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Emission Assets: Changing the Competitive Landscape of the European Power Market

Real estate agents refer to "location, location, location" as the key determinant of value for properties in the housing market. European power generators quickly are becoming familiar with a different kind of property value: emission assets. For power generators participating in the European Greenhouse Gas (GHG) Emissions Trading Scheme (to be launched in January 2005), "allocation, allocation, allocation" will be the key to unlocking value to the emission assets.

The "value at stake" for players having to operate under carbon constraints in the European power generation sector is, without question, financially significant. Our analysis illustrates that GHG emissions policy may well be the biggest determinant of power plant asset



Drax is the largest coal-fired plant in Western Europe, and produces more than eight percent of all electricity generated in England and Wales.

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Measuring the Economic Costs of Terrorist Attacks

A terrorist attack can lead to significant economic losses, both as a direct consequence of the attack, as well as through the secondary or ripple effects felt around the affected region.

A recent White House report, *The National Strategy for Physical Protection of Critical Infrastructures and Key Assets*, calls for efforts to "develop economic models of near- and long-term effects of terrorist

attacks." The report highlights the temporal and cross-sector complexities of modeling such economic damages because the ripple effects across sectors and geography may be significant although difficult to predict. ICF Consulting, in collaboration with Regional Economic Models, Inc. (REMI), is exploring methodologies and models to measure such potential economic damages.

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In Search of Electricity Transmission Capitalists: “Capex Conundrum” Facing Transmission Investments

How can we build more U.S. electricity transmission capacity and who’s going to pay for it?

This is a key question vexing the power industry these days. In addition to traditional needs for retrofits to maintain reliability, the formation of Regional Transmission Organizations (RTOs) will stimulate more transmission capacity to upgrade existing lines, support economic transactions, and build more electric “bridges” between regions. Eliminating congestion and accessing lower-cost wholesale power supplies will become of co-equal importance to reliability. The transmission investment mix will change.

Do we need more transmission?

Consider the following statistics:

- Congestion in the most developed market, PJM (a power pool in the mid-Atlantic region of the U.S.), has quadrupled since 2000
- Unfulfilled wholesale transactions increased five-fold in 2002 compared to 1998

- Transmission investment has fallen \$115 million per year for 25 years
- PJM, New England, and New York can only transfer 5-10 percent of their peak loads between them

In total, we may need \$30-60 billion in new transmission investment over the next decade.

Can we rely on traditional sources of capital to fill this gap?

It appears traditional sources of capital will not fill the investment gap for the following reasons:

- Utility bonds may be considered unattractive because there were 12 downgrades for every upgrade in 2002
- Industry financing fell from \$86 billion in 2001 to \$74 billion in 2002
- Electric utility stocks fell 24 percent in the past year
- More than \$25 billion of utility holding company debt is coming due in 2003

If not utilities, who will invest in transmission?

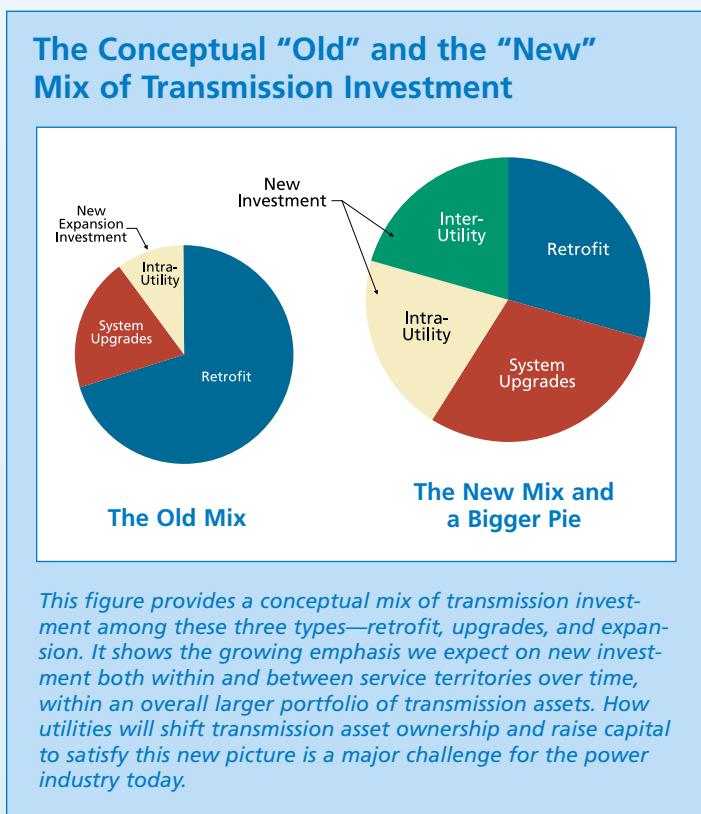
The answer: a wide range of equity investors, depending on project type, investment stage, and likely returns. Third-party transmission financing in North America primarily will fund discrete upgrades and expansion projects with defined revenue streams. Several billion dollars are available for new transmission for the right opportunities from some sources new to utilities. The figure on page 3 shows potential sources and their interests.

