Applications of Ocean Forecast Information for Economic Advancement in Developed and Developing Societies

Dr. Mary Altalo

Science Application International Corporation

LSE and GMU School of Management

GODAE SUMMER SCHOOL

20 September-1 October 2004

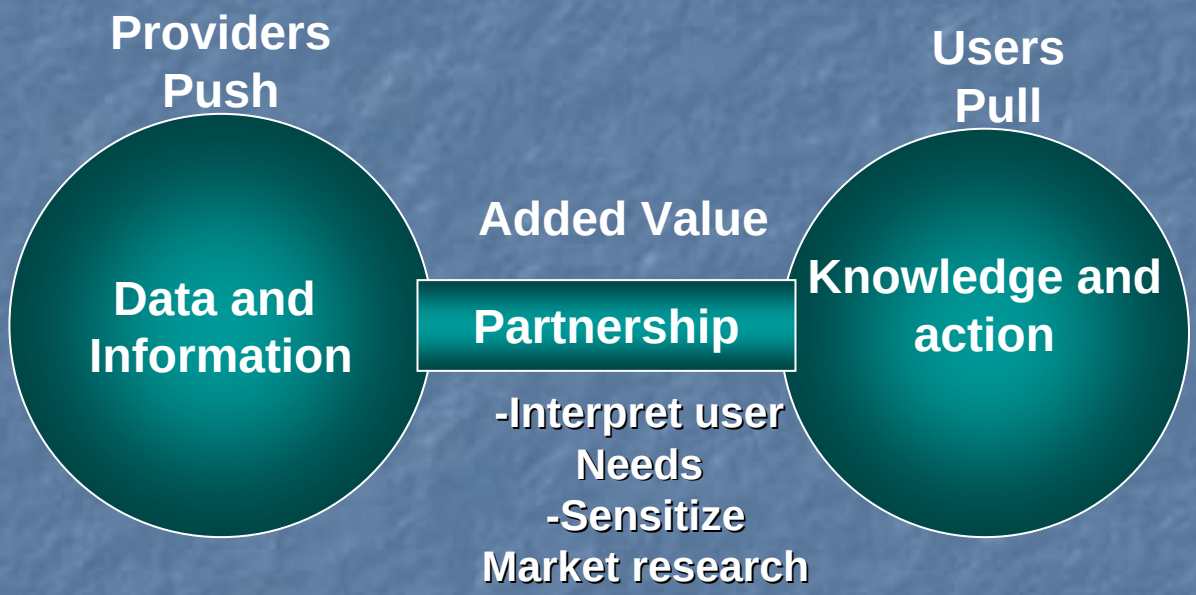
Concepts

1. Provider Push vs Industry Pull
2. Industry Drivers
3. Sector Specific Use
4. Industry Trials as information “beta testing”
5. Case Studies in the Energy Industry
    1. Developed
    2. Developing
6. Case Studies in the Tourism Industry
7. Creating Decision aids
8. Importance of a business case and financial investment strategy

Why is it so difficult to transition environmental information?

- Deals with Academic Disciplines taught in Business Schools, Schools of Government, Schools of Economics
- Field of Decision Science
- Information Technology Discipline
- Concepts of Operations Management, Policy Formulation and Strategic Planning
- Concepts of Business Process reengineering
- Biggest need is in improved metoerology- applies to every industry sector global

Methodology

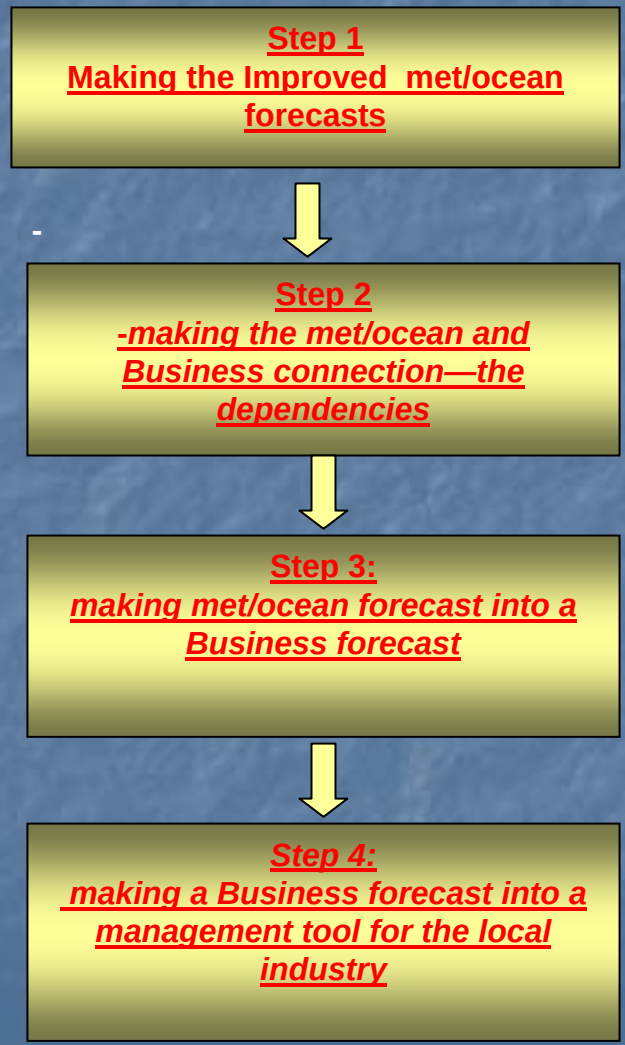


GODAE	National Met Ocean Services

Research	Government
Resource Management	Business

Technology goals → Development Goals

The Challenge:Making a MetOcean Forecast into a Business Decision Tool



Dual-Use Market Structure

Research Community	Government Policy	Business	Natural Resource management

- Energy
- Water
- Tourism & Leisure
- Health
- Construction
- Transport
- Financial Services
- Defense
- Agriculture

Uses for environmental information products

In Energy Industry Operations

- Energy load forecasting across grids
- Fuel mix determination
- Thermostat control
- Wind farm siting

In the Health Industry

- Health forecasts
- Spread of toxins and pollutants both airborne and waterborne
- Famine, flood, and drought climate forecasts
- Health facility scheduling

Other sectors---other uses

In the Transportation Industry

- Ship route optimization and planning
- Aviation routing and planning
- Intermodal transportation optimization
- Trucking industry logistics

In the Finance Industry

- Risk rating for compliance
- Weather derivatives for trading, futures and hedging
- Environmental evaluation for asset managers

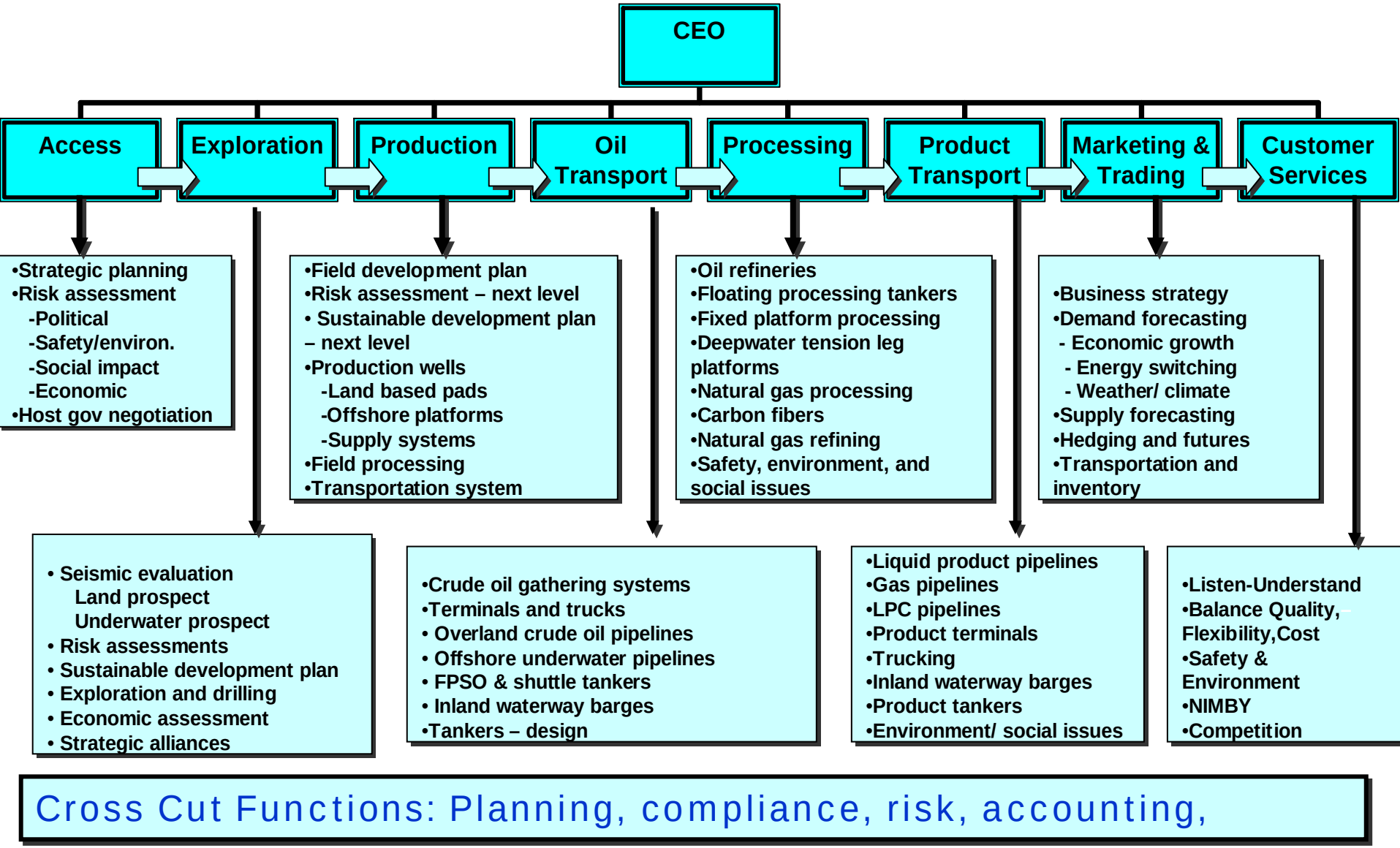
In the Tourism and Leisure Industry

- Infrastructure planning for new construction
- Training courses for staff development programs
- Seasonal planning for resort load capacity
- Hazard and risk management preparation
- Leisure line route planning and recreational boating

What do they use it for?

- Energy Supply/Demand Management
  - Oil and Gas Supply- Platform Management, Transport, (ship, pipeline)
  - Power Management (fuel type, generation, transmission and distribution management, power marketing and pricing, power procurement, infrastructure planning)
  - Building Energy Management
- Water Supply/Demand Management
  - Irrigation (pump load) control
  - Drinking water safety
  - Sanitation management
  - Hydropower/reservoir optimization
- Recreation and Tourism
  - Demand and Revenue forecasting for Hotels, Resorts and Parks Pricing
  - Siting and construction
  - Cruise line routing and seasonal repositioning
  - Recreational safety and emergency management
- Agriculture
  - Food supply security
  - Crop supply chain management
- Health
  - Pandemics
  - Facility scheduling and supply chain management
  - Health Insurance
- Construction
  - Siting, material selection, design
  - Code setting
- Inter modal Transport
  - Port security and safety
  - Transportation Routing
  - Congestion management
- Financial Services Sector
  - Underwriting
  - Premium and deductible rate setting
  - Hedges “weather derivatives”
  - Insurance – health,
- Trade Associations/Business Councils
  - Advocacy
  - Training

Value Chain Organization of CONOCO: Business Units and Functions Using Ocean, Weather and Climate Information



Driving Principles for Managing with Environmental Information

- Safety of Life and property
- Market Economics & Competitive Advantage
- Risk reduction
- Sustainability
- Corporate Social Responsibility- Indices
- How the Corporation impacts the environmental - regulatory

Framework for Problem Identification
Role of Weather/Ocean on Business Processes

What are the targeted business processes?

- Weather in Operations Management
- Weather in Supply Chain management
- Weather in Inventory management
- Weather in Fiscal projection
- Weather in Emergency Management
- Weather in Business Process reengineering

Weather/Climate Risk (risk FROM the environment)

"An estimated 70% of all businesses are impacted by some form of weather risk – earnings volatility" (*AON, 2001)*

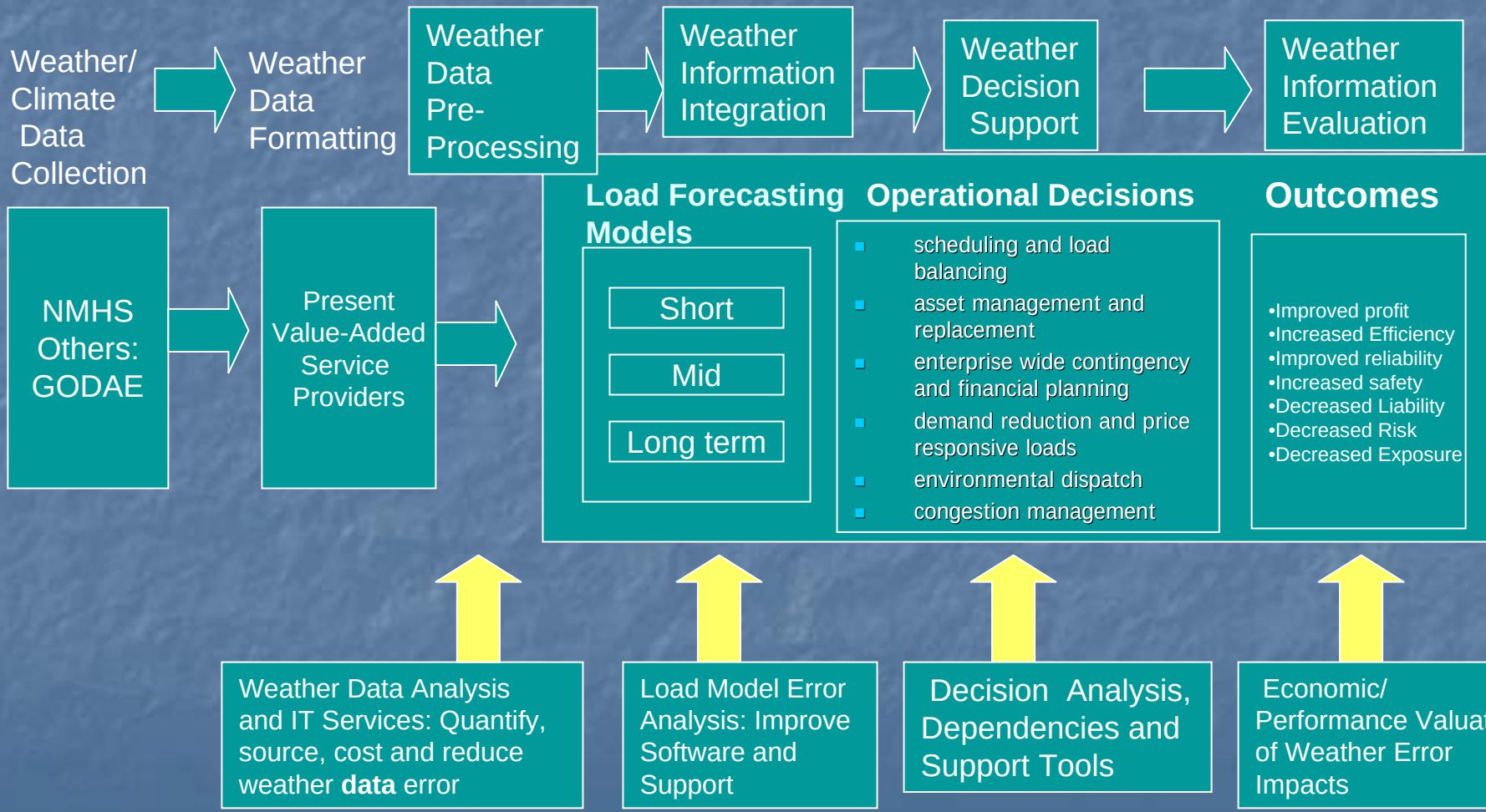
- The weather is energy companies largest source of financial uncertainty
- Adverse economic impact of 'deviation's' from usual weather conditions on trading results of corporations due to:
  - Increases in costs
  - Reductions in revenues
- Weather risk is the uncertainty in cash flow and earnings caused by weather volatility
- Coastal Weather uncertainties are related to adjacent ocean conditions

GODAE and Business Operations

- Critical Functions for the Environmental Information
  - Demand Forecasting across All sectors (tactical)
  - Incident (Emergency) Management (tactical)
  - Policy Formulation and Governance (Strategic)
- Provides
  - **Current and Advance "Situational Awareness"**
  - **for Decision Support** (situation influence modeling, consequence assessment and Tactical Decision aids)
  - **for Optimal operational response** (dispatch)
  - **Leading to Proactive Management Strategies and Policies**
  - **Reducing Risk**
- **A major contribution is to coastal weather and climate forecast accuracy**

Environmental Information "Flow" on the Operational Decision Process: Risk Reduction Areas

