in time

Controlling the grid: One Wind Platform serves as an “intelligent operations control center” for (new) renewables power generation

- Remote monitoring & control: global control room function for all assets (wind, solar, bio-gas & mini hydro) with automated event based error handling and tickets in PM systems
- Asset & power generation optimization: component level inventory, proactive spare parts mgt, predictive maintenance, asset insurance mgt, speedy emergency response
- Business performance & analytics: real-time KPI reporting, optimized power prediction & input to trading, technical excellence through analysis of downtimes, turbine error patterns, comparison of actual vs. OEM power curves

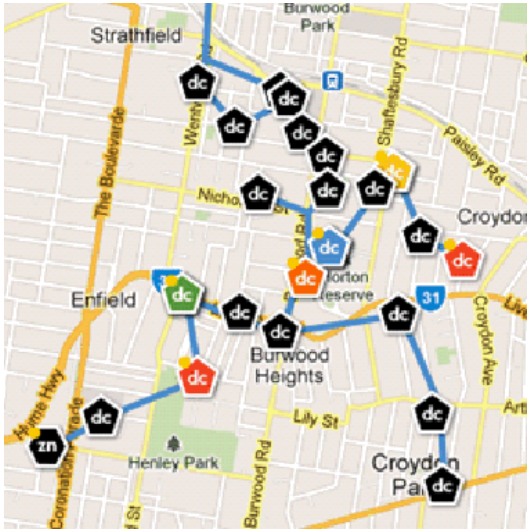


- Improved availability (monitoring, downtime BI)
- Improved revenue from trading (forecasting)
- Reduced O&M costs (e.g. OEM maintenance contracts, insurance, shared services, labor)

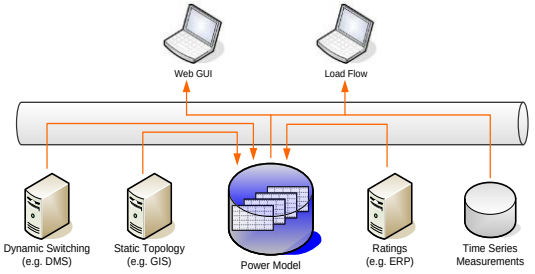
Optimizing the Grid: Improving grid reliability & planning with monitoring, analytics & common information model

EnergyAustralia

- No observability over aging distribution network, reacting to outages, planning by estimation, manual procedures
- Developed a real time integrated network distribution monitoring solution that automatically gathers network condition data to a centralized data warehouse.
- The Power Model spans all voltage levels of Transmission & Distribution. The Power Model is the Master Data Manager of all grid topology and connectivity data.
- All communication and data exchange takes places through CIM-based messages.

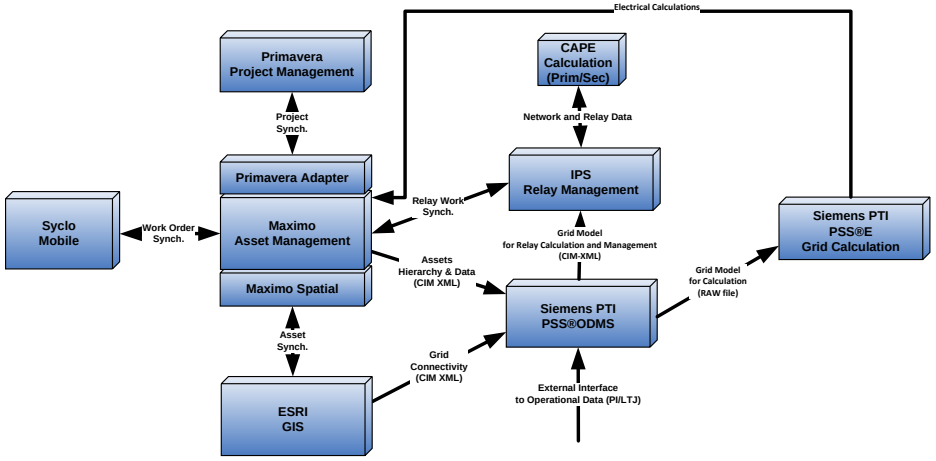


- Improves asset and power management incl. efficiency and reliability
- Identification of faults in real time, speeding up fault restoration times, and identify assets requiring preventative maintenance
- Analyze and correlate grid events in terms of time, connectivity and location, ultimately to generate a single and integrated view of their entire network



Optimizing the Grid: Optimize CAPEX & OPEX through asset lifecycle management

- 'New integrated asset lifecycle management system composed of asset management, geographical information management, management of workflow and contracts, maintenance management, outage planning, network planning, failure and disturbance management, cost management, relay settings management and calculation, and network modeling.'
- ELVIS is a foundational system to optimize future grid infrastructure investments
- Enable improved management of the electrical network in the future characterized by more renewable and highly fluctuating energy resources.



- Reduce amount of customization (preferably off the shelf solution)
- Open Architecture and CIM compliance, follow emerging Industry Standards
- Improved user experience, and efficient workflows
- Ability to integrate with other internal and external systems

Agenda

- IBM's perception of the E&U Industry trends and directions
  - Problems/challenges/issues
  - Industry's answers/movements we are seeing in the field
- Future trends and solutions
  - Overview of a few IBM Research energy projects
- Real-world implementations using readily available IBM expertise, IBM software and hardware technology
  - Incl. an introduction to ILOG Optmization solutions for E&U

Sessions describing IBM solutions used in the previously described projects

ISO01: Optimisation ILOG - Démonstration avancée des étapes de développement d'applications personalisées

Aug 28, 2:00pm - 2:45pm, salle Picpus

IM01P2: Le Big Data pour enrichir, complémenter et travailler en synergie avec vos Warehouse

Aug 28, 3:00pm - 3:45pm, salle Longchamp

SAN06: L'analyse prédictive avec IBM SPSS

Aug 29, 4:00pm - 4:45pm, Auditorium Blaise Pascal

TIV09: Solution d'EAM qui répond aux besoins de mobilité, planification et contraintes réglementaires

Aug 30, 10:45am - 11:30am, salle Longchamp

Questions / Answers