This expansion of the capital pool will require new transactions and project structures as transmission owners try to blend corporate and public finance with project-oriented, private sources. This expansion is the best near-term hope for filling the “capex gap.” These sources should partner with utilities for regulatory and rights-of-way reasons.

Will we achieve sufficient investment in transmission?

It is unclear whether an expanded capital pool as described above would provide sufficient investment, but to answer “yes,” we envision several techniques working to reach that goal.

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In Search of Transmission Capitalists... (cont. from page 2)

Potential Sources and Priorities of Capital for Transmission

| Potential Sources | Dividends | Stable Cash Flow | Equity Participation | Value Appreciation | EPC, O&M Contracts | Management Fee | Regulation (Fed & State) | ST Perspective | LT Perspective |
|--------------------------------|-----------|------------------|----------------------|--------------------|--------------------|----------------|--------------------------|----------------|----------------|
| Transmission Companies | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Private Equity | | | | | | | | | |
| Pension Funds, Endowments | | ✓ | ✓ | ✓ | | | ✓ | | ✓ |
| Investment Firm | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| Asset Management Firm | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| Participant Funding | | | | | | | | | |
| LSEs, IPPs, Industrials | | ✓ | ✓ | ✓ | | | ✓ | | |
| Leasing Companies | | ✓ | | | | | ✓ | | ✓ |
| Engineering, Construction, O&M | | | ✓ | ✓ | ✓ | | ✓ | ✓ | |
| Public Markets | | | | | | | | | |
| Stocks | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | |
| Bonds | | ✓ | | | | | ✓ | | ✓ |
| Structured Finance | | | | | | | | | |
| Partnerships | ✓ | ✓ | ✓ | ✓ | | | ✓ | | ✓ |
| Debt Finance | | ✓ | | | | | ✓ | ✓ | ✓ |

- Transmission costs rise to cover new investment, but lower customers' bills overall
- Strong RTOs, ITCs, and financial incentives to encourage transmission
- For national security or the economy, the U.S. Administration could serve as a catalyst for transmission investment

Given the current state of the transmission system, the benefits of new transmission would far outweigh its costs if those investments are well targeted. As with an insurance policy, having too little transmission is a risk. It is possible to solve the Transmission Capex Conundrum in the relatively near term, but only with new deal structures and sources of capital.

- An increasing share of new investment from non-traditional sources
- More utilities deciding to sell or contribute transmission assets to independent transmission companies (ITCs) and private firms

An expanded version of this article was published in the April 2003 issue of *Public Utilities Fortnightly* and can be viewed at www.icfconsulting.com/transmissionarticle.

For more information on ICF Consulting's energy capabilities, please visit www.icfconsulting.com/energy

Innovations in Grants Management

Government and private organizations alike struggle with effectively processing large quantities of information and financial transactions among dispersed user communities. Many are still trying to translate old paper-based processes to computer and Internet technologies. One area where the U.S. Government struggles is the management of tens of thousands of annual grants (totaling more than \$300 billion a year) to state and local communities. The U.S. Department of Justice's Office of Justice Programs

(OJP) has one of the most complex challenges as it administers more than \$6 billion in funds and processes more than 10,000 grant applications annually in support of state and local law enforcement initiatives. The bar has been raised further as a new law requires federal agencies to streamline the grants process to increase qualified applications, reduce the burden on applicants, shorten the time to award, decrease administrative costs, and enhance mission fulfillment.

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Emission Assets... (cont. from page 1)

value in Europe for several years to come—given the concomitant and substantial impacts on wholesale power prices, fuel mix, generation mix, and renewable energy premiums. In an emissions trading system, companies are assigned emission targets and can sell or purchase allowances to help meet their targets. With so much value at stake, power generators can little afford not to analyze the options for permit allocation—a decision which, based on the European Union’s principle of subsidiarity, is left to individual Member States.

With so much value at stake, power generators can little afford not to analyze the options for permit allocation.

The introduction of GHG emissions constraints throughout the European Union power sector will add significant extra costs to power generation, increase power prices, accelerate the shift to natural gas, and have dramatic consequences for the commercial viability of existing power stations in the region. In many cases, depending upon the allocation method selected, it will alter the relative competitiveness of specific power plants.

The scale of financial implications for power generators will vary considerably by country because of the differences among countries in how well they are meeting their emissions reduction targets. Regardless of one’s country of focus, however, the potential value-at-stake from decisions regarding emissions permit allocations can be calculated from a few simple assumptions.

Let us assume that the United Kingdom decides to use a reference year in which efficient coal plants are running at high load factors and the quantity of emissions permits given covers a high proportion of the output. Both of these seem reasonable given the political affinity towards coal in the UK and the UK’s relatively good position in reaching its carbon emission reduction targets.