DATA → INFORMATION → KNOWLEDGE → ACTION → OUTCOMES → IMPACTS

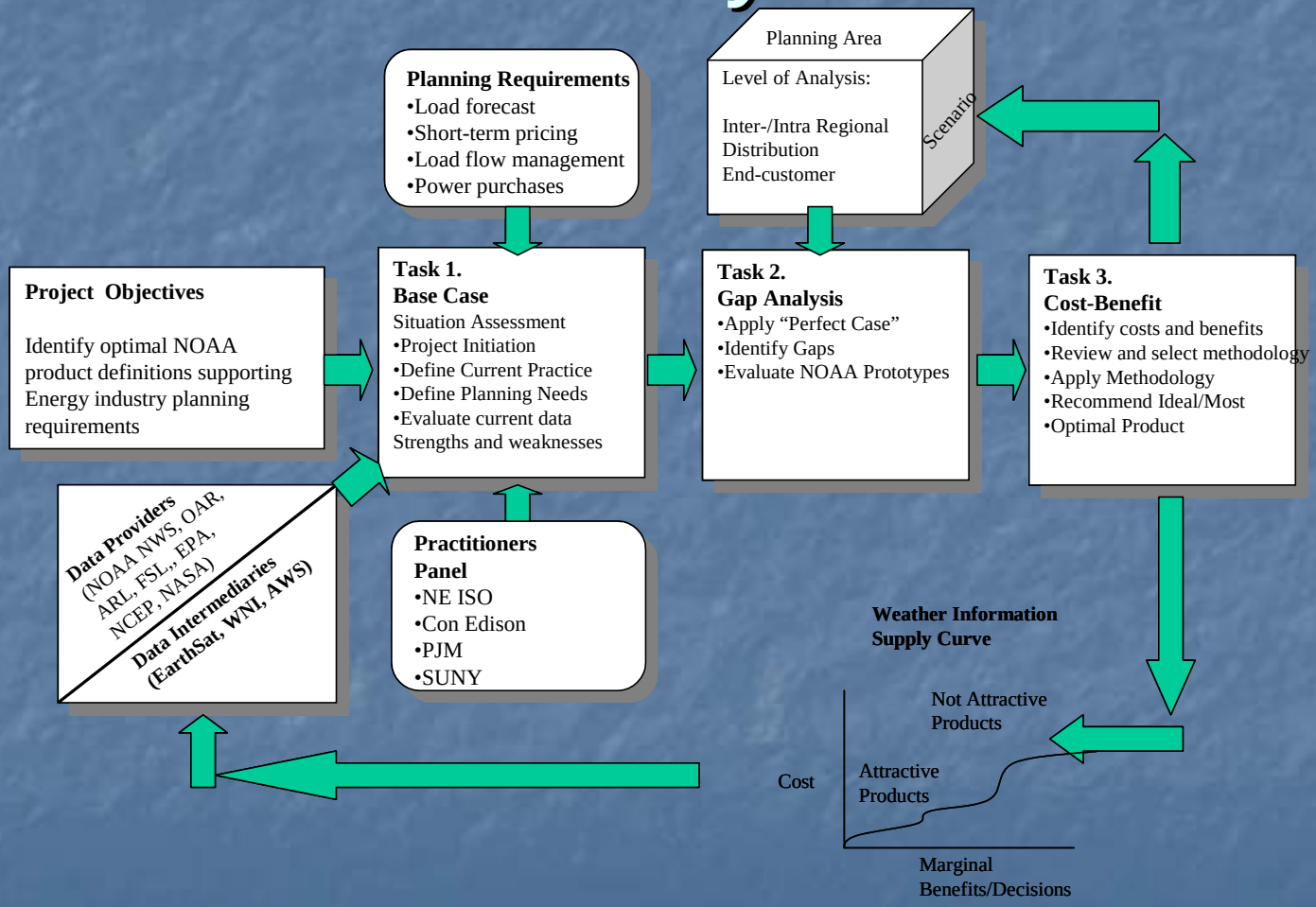


Situational Awareness----Decision Support----Optimal response

What is an Industry Trial?
A diagnostic way to assign VALUE of Data

1. Economic Cost-Benefit Analysis---OR
2. Industry Trials or **Performance Assessment**
   a. "User-Supplier" **Partnership**
   b. Environmental Forecasts becomes Business Forecasts
   c. Improved **Skill** of Environmental Forecast increases Skill of the Business Forecast, thus **"Demand Pull"**
   d. Requires **Integrated** Information from Ocean, Weather, terrestrial and Climate Observing Systems at all scales
   e. G**uides Marketplace** Decisions and Strategy
   f. Informs National Policy and Strategy
   g. Prioritises National S & T Strategy for Observing system design, implementation and operational decisions

Diagnostic Approach to Assessing Vulnerability and Risk

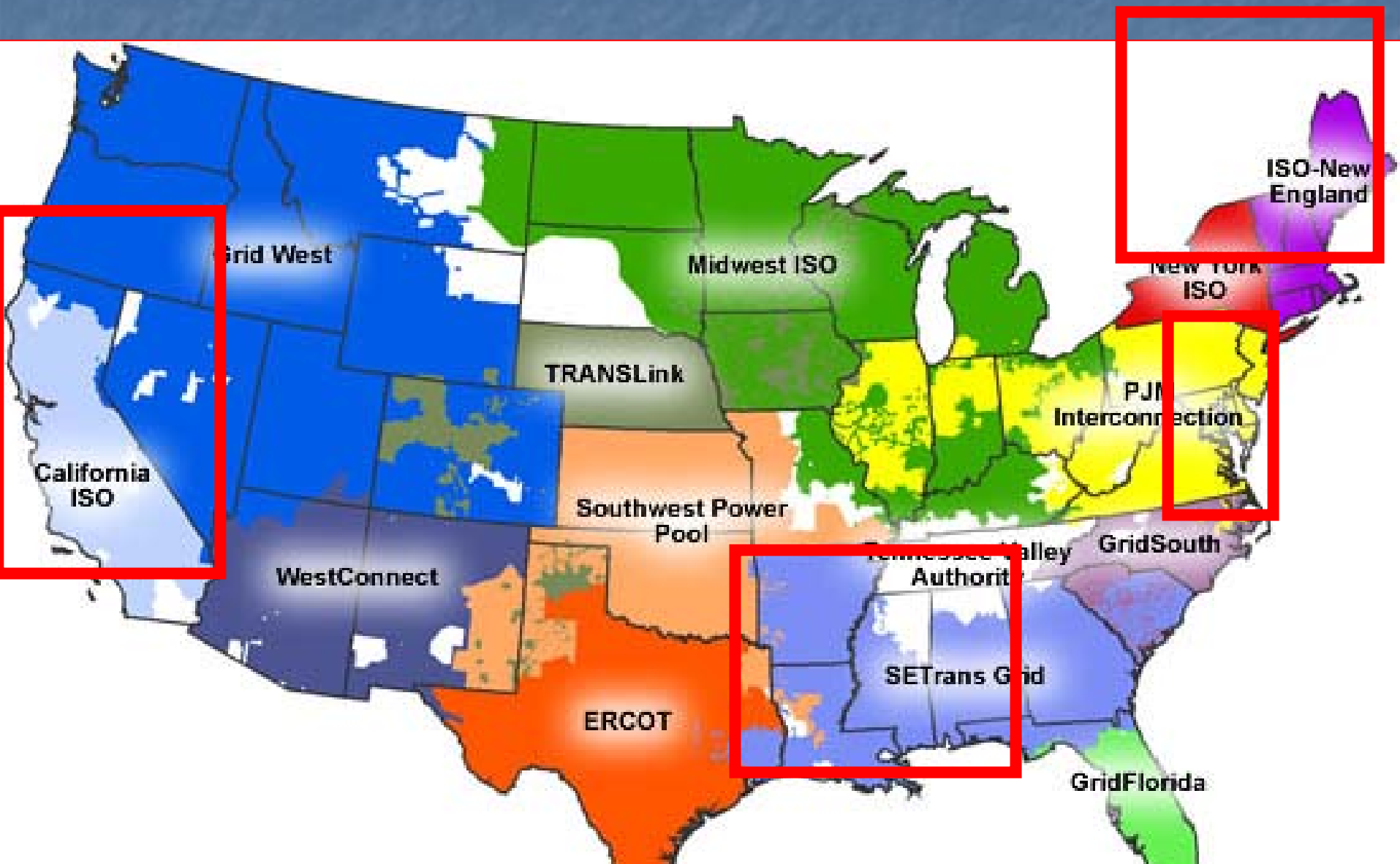


CASE STUDIES
Power Industry
Leisure Industry

Overall Goal

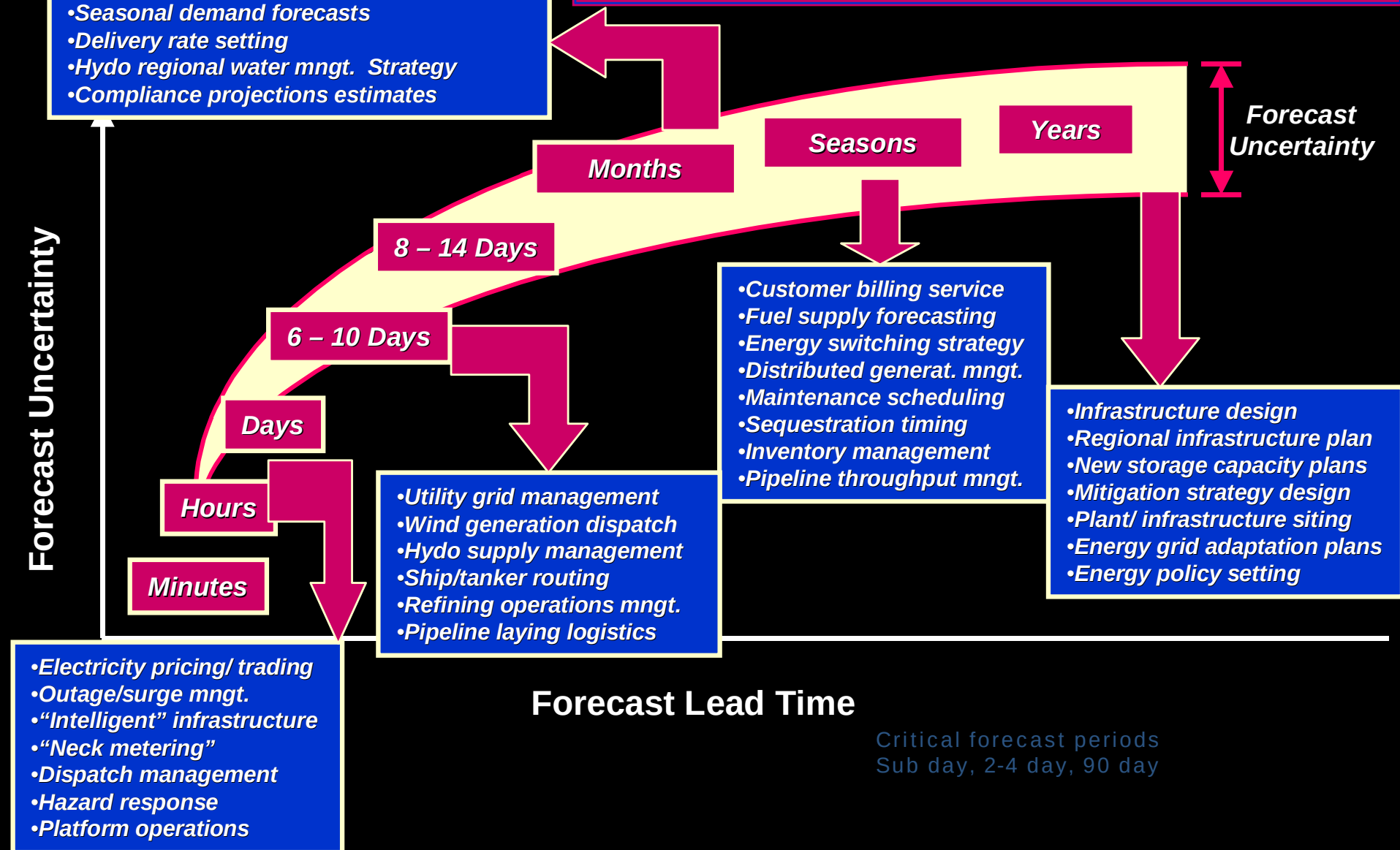
- Determine the precise requirements of the stakeholders for the improvements of decisions-”what do you do?” what operations are vulnerable
- Examine the value of improvement in weather/climate/ocean forecast accuracy to major stakeholders for example in the Electric Power Value Chain (Sellers, Distributors, Buyers)
- Establish the Impact of forecast accuracy on the operation and planning decisions of the Industry
- Examine and Improve the Decision Support Tools of the User community to “institutionalize” information
- Develop the Stakeholder Advocacy through experience

Energy Industry "Trials" Areas



Energy Operations Aided by Reductions in Environmental Forecast Uncertainty

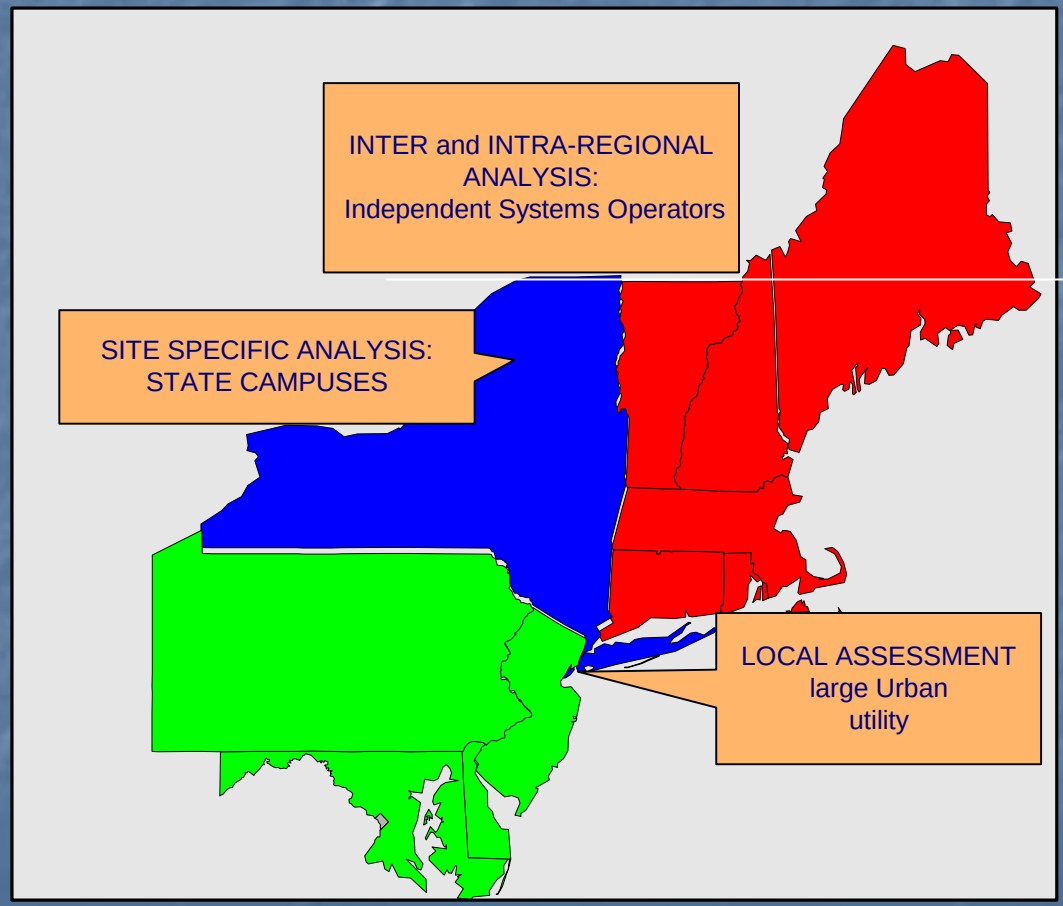
- Sales/earnings forecasting
- Energy storage replenishment strategies
- "Flexible" energy production and delivery
- Storage requirements needs assessment
- Storage logistics planning
- Regional Energy mngt. planning
- Stockpile planning
- Seasonal demand forecasts
- Delivery rate setting
- Hydo regional water mngt. Strategy
- Compliance projections estimates



Critical forecast periods
Sub day, 2-4 day, 90 day

The Setting for the Stakeholder Assessment 1

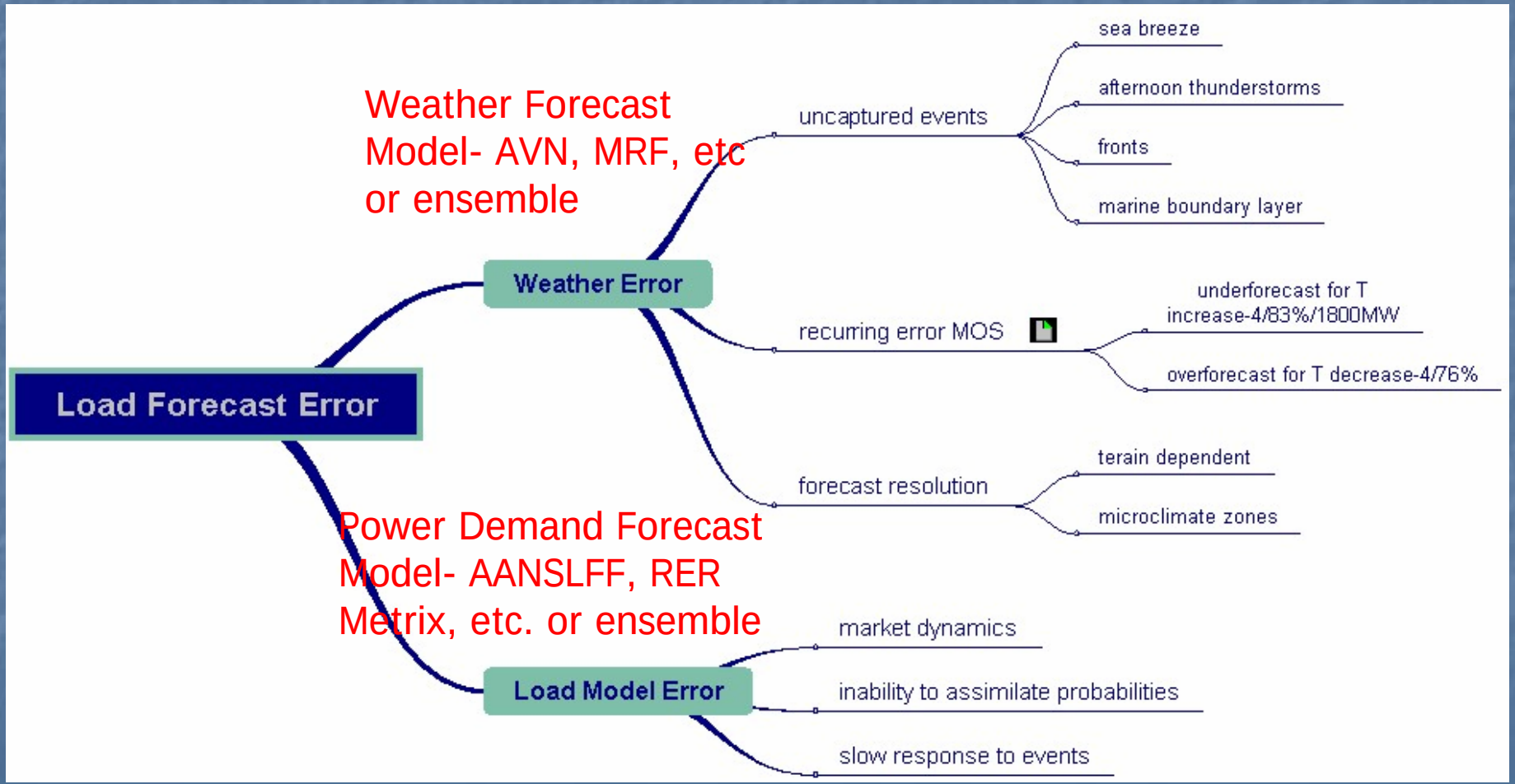
- **New England** Grid Operator– weather impacts on short term load forecasting
- **Major Urban Utility** – weather impacts on distribution system loads
- **Major state owned end user**– use of weather forecasting to control day ahead electric prices and manage natural gas and electricity costs at state facilities



Key Utility functions/decisions requiring coastal weather/climate/ocean data

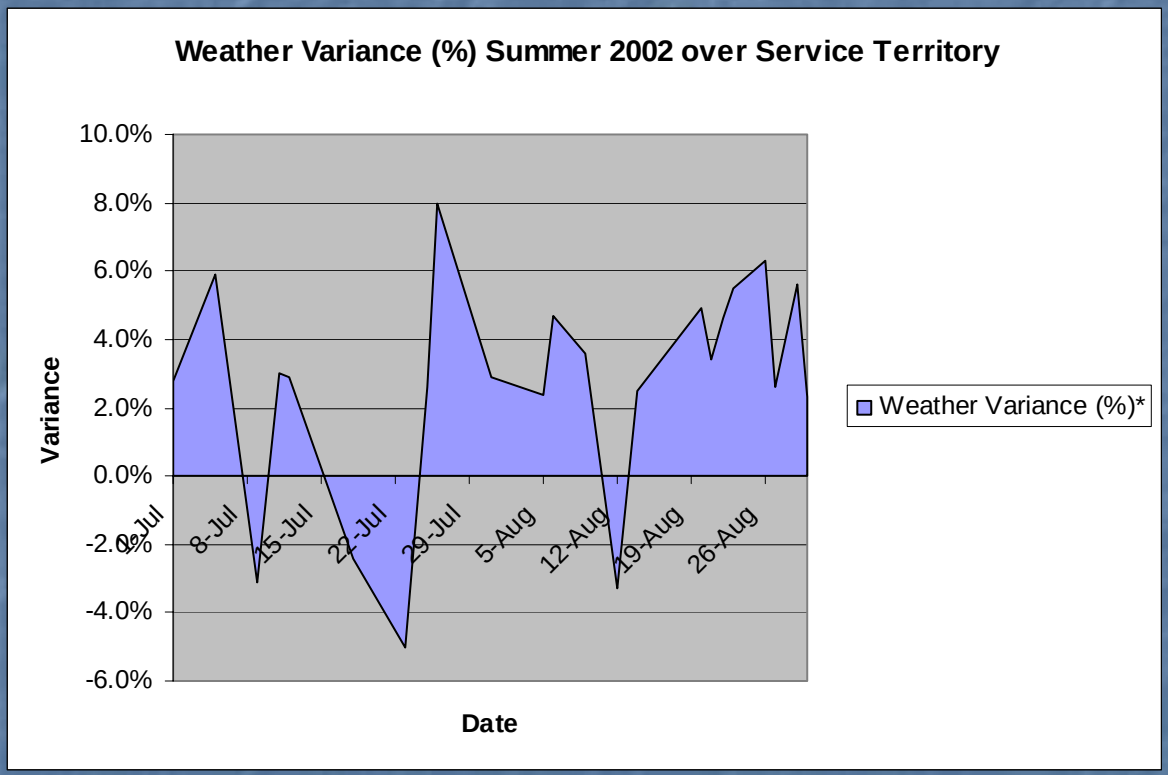
- Load Balancing-single utility and grid
  - Generation commitment- fuel mix choice (fossil fuel, hydro, wind)
  - Dispatch scheduling
- Power Marketing
  - Cash trading
  - Power pricing
  - Fuel pricing and procurement
- Tariff Scheduling
- Natural Gas Storage Management
- Revenue Projections
- Infrastructure siting
- Management strategic planning

Electricity Demand Model Error - Neural Net Diagnostics

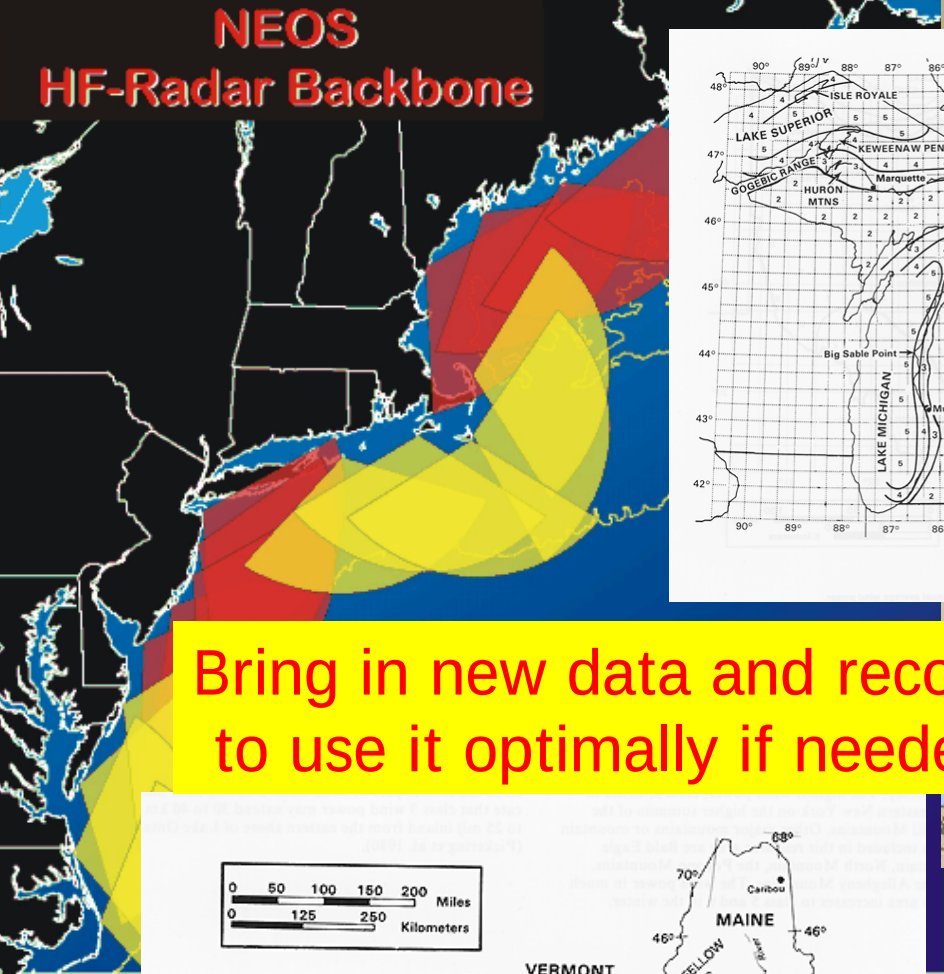


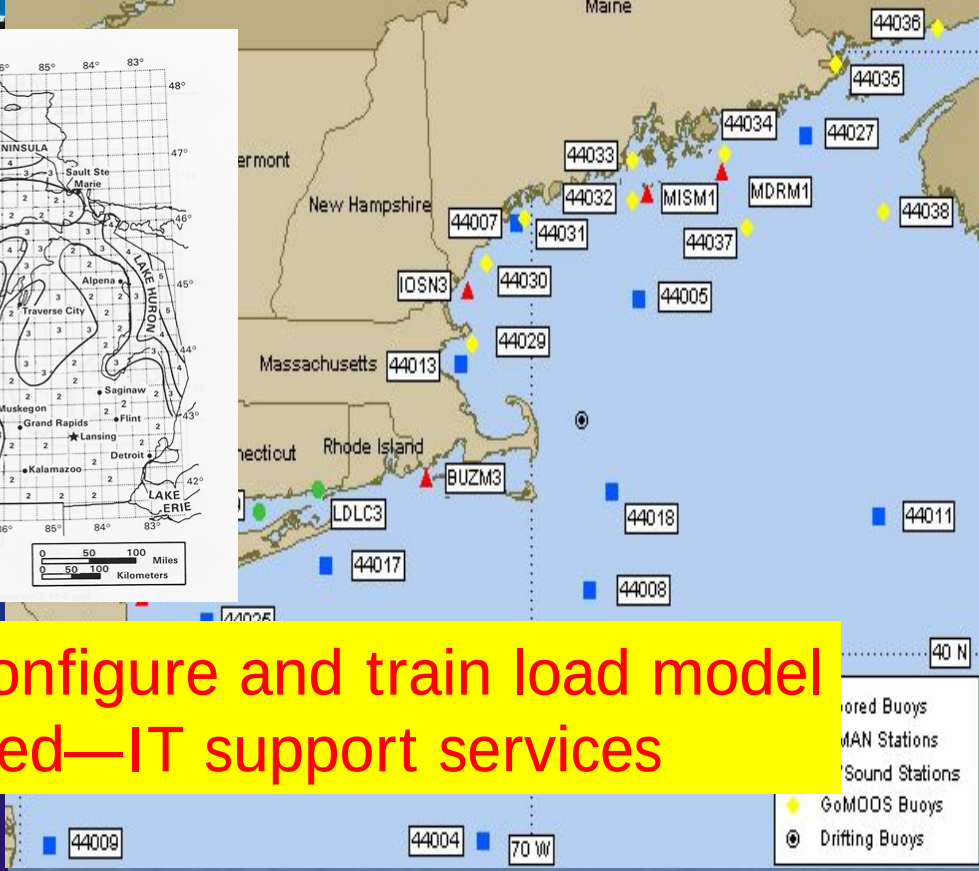
Skill of the Environmental Forecast Impacts the Skill of the Power demand forecast

Urban Utility Case Study Findings 1: Significant load error due to weather

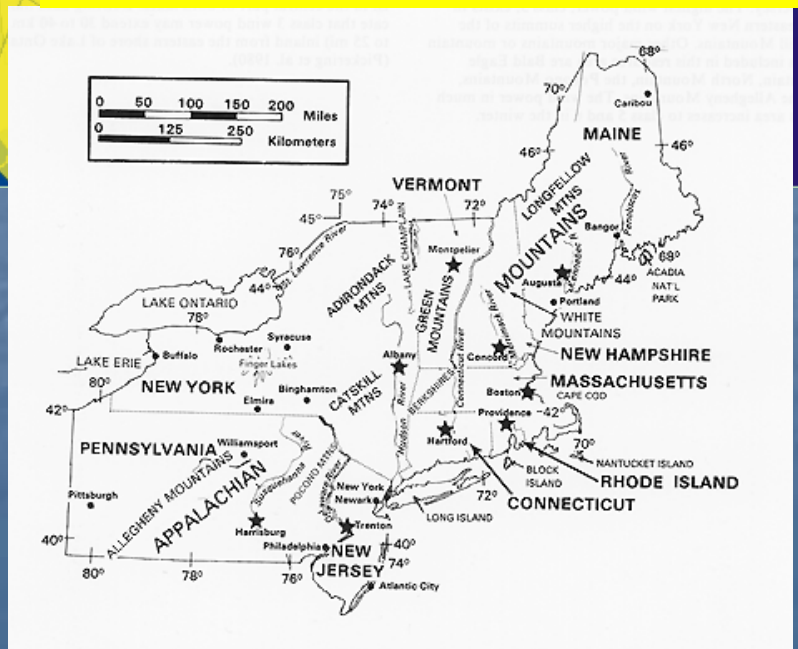


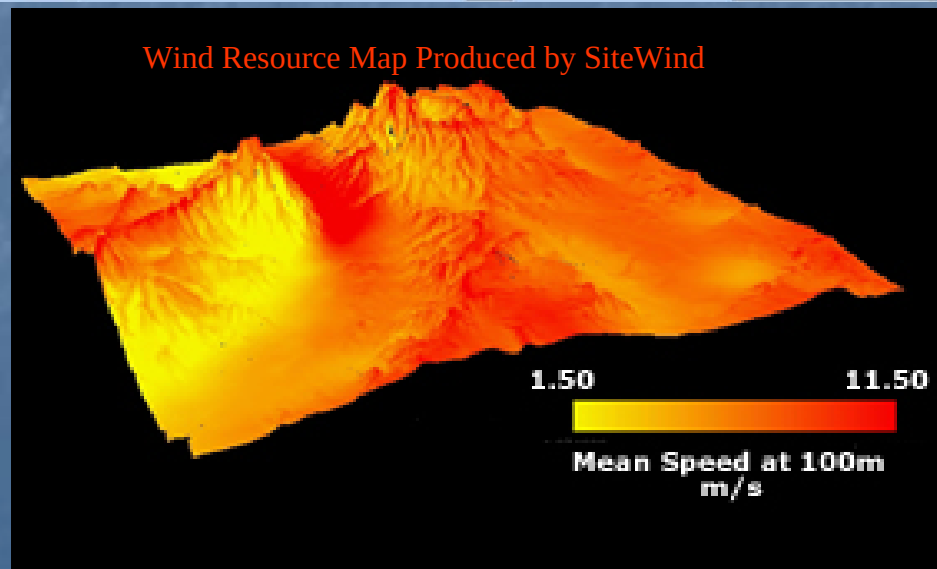
Most utilities calculate weather error in MW as well as percentage of variance of the load. Analysis indicates that on some days, variance in the load forecast in MW may be solely due to weather error. This appears to be from events or unmodeled mesoscale features such as **back door fronts, sea breeze and afternoon thunderstorms**. The cost of such events can be up to $10M/day in wasted generation





Bring in new data and reconfigure and train load model to use it optimally if needed—IT support services





Key Cost Findings
2002-2003 Northeast Energy

"The project estimated that the benefits of improving day ahead weather forecast accuracy by one degree F or by reducing forecasting error by 50% for days 2-7 is:

- **--$20-25 million per year for a regional transmission authority**
- **--$1-2 million/year for a major distribution utility.**

Optimal use of weather information could yield savings of $8–18 million/year for a major university system (electric and natural gas).

If these savings were generalized to other regional transmission organizations, large statewide colleges and universities and regional transmission authorities the total savings would be for the Northeast Region:

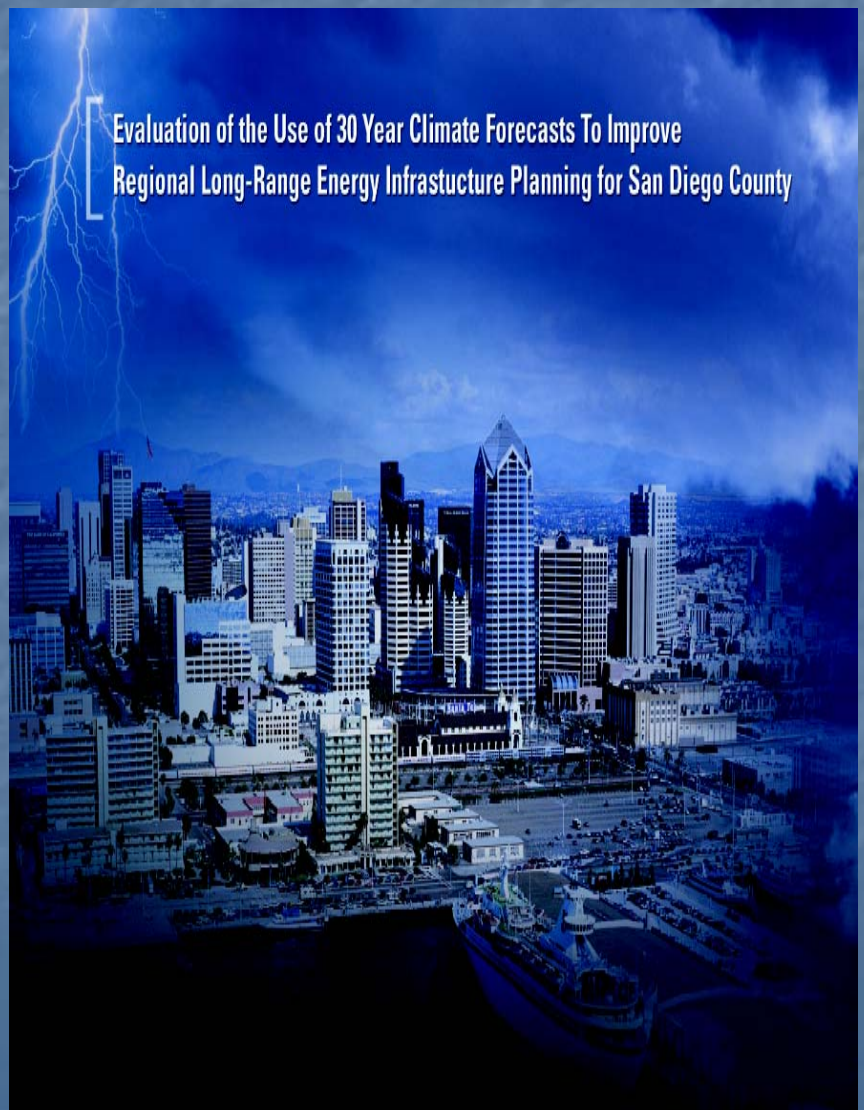
-- $100-140 million/year for ISO's

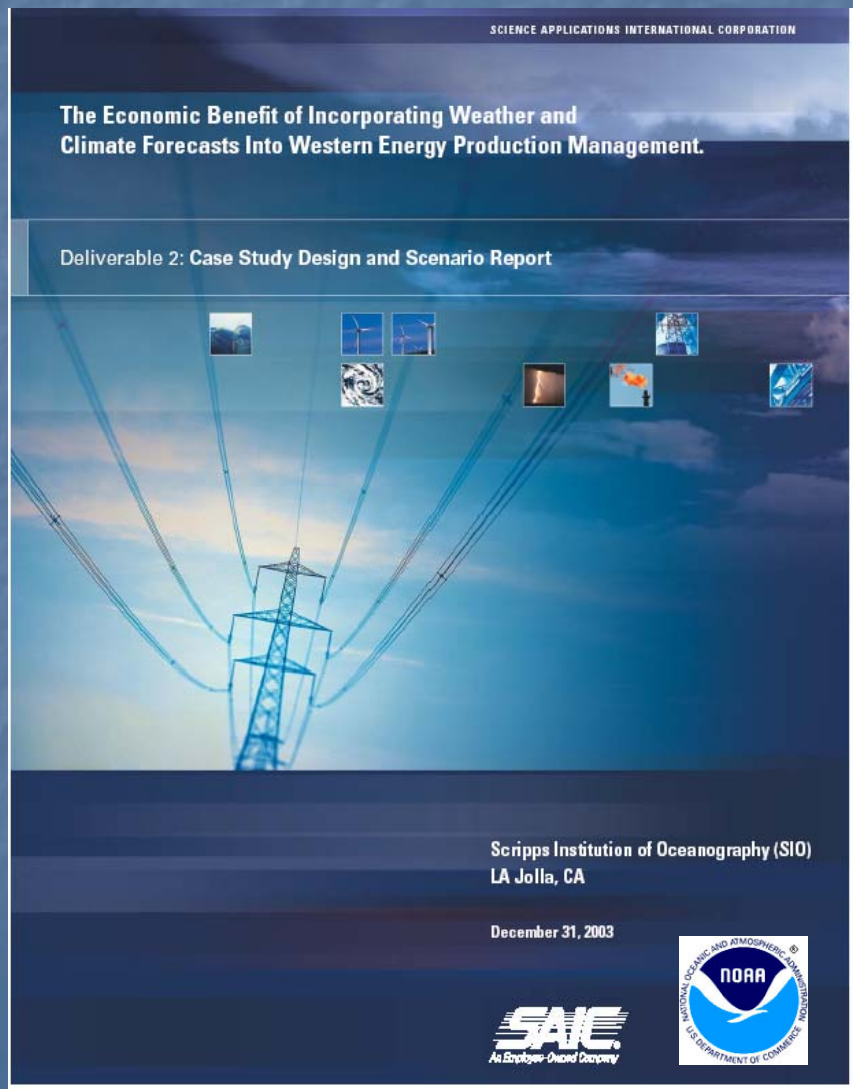
--$30-60 million for regional electric distribution companies.

-- $38-67 million for Statewide university campuses

Furthermore, capturing the "events" on top of this will yield significantly higher savings (millions/day).- seabreeze, backdoor fronts, afternoon showers

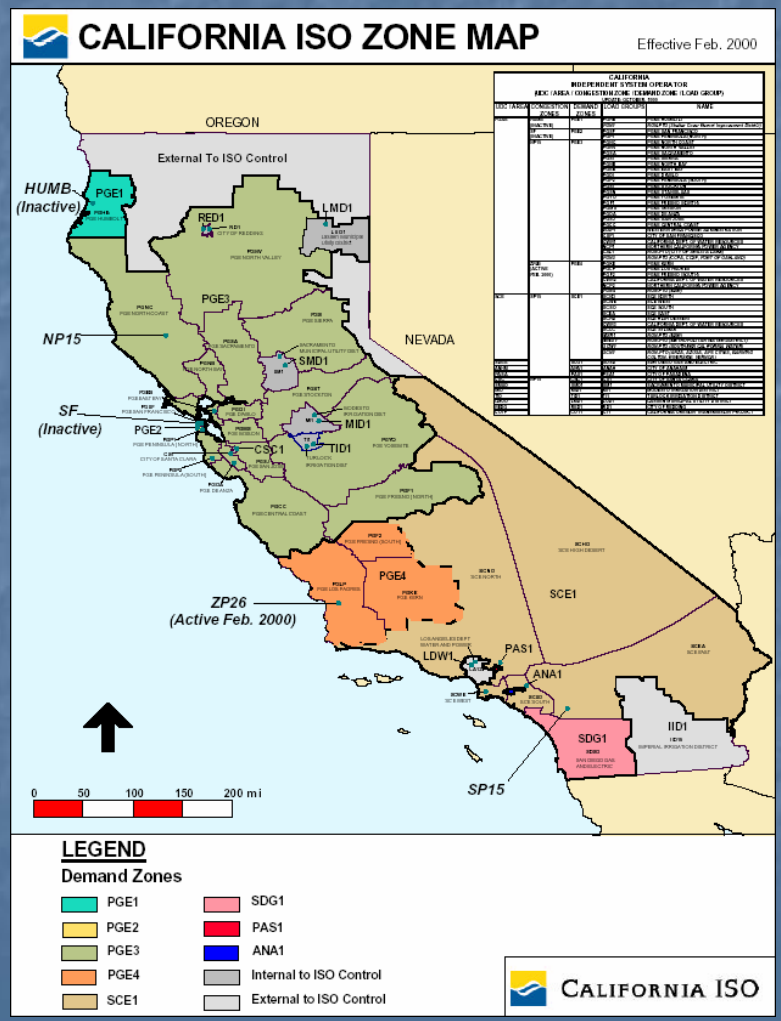
Case Studies 2 and 3





West Coast Power

- Load balancing Problems
  - Coastal winds
  - Coastal fog
  - Microclimates
  - El Nino

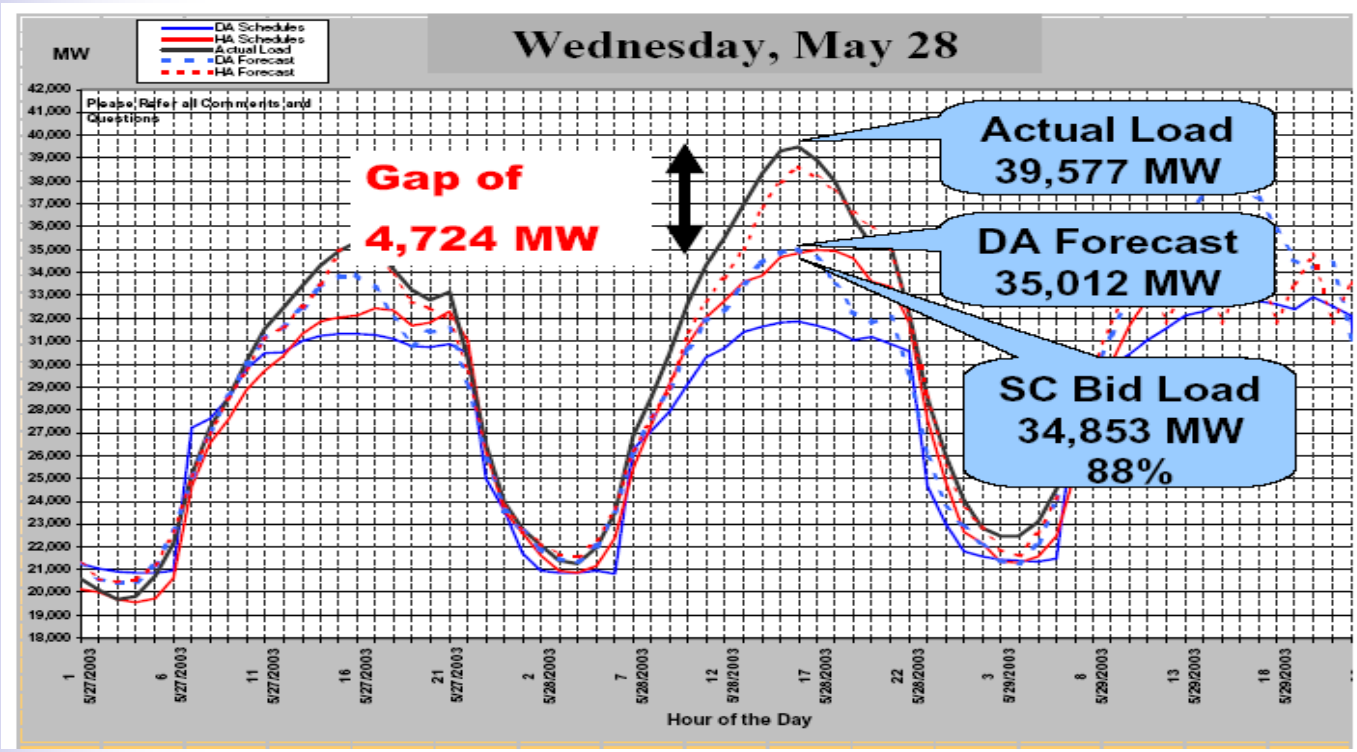


Consequences of Electrical Load Error

- Underforecast- May
  - Generation shortfall of 5000MW (load required by 500,000 homes)- near blackout
  - Buy on spot $200+ with caps up to 1000 w/o caps
  - One day 5-7% error costs of up to 5M
  - Cause- weather forecast error of 4%
- Overforecast- September
  - Generation overcommittment
  - Similar magnitude
  - Less costly (previously contracted generation) and less visible impact

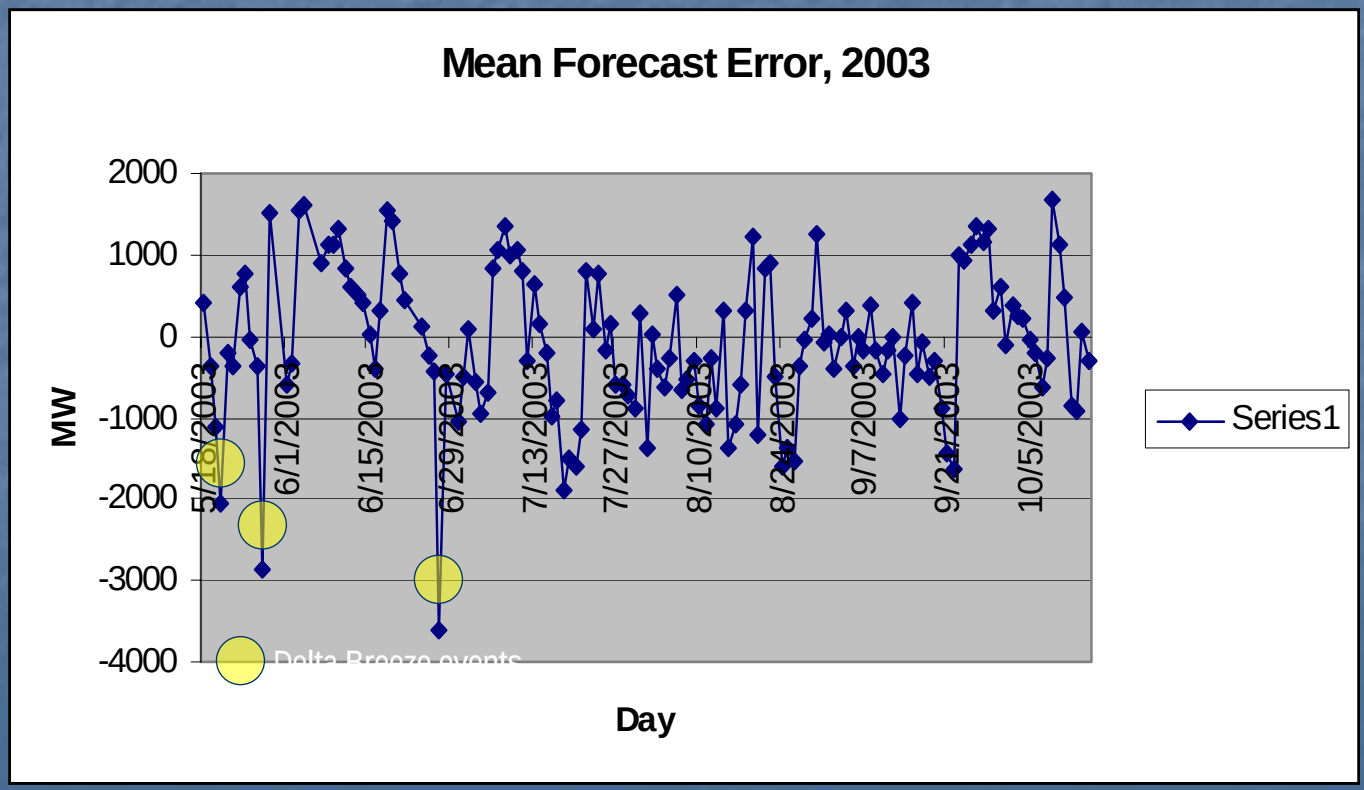
Retrospective Analysis:Relationship of Coastal Weather Uncertainty and Cost

- Underforecast T Case Study . Weather forecast error of 4% leading to a demand forecast error of nearly 5,000MW leading Cal ISO Weather Forecast Error and Potential Cost $4-7M/day



Cal ISO Mean Daily Forecast Error

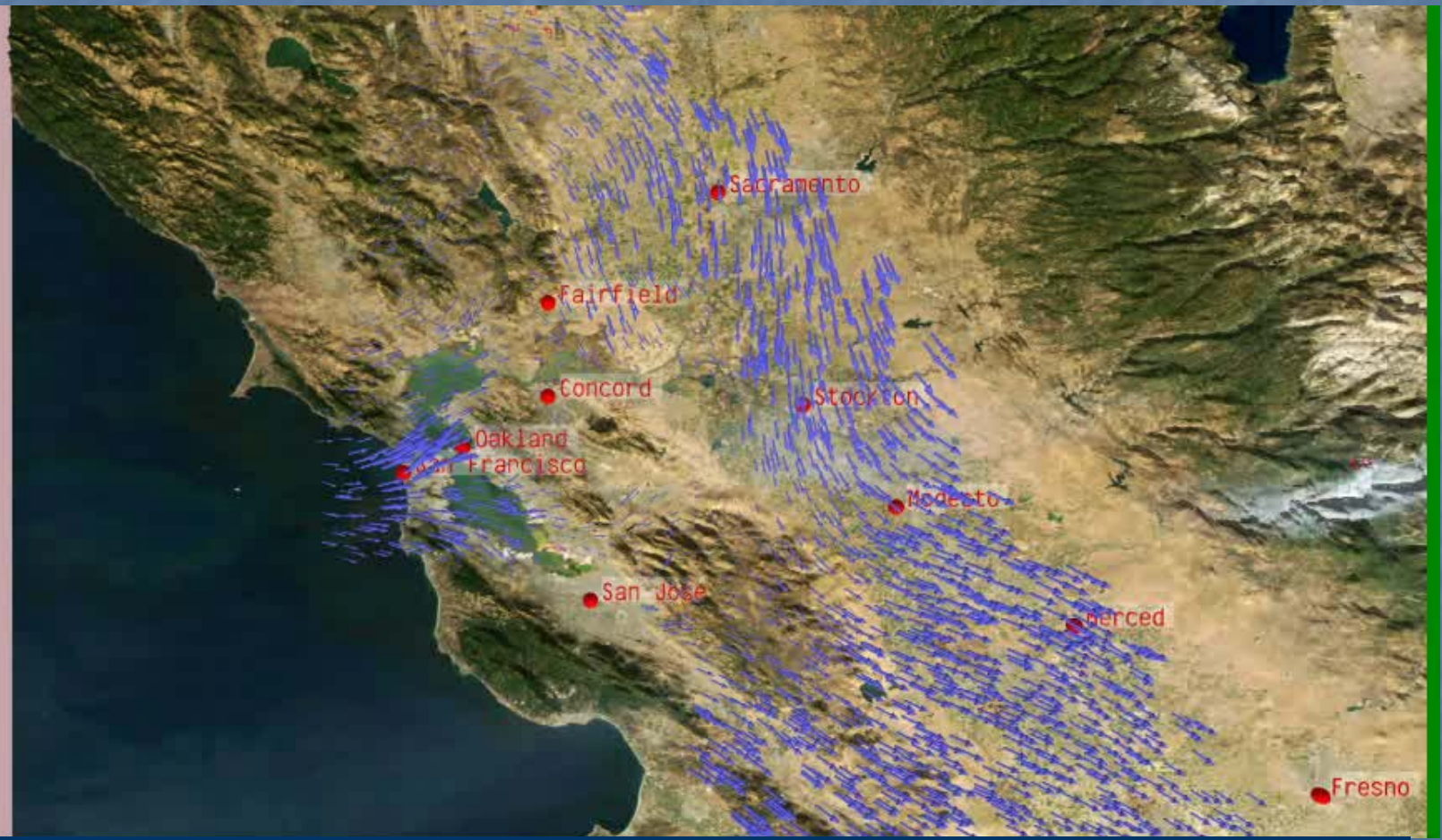
- Delta breeze and weather/load forecast errors contribute to major errors in prediction of Delta Breeze effects.
- Delta breeze is defined as the conditions when the wind speed is > 12 knots and the direction is between 190 degrees and 280 degrees.
- Delta Breeze can change load by 500MW
- Direct Costs: 250k per breeze day; 40 events per year
- An overforecast problem



California "Delta Breeze"

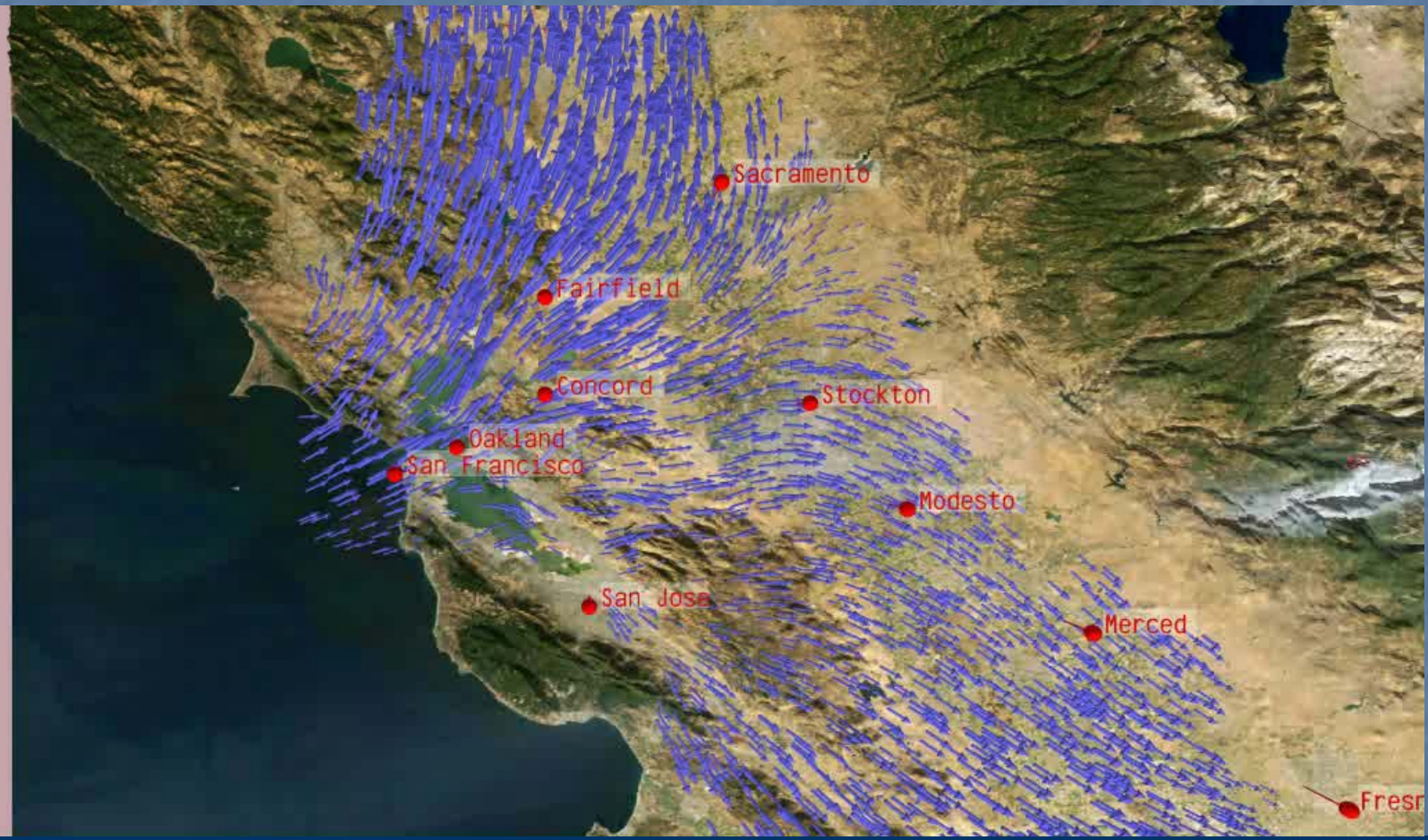
- An important source of forecast load error (CalISO)
- Big events can change load by 500 MW (>1% of total)
- Direct cost of this power: $250K/breeze day (~40 days/year: ~$10M/year)
- Indirect costs: pushing stressed system past capacity when forecast is missed!

NO delta Breeze



Sep 25, 2002: No delta breeze; winds carrying hot air down California Central valley. Power consumption high.

Delta Breeze



Sep 26, 2002: Delta breeze starts up; power consumption drops >500 MW compared to the day before!

The Inextricable Relationship of Weather Uncertainty and Cost: Grid Operating Companies

- Cost:
  - Driven by spot market and last marginal unit required
  - Replacement power costs are often highest during periods of high peak demand and congestion
  - Replacement power costs can be anywhere from from $200/MWh to over $1000.
  - Price caps exist in California and western states which artificially suppress real market clearing prices
  - Potential market value costs might range anywhere from $200-$1000/MWh
  - Cutting forecast error by 70% can save as much as $560,000-$2,800,000 per hour during critical peak periods!

Principle Causes of Uncertainty on Energy Operations and Planning

- **Uncaptured WIND Events**
  - Coastal Delta Breeze- Cal ISO
  - Lake effects- Salt Lake City- Pacificorp, Great Lakes- SUNY Buffalo
  - Seabreeze- NE ISO
  - Coastal Frontal passage- 2-4 day
- **Uncaptured PRECIPITATION Events**
  - Rain vs. snow/ice
  - Regional day ahead error in precipitation- Pacificorp
  - Afternoon thunderstorms
  - Marine Layer, fog- SDG&E
  - Drought and flood, flash flood
- **Uncaptured CLIMATE Events**
  - Climate outlooks –weather events frequency
  - El Nino and seasonal events
  - Decadal ocsillations- NAO
- **RESOLUTION- Spatial, temporal**
  - Sub grid level
  - Targeted watershed level, Nodal, congestion and population
  - Topographic Effects- microzones
  - Hourly changes during events
- **Load Model Error**
  - 50% load error at certain event periods
  - Can't incorporate probabilities/ ensembles
- **Sub-optimal Use**

Requirements

Environmental Information in the Power Value Chain

Energy Operations / Environmental Dependency	Fuel choice	Generation	Pricing	Transmission	Transport (gas)	Distribution	Energy Procurement	Demand Side management	
Sea breeze						x		x	
Offshore wind prediction		x							
Fog						x		x	
Back Door fronts						x			
Sea/lake Level/wave height	x	x			x				
Air Quality		x							
Microclimates						x			
Precipitation Forecasts						x	x	x	
Radiation						x		x	
Water Temperature		x							
Air Temperature			x	x	x	x	x	x	

Alternative Energy Supply Issues

- Renewables Portfolio Targets for National Needs
  - Governors targets- e.g. CA, 20% Renewables by 2017- currently at 12%;
  - Federal Needs-Energy Security, energy efficiency, emissions reductions (health)
- Renewables (wind/hydro) Siting, Construction & Operation
  - Offshore wind fields, wave height, subsurface currents, storm prediction, sea level, sedimentation, precipitation, evaporation, floods
- Renewable Energy Delivery and Storage
  - Demand variability due to extremes, storms, fog
  - portfolio management with offshore wind prediction

“Industry Trials” for African Business Needs

- **Tourism and Leisure**- Revenue Forecasting and Unit Pricing
- **Power Utilities** –Energy Grid/Dispatch Management and temperature and ppt forecasting
- **Oil and Gas**- Platform scheduling and wave height forecasts
- **Health and EM**-Disease Prediction and Seasonal to interannual ppt forecasts
- **Finance**- Insurance and Underwriting
- **Transport**- Port security, congestion management
- **Construction**- Sustainable Housing and materials

Candidate Industry Trials

Business	Country	Institution	Information Requirements	Needs
Tourism & Leisure	NEPAD Pilot, Tunisia	OTT, Starwood	1-2 week forecast, Seasonal Prediction	More atmospheric and ocean observations-remote sensing
Power & Utilities	Mozambique, Zambia, Zimbabwe (Hydro power)	Zambezi water Authority	Now casting, Event Monitoring, 2-4 day forecasting	More radar coverage, Coastal Buoys & weather stations, Downscaling and models nesting, Bathymetry, Thorpex
Oil & Gas	Nigeria, Algeria	Shell, Sonatrach	Wave, Winds, Storm tracking, Sub-surface currents,	Dispersion Models, more ocean observations, moorings and drifters
Health & EM	Burkina-Faso , South Africa	MDSC, MARA, Medical Centres	Seasonal predictions (Temp, Pres), 1-2 weak forecasts,	Ocean, Global atmospheric observations.
Finance	South Africa	UNEP-FI, GENSEC	Historical Climate Info, Seasonal predictions, 1day -2week forecast	Global atmospheric observations, Remote atmospheric observations
Transport	Abidjan, Accra, Cotonou	Port Athoroties, Container shipping companies	Waves, Currents, Winds, Storms	More Over and In ocean sensors, Improved surface models
Construction	SA	Bouygues, Bovis Lend Lease	Sort term forecasting, Seasonal predictions, Inter-annual (Temp, Pres)	More Over and In ocean sensors, Improved surface models
Mining	SA, RDC	Anglo American Seabed mining companies	Pres, Event monitoring, Now-cast, Waves, surface and sub-surface currents	Spatial resolution models, moorings
Telecoms	JHB	Rascom	Lightning, winds, storms	Lightning networks,

Developing Countries Applications : Cost impacts of climate induced hydroelectric power failure in Ethiopia

(extensions from IRI study)

- Ethiopian Electric and Power Corporation – 97% hydro from Koka Dam
  - Mitigate flash flood hazards and identify periods of water scarcity- risk analysis
  - Incorporate surface variables (ppt, t) into hydrological forecast
  - Skill score of climate forecasts
  - Dam capacity impacted by erosion in basin
  - Flash floods and water releasing schemes from dams by Ministry of Water Resources
  - During drought power rationing leads to revenue loss -Linkage effect of power production and customer revenue loss -$8M, enough to destabilize the economy
- Recommendations
  - EEPCo must include seasonal forecasts into its long term plan
    - Produce power demand scenarios based on seasonal rainfall outlooks
  - Development of future models hydro parameters be included in addition to meteorological variables
  - Combine variability of rainfall and complex topography and behavior of rainfall on subgrid level

Developing Countries Case Studies:Cost impacts of climate induced hydroelectric power rationing in Kenya (IRI study)

- Kenya Power and Lighting Company and KenGen
  - 75% hydro, drought induced rationing decrease to 40% production, emergency power credit of $72M to purchase fuel since no internal source of fossil
  - World bank 47M to import and operate generators
  - Economic losses from rationing and failure $2M/day, KPLC lost 20M /6 mo with expenditure of $141M for fuel
  - 12 hr rationing= massive layoff, 70% manufacturing firms not willing to increase investment if power reliability not addressed
  - Energy crisis loss to economy of $100M/month
  - Drought, deforestation, environmental degradation, poor agriculture practices in catchment areas
  - Low water levels and under performance of turbines, cascade operations sustained thru low level outlet releases
- Recommendations:
  - must include seasonal forecasts into its long term plan
  - Increase rainfall and prediction tools
  - Incorporate soil and evaporation for calculation of water losses

Relative costs for developing and developed Nations

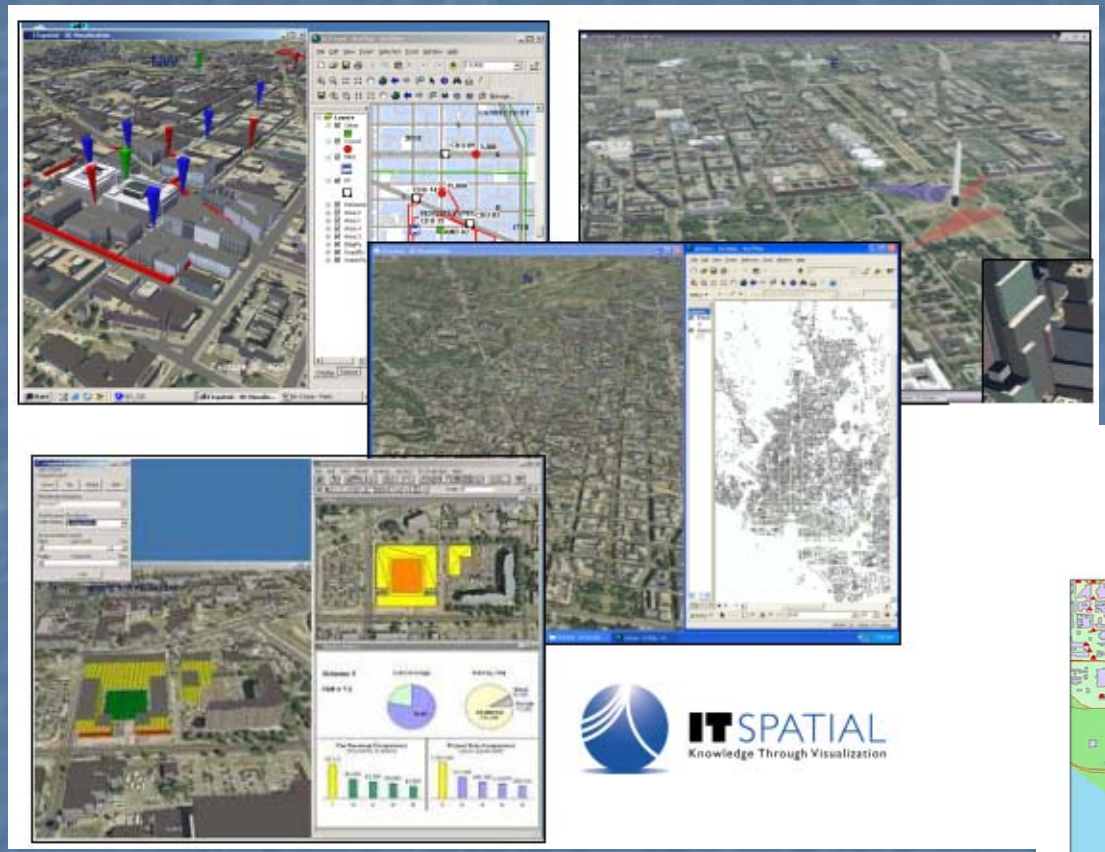
- 8M to Ethiopa is enough to destabilize the economy
- 8M to California causes minor institutional discomfort

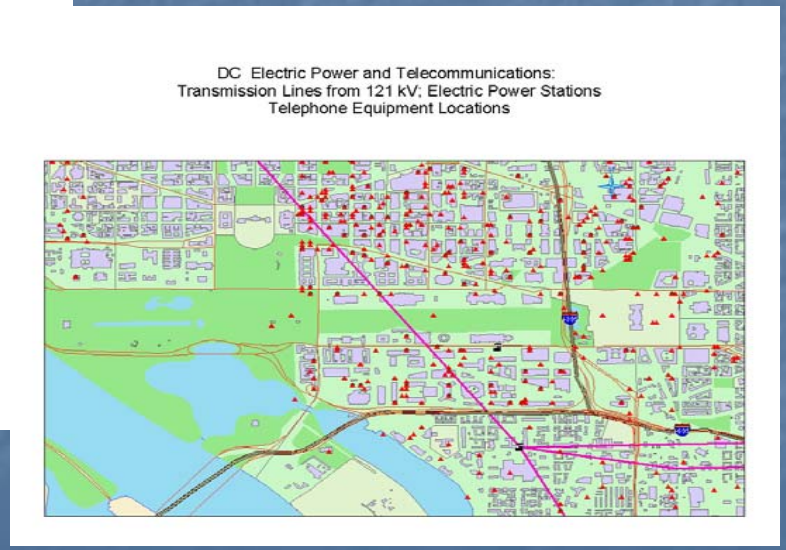
- PRIORITY MUST BE DEVELOPING NATIONS---WHO WILL PAY FOR THEIR COSTS

The Power of Linking Decision Support Tools to get a Solution Set

Severe Weather/Climate/Ocean Forecast +
Impact Assessment on Operations +
Emergency Power Dispatch Management

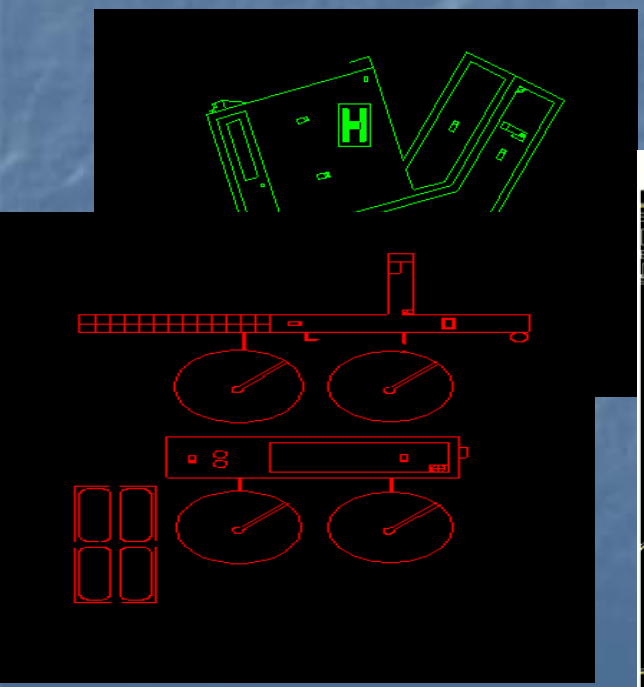
Decision Support Tools Analyze and Inform Decision Making

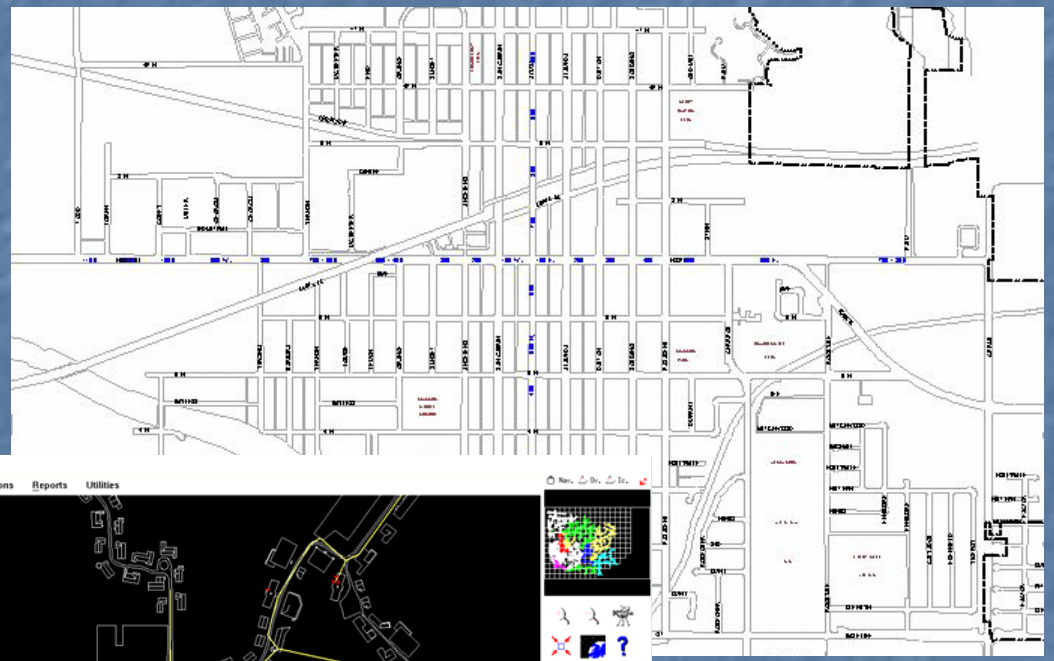


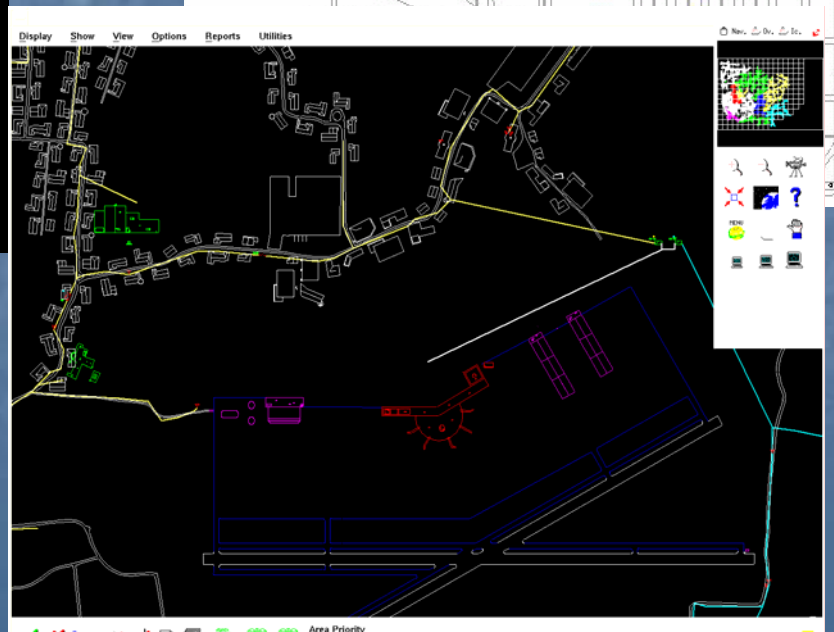


Electricity Visualization and Modeling at the Distribution Level is Essential

- Using the existing GIS from utilities and state & federal agencies
- Import Electrical Data
- Identify Critical Customers
- Assess Consequences
- Improve Mitigation Approaches





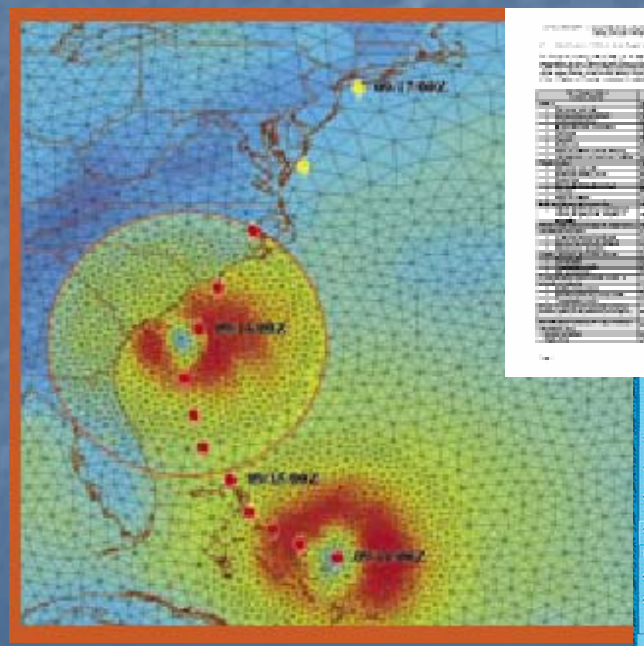


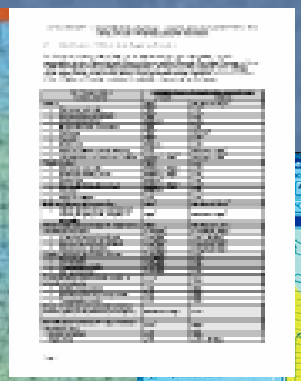
The Solution: Linking Weather Forecast Simulation Tools with Emergency Response Simulation Tools for Severe Weather Emergency Energy Management

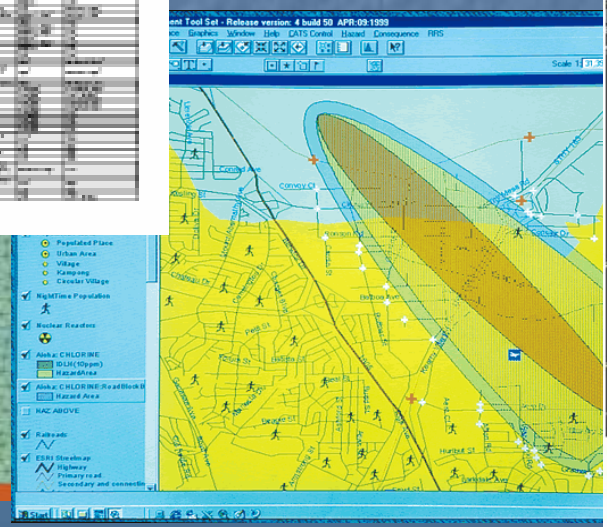
Storm Tracking with simulation tool- predict hurricane landfall

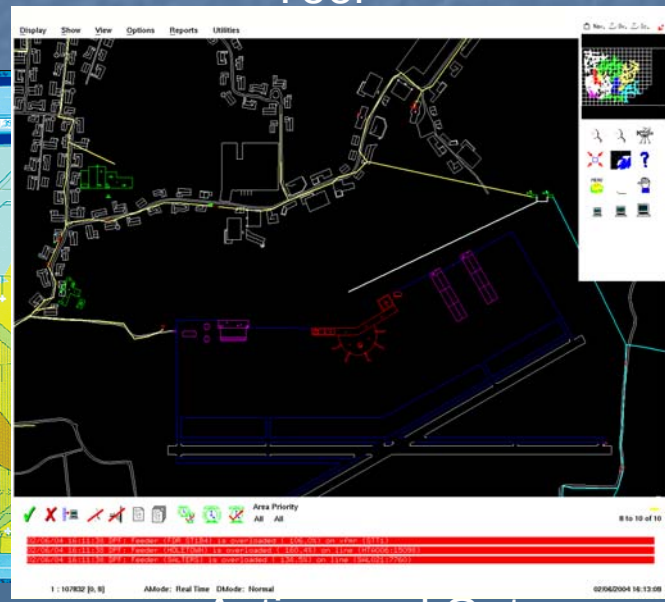
Emergency preparedness with "**CATS" (consequence assessment tool set)** Locate critical energy assets, estimate damage and position for relief

Expert "Grid" Management Situational Awareness and Power Restoration Management Tool







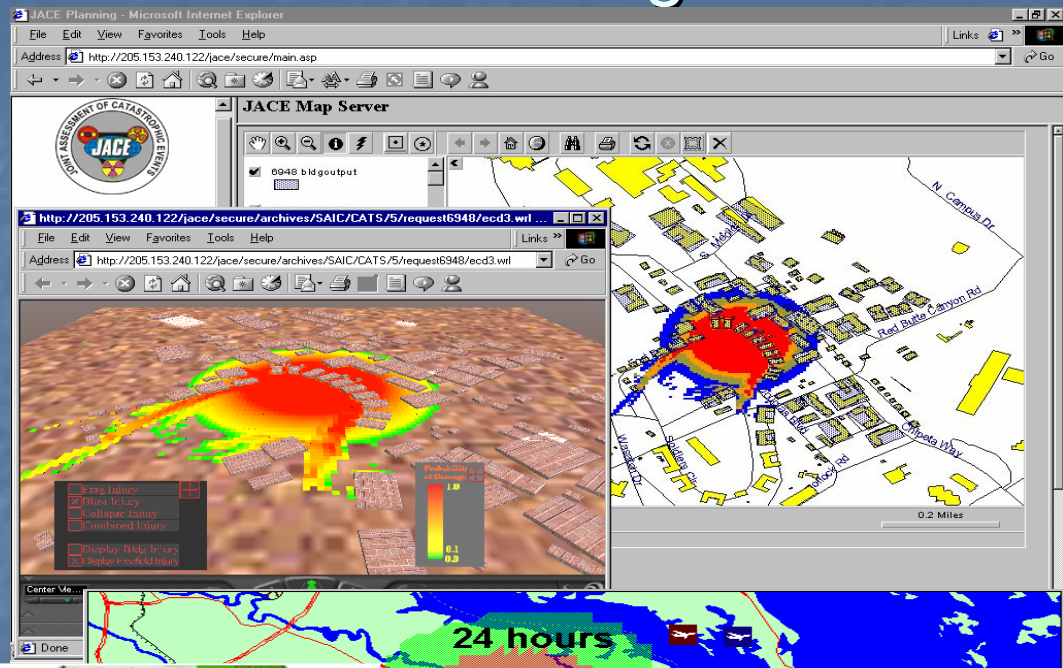


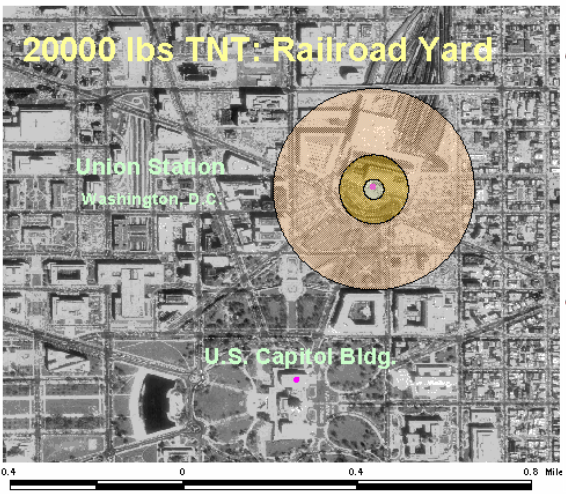
Data-Information

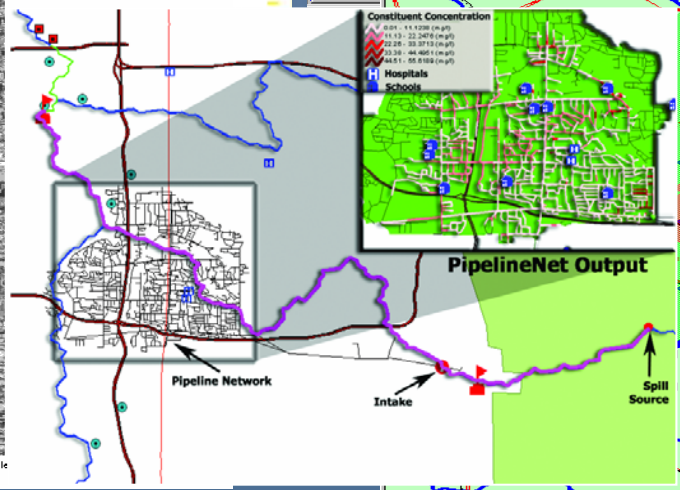
Knowledge

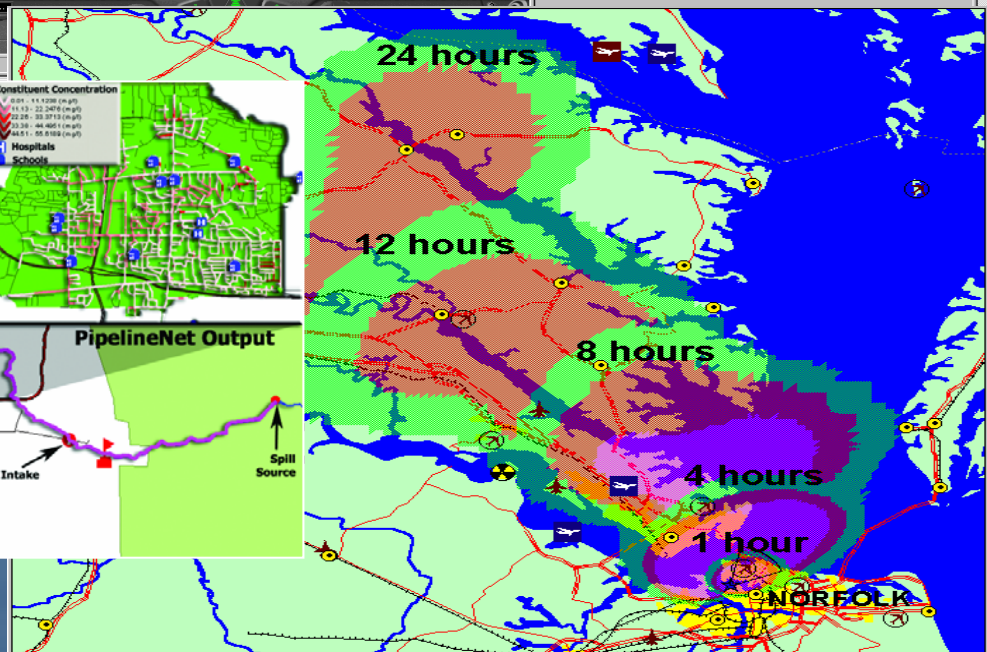
Action and Outcomes

“Chem-Bio Weather” Forecasts and Dispersion Models Predict Hazards and Allows Mitigation









Requirements of the Recreation and Tourism Industry for Weather, Climate and Ocean Information

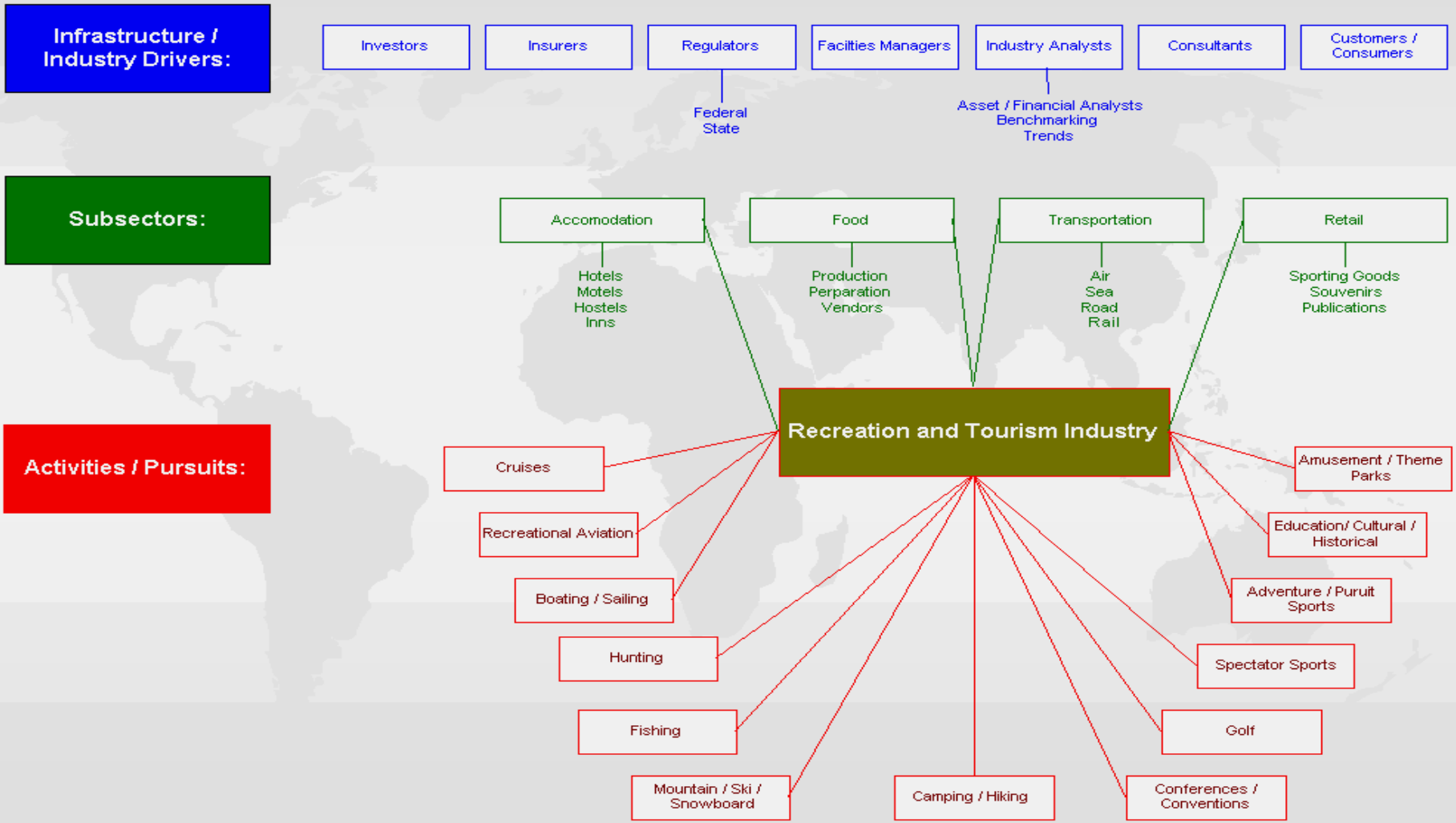
The Industry in Perspective:Global Economics

- *GDP output was $3.5 trillion in 1999;*
- *Accounts for 11 per cent of all international consumer expenditures, 11.3% of all capital investment, 6.7% of all government spending;*
- *Is the world's largest tax contributor with an estimated $800 billion contribution in personal and corporate taxes for 1999;*
- *Accounts for over 25% of the world's trade in services;*
- *Is the world's fastest growing industry, expected to become the largest industry (outside of agriculture) by 2010;*
- *Is the world's largest employer next to agriculture, providing direct or indirect employment for 200 million people or one out of every 12 workers.*
- *The U.S. and Europe dominate the list of the 15 most important tourism destinations in terms of total receipts (9 out of 15 destinations);if tourism is considered on a per capita basis, the countries of the Caribbean constitute a significant portion of the market.*

Structure

1. Hospitality
   - Food service
   - Accommodation
2. Distribution
   - Travel Agents
   - Tour operators
3. Transport and Infrastructure
   -Aviation
   -Marine
4. Visitor Attractions
   - Man-made (theme parks, marinas, golf courses)
   - Natural (e.g. natural parks, coast, lakes)
5. Host city/infrastructure
   - Olympics

Complexity


Infrastructure / Industry Drivers:
Investors
Insurers
Regulators
Facilties Managers
Industry Analysts
Consultants
Customers / Consumers
Federal
State
Asset / Financial Analysts
Benchmarking
Trends
Subsectors:
Accomodation
Food
Transportation
Retail
Hotels
Motels
Hostels
Inns
Production
Perparation
Vendors
Air
Sea
Road
Rail
Sporting Goods
Souvenirs
Publications
Recreation and Tourism Industry
Activities / Pursuits:
Cruises
Recreational Aviation
Boating / Sailing
Hunting
Fishing
Mountain / Ski / Snowboard
Camping / Hiking
Amusement / Theme Parks
Education/ Cultural / Historical
Adventure / Puruit Sports
Spectator Sports
Golf
Conferences / Conventions

Environmental Information in Policy and Planning of the Tourism Industry

Federal & State Planners, Regulators, International

State Recreation Plans
Building Codes, Tax Rules

Tactical Planning

Commercial Resort and Recreation Planners, Architects, Landscape Architects, Designers

Funders, Investors Owners,Shareholders, Developers Finance developments, Design facilities, Building and Construction Financing

Builders, Construction companies, Port Developers

Strategic Planning

Accommodation, Hotel managers, Franchises, 'Chain' operators, Restaurants,Cruise lines, Resort managers

Support and Subsidiary Organizations
DMOs, Insurers, Retailers, Services (e.g. laundry)
Business Consultants, Trainers, Research Organizations
Industry Organizations, Trade Associations,NGOs

WHO IS REGULATED?
(thus compliance reporting)

- Developers and planners;
- Transportation services, including airlines, car rental companies, rail services, urban mass transit, etc.;
- Hospitality industries, both lodging and restaurants;
- Community attractions;
- Parks and public lands;
- Amusement parks and theme parks;
- Winter resorts;
- Beach resorts;
- Cruise ships and boating;
- Professional and amateur sports organizations, including sports facilities;
- Travel Agents; and
- Destination management organizations (DMOs).

Examples of What Is Regulated in Resort Construction Industry?

- ***Snow Loads.*** Depending on the location and altitude, rules determine the loads for which structural systems will need to be designed. Increases in design loading can improve project feasibility. In the continental U.S., design loads go as high as 100 pounds per square foot. Alaska has design values ranging from 25 to 300 pounds per square foot.
- ***Wind.*** Codes addressing wind conditions generally apply to winds reaching 55-year storm speeds measured at a height of 33 feet above ground level. Wind speed requirements are categorized into four levels, Exposures A through D. More stringent requirements are places on higher portions of buildings that consider both wind pressure and gusting..
- ***Floodplains.*** Floodplain development is regulated by the Federal government under a number of rules, including Executive Order 11988 on Flood Plain Management (May 24, 1987). Federal law excludes new projects constructed in designated floodplains from receiving aid or assistance through federal flood relief programs, and many zoning ordinances prohibit new construction or reconstruction in floodplains.

What environmental aspects are regulated

pollution control laws relating to water and air quality;

- wetlands permitting and regulation;
- coastal zone development regulation;
- protection of marine resources;
- water conservation;
- stormwater runoff regulation;
- management of natural resources;
- protection of endangered species;
- marine pollution regulation;
- solid waste management and recycling laws;
- hazardous waste management;
- energy use and conservation;
- noise pollution;

environmental impact assessment under the National Environmental Policy Act and related State laws [42 U.S.C. §§4321-4370d; see California Environmental Quality Act (CEQA), Cal. Pub. Res. Code §21000 et seq.]

Weather, Climate, and Ocean Sensitive Recreation and Tourism Operations

Property: Hotels, Resorts, and Accommodations

- Determining rack rate and discount rates
- Maximizing RevPar
- Gaining optimal occupancy
- Setting budgets
- Determining reservation/cancellation policies
- Obtaining insurance/decide on level of self-insurance
- Purchasing equipment
- Selecting suppliers
- Attracting visitors
- Sending out Press Releases countering weather misinformation
- Deciding where to site a new development or acquisition
- Determining and complying with building regulations
- Deciding on building materials
- Maintaining buildings
- Planting and maintenance of landscape
- Regulatory compliance
- Determining energy loadings
- Maintaining comfort levels
- Fine tuning engineering systems
- Setting mechanical/electrical engineering specifications
- Applying agri-products
- Formulating internal environmental policies
- Ensuring health and safety of staff and guests
- Identifying risks to life, property, equity, reputation
- Managing and mitigating risk
- Formulating emergency preparedness measures
- Planning daily guest activities
- Whether or not to discount (offload stock)

Insurance

- Deciding if a property is 'insurable'
- Determining premiums
- Determining deductions
- Inspecting properties
- Issuing 'Cat Alerts'
- Ensuring under-exposure of total potential liability

Sports Events

- Submitting bids to host events/conferences/conventions/expositions
- Selecting venue for event (e.g., indoors, outdoors; region, state, city)
- Scheduling of events (year, month, day, time)
- Snowmaking
- Open or close the ski lift
- Turning on underground pitch heating

Maritime and Cruise Industry

- Seasonal/yearly schedule
- Expansion into new areas
- Route planning
- Safety
- Pricing
- Vessel maintenance
- Port to go to
- Guest activities
- Compliance with regulations

Aviation

- 'Go' or 'No Go' decisions
- Preparing aircraft for takeoff
- Preparing aircraft for landing
- How much fuel to load
- Route planning
- De-icing requirements
- Ensuring safety
- Tying down aircraft
- Moving light aircraft to shelter

Emergency Management

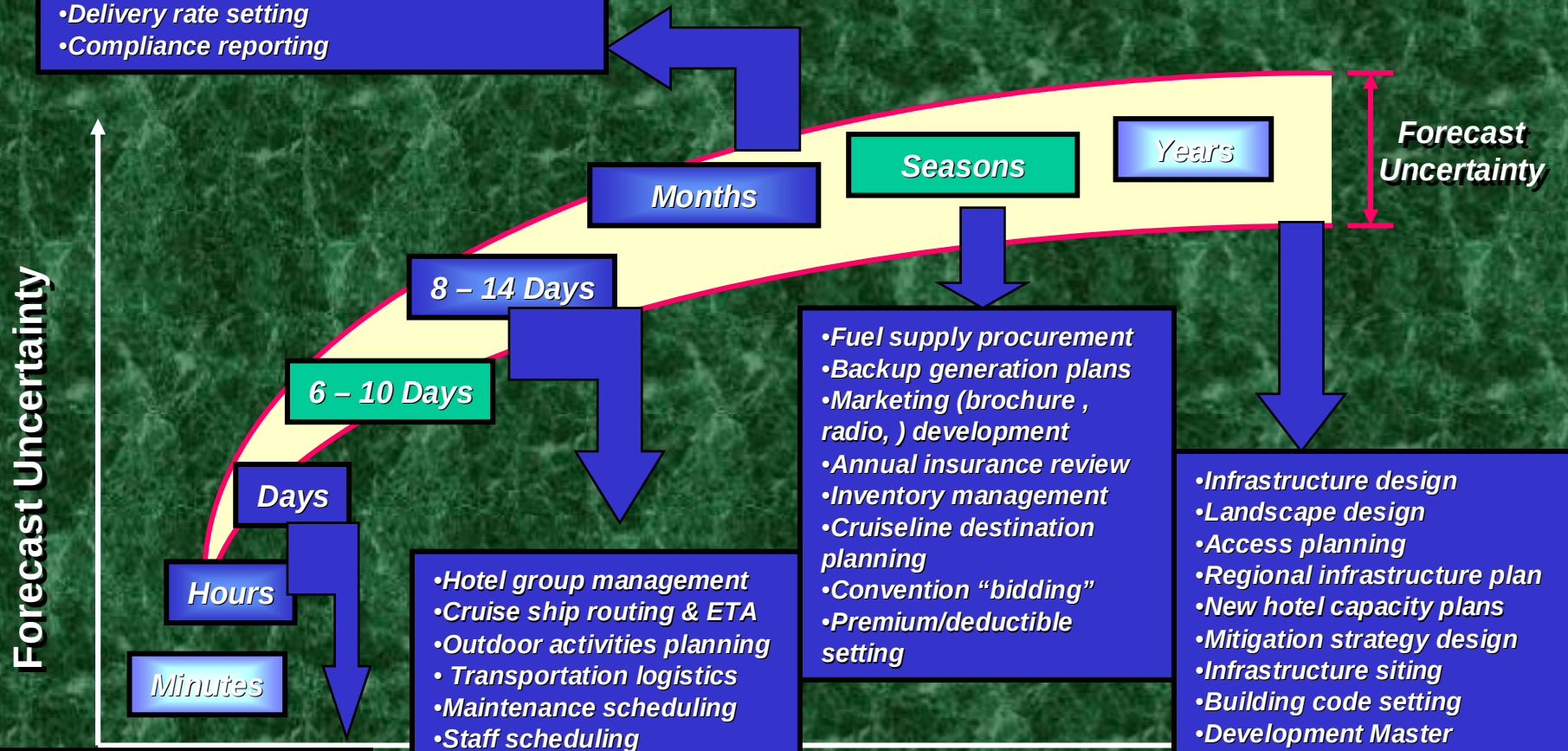
- Formulation of emergency plans
- Mitigation measures
- Provisions (issuance of warnings, supplies, services, etc.)

Global Concerns

- Greenhouse gas emissions
- Safeguarding reputation risk
- Participating in hotel industry Environmental initiatives (e.g., IHEI, etc.)
- Globalization and harmonization across group regions (e.g., hotel groups)
- Recession of economies in visitor source areas
- Cross border liability issues
- Shareholder/stakeholder pressure
- Consumer pressure

Recreation/ Tourism Operations Aided by Reductions in Environmental Forecast Uncertainty

- Sales/earnings forecasting
- Stock pricing
- Food service/supply procurement
- Group properties budgeting
- Unit price setting
- Rev par estimation
- Seasonal "occupancy" forecasts
- Delivery rate setting
- Compliance reporting



- Fuel supply procurement
- Backup generation plans
- Marketing (brochure , radio,) development
- Annual insurance review
- Inventory management
- Cruiseline destination planning
- Convention "bidding"
- Premium/deductible setting

- Infrastructure design
- Landscape design
- Access planning
- Regional infrastructure plan
- New hotel capacity plans
- Mitigation strategy design
- Infrastructure siting
- Building code setting
- Development Master planning and revisit\
- Regional Policy plans
- Federal Policy Development

- Hotel group management
- Cruise ship routing & ETA
- Outdoor activities planning
- Transportation logistics
- Maintenance scheduling
- Staff scheduling
- "Conditions" forecasts

- Building energy mngt.
- Disaster risk mngt.
- Daily staff briefings
- Daily guest information
- "Intelligent" infrastructure
- Cruiseship positioning
- Snowmaking

RECREATION & TOURISM INDUSTRY PERFORMANCE METRICS: The Business Models

Revenue per available room (RevPar)	Accommodation sector
Occupancy rates	Accommodation sector
Occupancy percentage	Accommodation sector
Average Daily Rates (ADR)	Accommodation sector
Comparative Operating Rates (COR)	Accommodation sector
Gross Operating Profit (% before fees)	Across the industry
Economic Impact Assessment	Across the industry
Financial rate of Return (FRR)	
Economic Rate of Return (ERR)	
International arrivals[1]	Travel sector
Journeys made	Travel sector

Environmental Information in the Operational Business Models

- Average daily temperature
- Average Annual temperature
- January rainfall in inches
- July rainfall in inches
- Snowfall in Inches
- Number of Heating degree-days (Last 30 years)
- Number of Cooling degree-days (Last 30 years)
- Wind speed in Miles per Hour (Annual average)
- Annual number of days sunny or partly sunny
- Elevation (Mean feet above sea level)
- Wave height
- Current speed and direction

Case Studies in the Tourism Industry

"INDUSTRY TRIALS"

Observing System Product Performance Assessment in Business Operations and Policy Development

Utilities-Energy Pricing & 4hr forecasts of temp./ sea breeze - Scottish Power

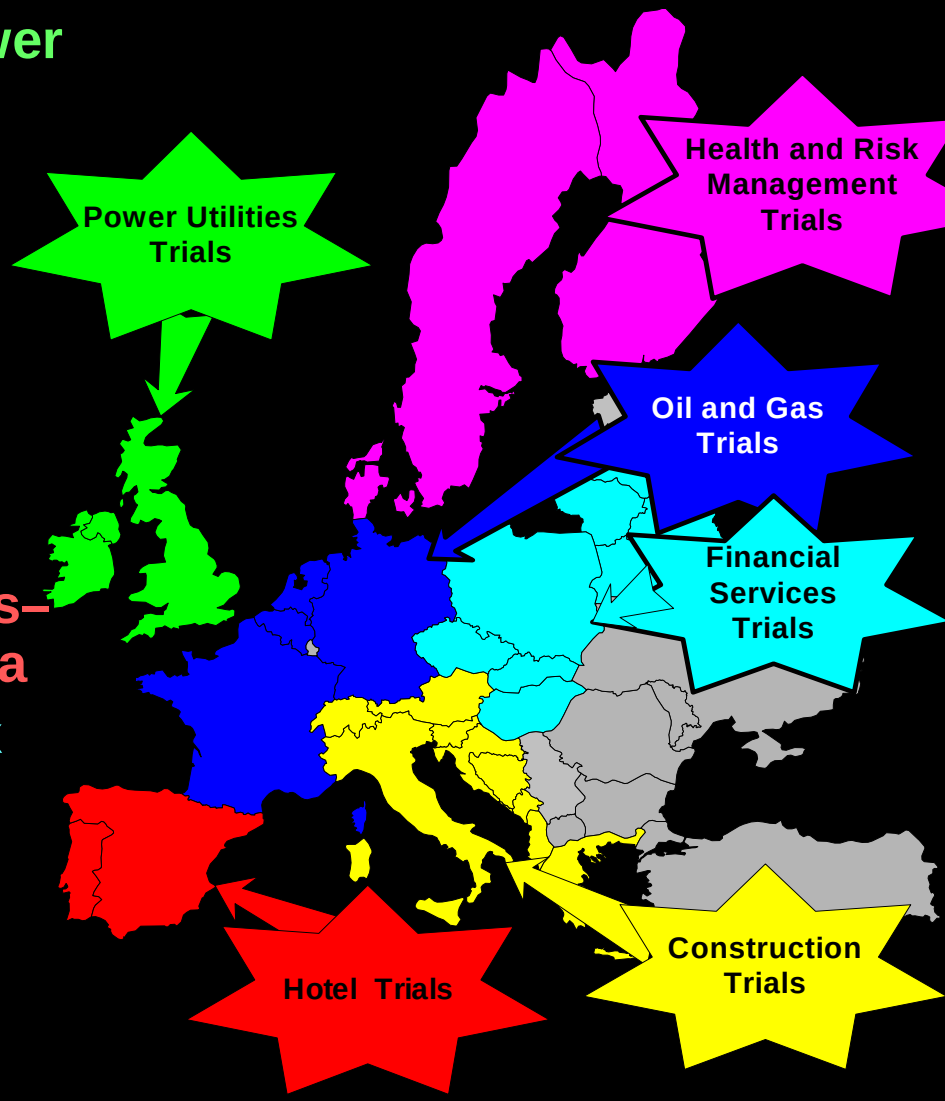
Oil and Gas- Regional Energy infrastructure master planning and climate/ocean conditions - BP

Construction- Building codes & standards with 20 year heat/ precipitation/sea level forecasts- Building Research Establishment

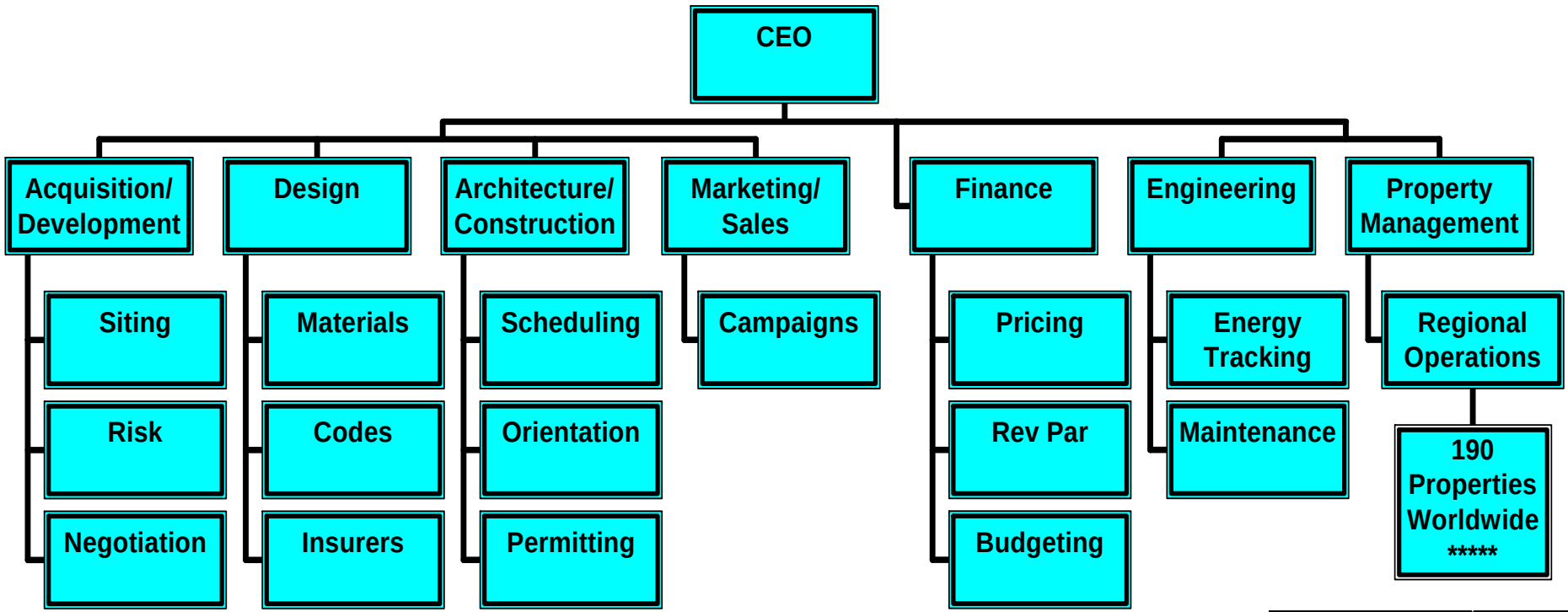
Leisure - Revenue projections and seasonal temperature/ppt forecasts– The Starwood Group, Europe/Africa

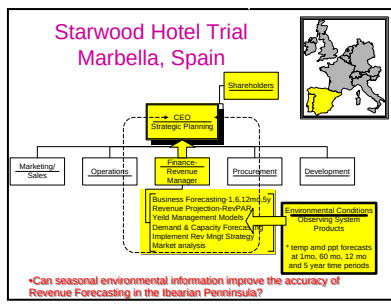
Finance – Financial Risk Rating Index and air/water quality and climate forecasts- SERM Rating Agency

Health and EM- Coastal metropolitan health alert planning and met/AQ forecasting

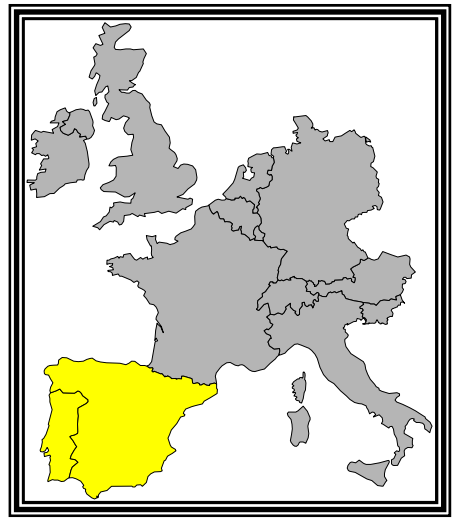


Value Chain Organization of Starwood: Business Units & Functions Requiring Environmental Information





Starwood Hotel Trial
Marbella, Spain



Shareholders

CEO
Strategic Planning

Marketing/
Sales

Operations

Finance-
Revenue
Manager

Procurement

Development

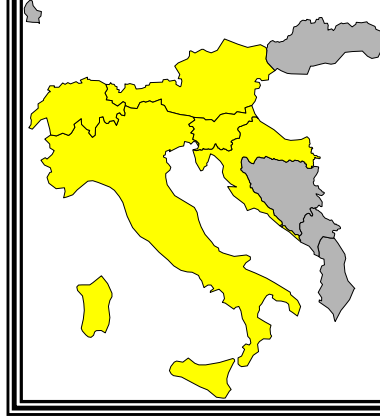
Business Forecasting-1,6,12mo,5y
Revenue Projection-RevPAR
Yeild Management Models
Demand & Capacity Forecasting
Implement Rev Mngt Strategy
Market analysis

Environmental Conditions
Observing System
Products

* temp amd ppt forecasts at 1mo, 60 mo, 12 mo and 5 year time periods

•Can seasonal environmental information improve the accuracy of Revenue Forecasting in the Iberian Peninsula?

BRE Trial to Inform Sustainable Construction Policy



Foundation for the Built Environment (NFP parent)

Assembly

European Commission

BRE CEO Strategic Planning

Consultancy

Commissioned Research

Testing

Codes and Standards

Certification

Training

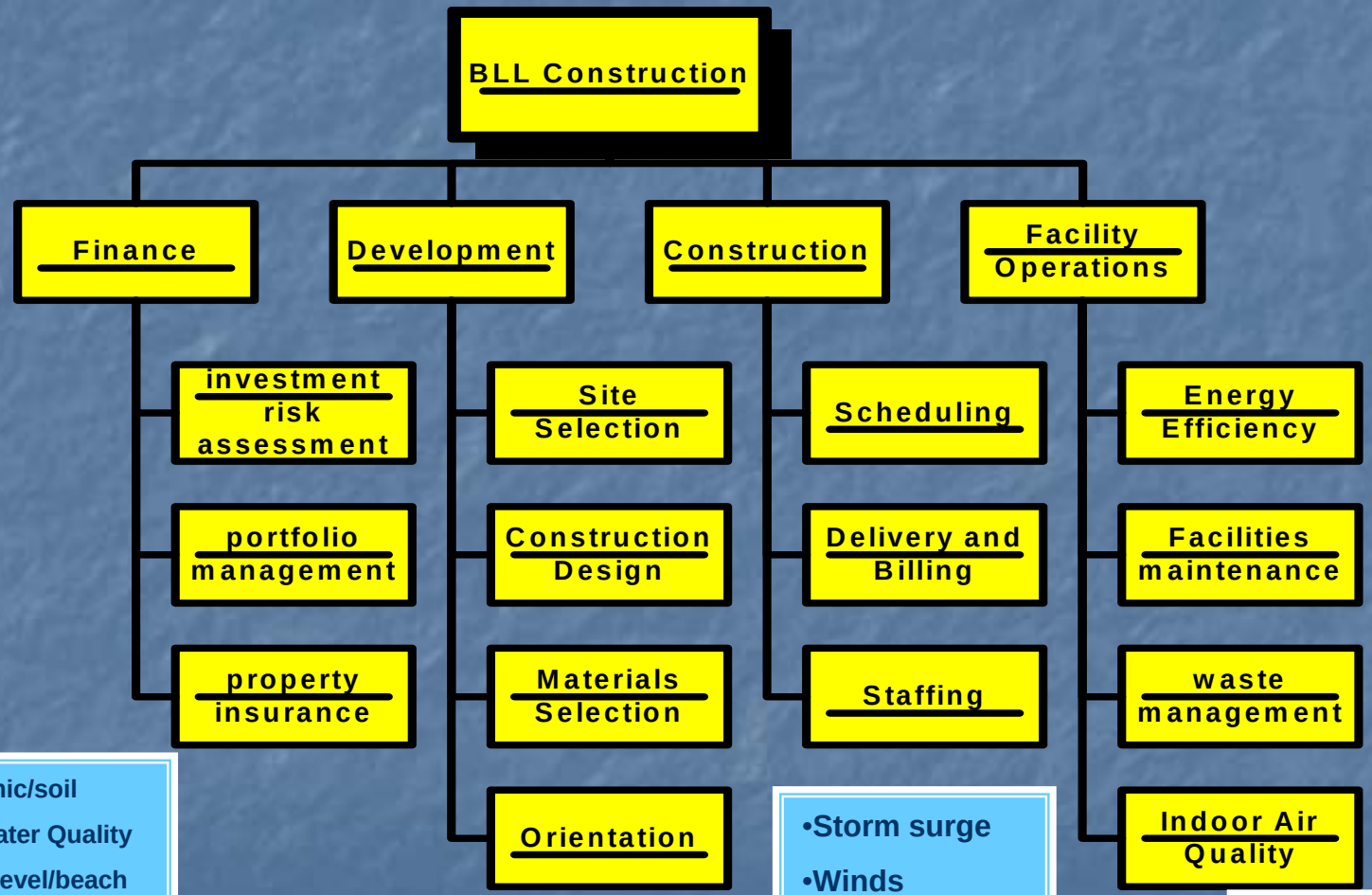
- set up initial conditions
- run tests
- evaluate materials/ design performance
- rate for fire, structural integrity
- input test info into codes development
- interact w/ nations and EC standards oversight bodies

Observing System Products used:

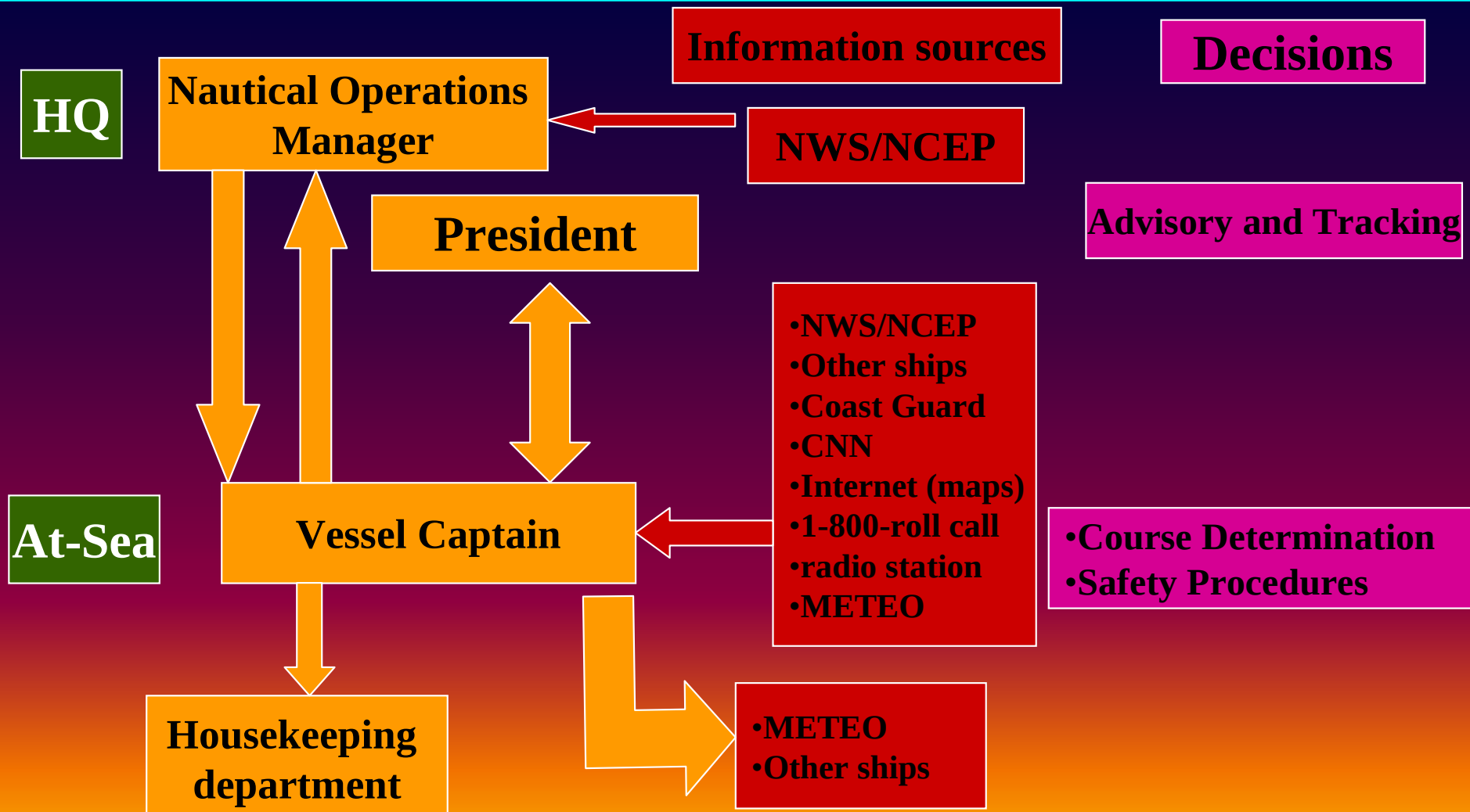
* temp,wind, ppt forecasts at decadal to century scales for Southern Europe

Q? Can the improved regional decadal scale climate forecasts of heat, ppt and wind improve the codes and standards for urban construction in Southern Europe resulting in more sustainable shelter?

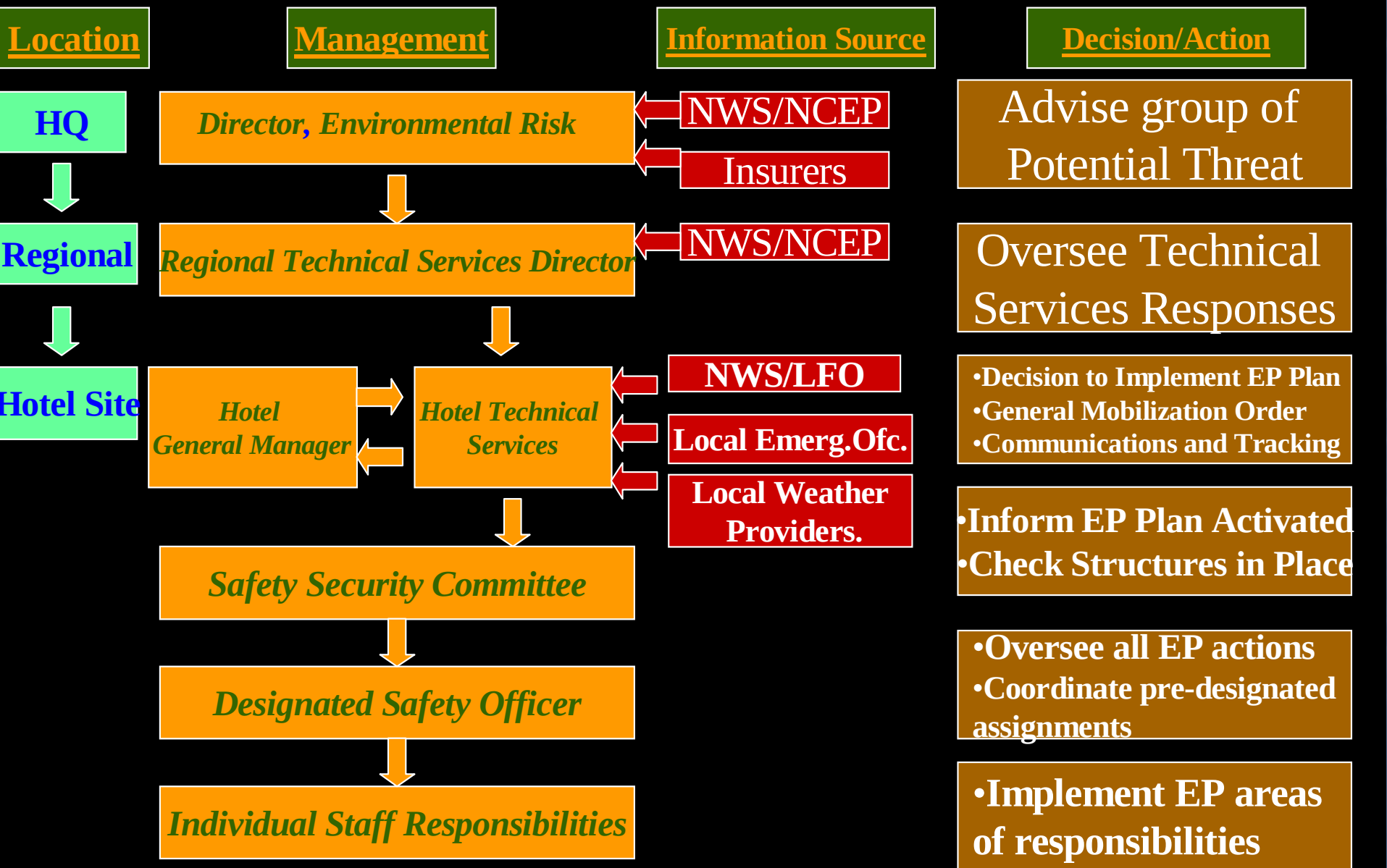
Building Industry Decisions Requiring Environmental Information



Weather and Sea Conditions Information in the Cruise line Management Chain:Tactical Planning

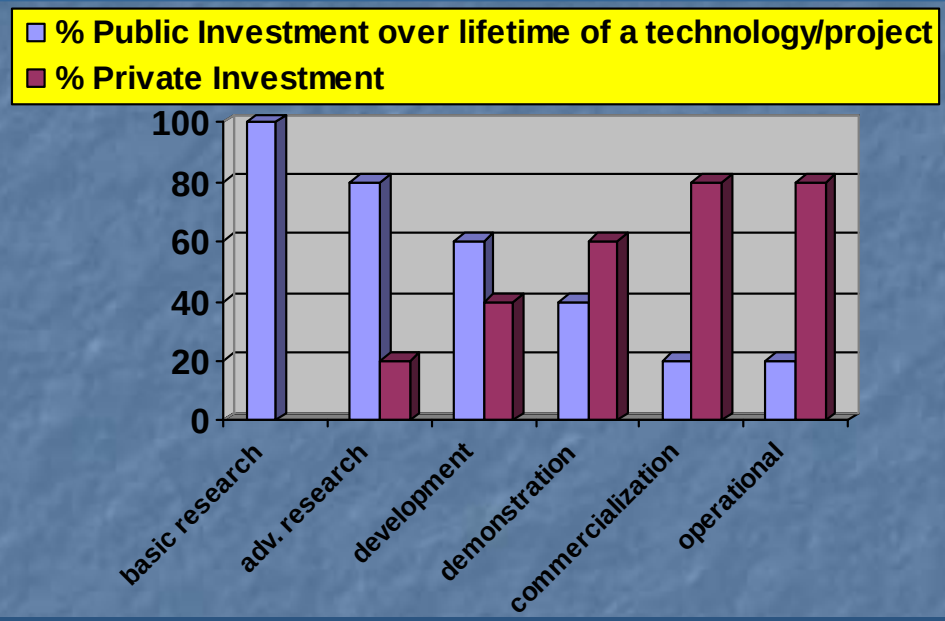


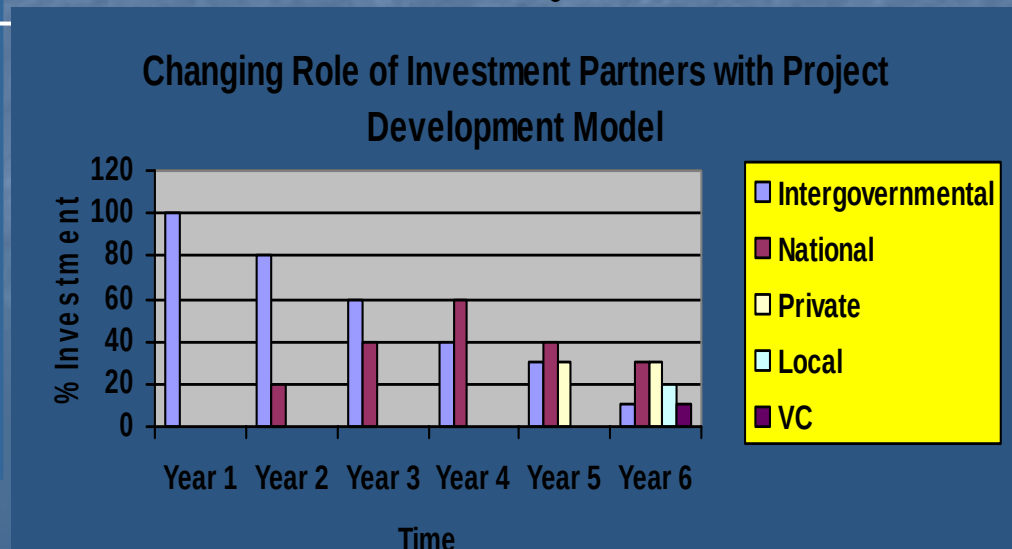
Weather Information Flow in A Coastal Hotel Risk Management Chain



Challenge:Develop a Sustained Investment Strategy for Observing Systems

- This defines
  - ***PLAYERS/PARTNERS*** usually consisting of foundations, inter-governmental aid agencies, national science agencies, social and economic agencies, the private sector and venture capitalists
  - The ***ROLE*** of the players with risk/maturity of project and time. Possible continued reduced level of public funding if in public good (global commons).
  - Allows the players sufficient lead time to acquire resources- in other words, to plan.





Changing Nature of R&D

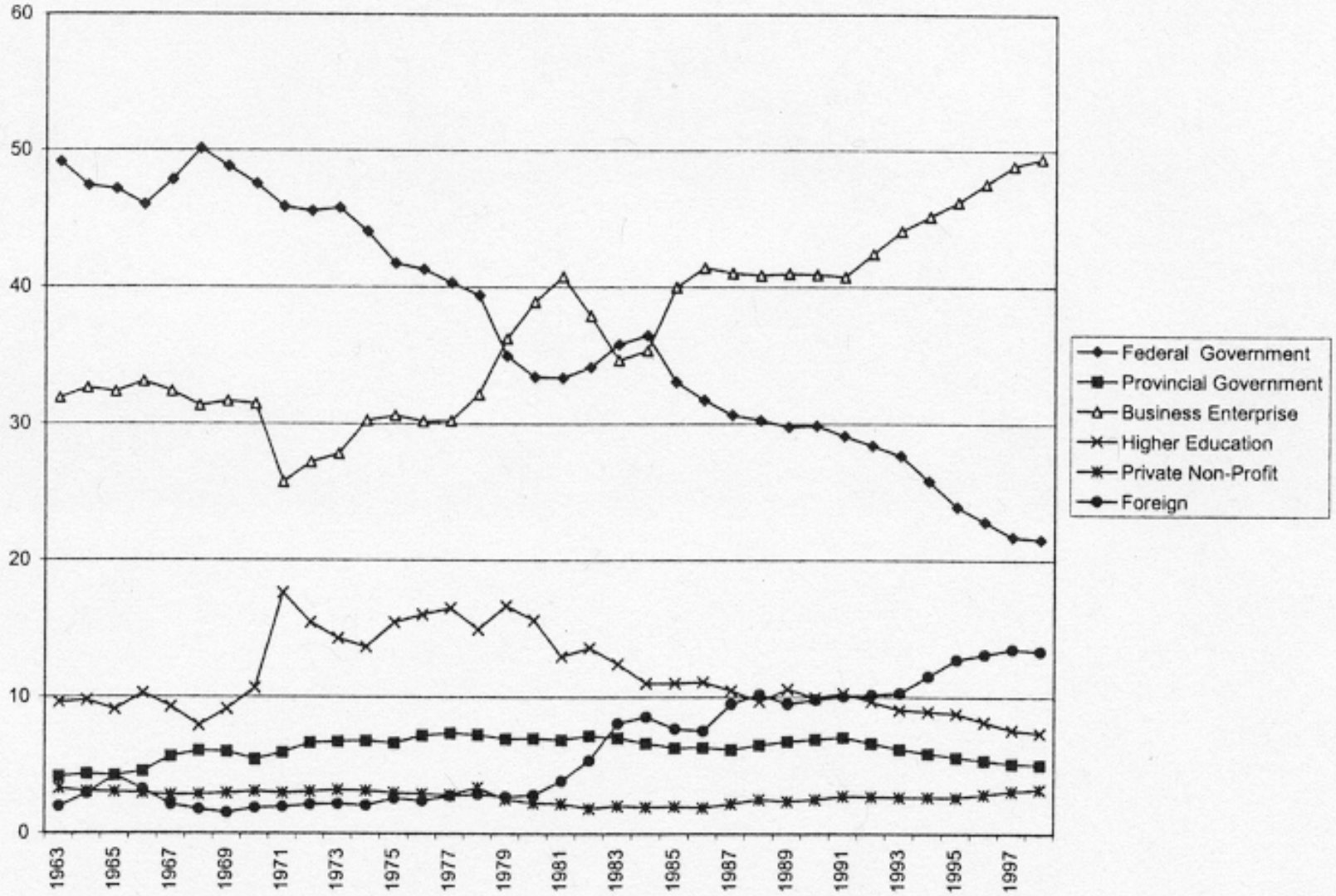


FIGURE 2. The distribution, by source of funding, of Canada's gross expenditure on R&D, 1963–1998.

Source: Statistics Canada, Estimates of Canadian Expenditures on Research & Development (GERD), various years.

Conclusions

- GODAE provides situational awareness to enable optimal operational management, strategic planning and policy support to the business community thus enhancing the development of national economies to meet their individual development goals.
- Retrospective analysis of the dependencies of metocean events with business performance can help set priorities for research with potentially high payoff to society
- Beta Testing of new environmental information products through an industry trials approach can lead to the rigorous estimation of the costs associated with the incorporation of the new information
- Impact of new information is highest in developing nations