Running baseload, a coal plant will emit approximately 8,000 tons of carbon dioxide (CO₂) per mega watt (MW) each year. If permits are given to cover 70 percent of emissions, that equals 5,600 tons per MW. An assumed carbon emission permit value of 5 Euros per tonne (at the lower end of market expectations) gives a value for carbon emission permits of 28,000 Euros per MW per year. Put in terms of the Drax power plant, one of the UK’s best known plants, that is more than 100

million Euros each year. The minimum period for which permits likely are to be allocated is a pilot period of 2005-2007, followed by a second phase from 2008-2012, and the value of carbon emissions is expected generally to rise through time.

Will the value of carbon emission permits received be offset by the cost of buying permits to cover generation by the plants? No. Power generators and traders are sophisticated enough to see the opportunity cost of carbon emission permits and factor it into the price at which they will sell electricity. This means that the electricity price will rise to offset this extra cost. If the UK market were starting at nearly an equilibrium position, then new gas-fired generation would come onto the system as prices rise, and this would limit the increase (gas-fired plants have lower carbon emissions per unit output than coal). However, with the current excess capacity in the UK market, there is plenty of room for prices to rise before new plants will be competitive with existing coal-fired generation.

Even without including the value of emission permits received, many power stations in the UK will make more money with carbon emissions trading. This is because the marginal plant on the system is generally less efficient than other

The profit increase for viable plants likely is to be reinforced as carbon emission costs accelerate the closure of marginal capacity.

operating power plants. As the marginal plant adds its cost of emissions into its bids, the resulting price rise is greater than the additional costs faced by most of the infra-marginal power stations. As prices rise more than costs, profits will increase. The effect will be most evident for nuclear and hydro plants, which will incur no carbon emissions costs. The profit increase for viable plants likely is to be reinforced as carbon emission costs accelerate the closure of marginal capacity—thus, bringing the market back into balance and strengthening wholesale prices. Closure decisions may, however, be affected by the mechanism chosen for permit allocation; if power plants are granted their permits on the condition that they remain operational, this secondary effect will be less pronounced.

The plan for allocating emission permits among affected installations will be set by all Member State Governments before March 2004. The European Commission has the

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Emission Assets... (cont. from page 4)

right to reject these plans if they appear to violate competitive principles. There are a range of mechanisms that can be used to decide how many permits the power sector as a whole receives vis-à-vis other sectors and on what basis this is split among the power stations. The system for distributing permits will have a direct effect on the value of power plants through the number of permits they receive. There also may be an indirect effect through ongoing distortions to the power market if receipt of future permits is conditional on future operating patterns. It actually is

possible for carbon emissions trading to drive power prices downward if the permit allocation system includes particular features.

In short, the permit allocation mechanism is the critical variable that determines who wins and by how much. Of course, for every winner in the permit allocation contest, there inevitably will be a loser.

For more information on ICF Consulting's energy capabilities, please visit www.icfconsulting.com/energy

Due Diligence in Mergers and Acquisitions: More Than Just Numbers

As part of any financial transaction, it is incumbent upon the potential purchaser to obtain as much information as possible about any entity being considered for purchase, a process known as due diligence. In the case of mergers and acquisitions, due diligence typically is conducted in a number of areas, including financial, human resources, and environmental. Knowing how to quantify the risks and place a true value on assets is paramount to financial success and requires analytical tools and expertise in financial analysis, hydrogeology, regulatory requirements, manufacturing, and environmental engineering and management.

In the case of environmental due diligence, it is critical to conduct a comprehensive assessment that considers both potential liabilities and business operational procedures and risks. ICF Consulting performed a due diligence assessment of a large power generator and transmitter with multiple locations throughout North America in anticipation of a potential purchase by a client.

The purchaser recognized the need for comprehensive environmental assessments of the seller's real property, as well as assessments of regulatory and other risks associated with power generation and transmission companies. Specific questions considered during the analysis included the following:

- What pollution control investments will be needed after completing the transaction?

- How will environmental regulatory policies affect the seller's core markets and the value of assets?
- How is return on investment estimated given volatility and uncertainty in power markets?
- How do environmental, health, and safety issues affect a purchase bid?

Air regulatory risk assessments and power market forecasts were completed using ICF Consulting's Integrated Planning Model (IPM®). The assessment projected the asset value impact of a range of potential environmental regulatory futures, the corresponding control costs, and electric and fuel market dynamics. Alternative control, operation, retirement, and fuel options were optimized to maximize the value and flexibility of the seller's assets. ICF Consulting projected power, fuel, and emissions allowance price impacts that could help offset air compliance costs.

ICF Consulting's proprietary Decision Analysis Tool™ was used to evaluate environmental, health, and safety (EHS) concerns to identify and characterize significant potential liabilities associated with past and current practices at each facility or from off-site locations. Site assessments also were conducted to further characterize the nature and



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Calendar of Events

June

June 26-27

Norman, OK. Tom Gloria of ICF Consulting will participate in a workshop on **Assessing the Sustainability of Biobased Products** at the University of Oklahoma. This two-day international workshop will bring together approximately 35 representatives of government, industry, and the research community to review the state-of-knowledge of the impacts of biobased materials. The workshop will work to build a consensus regarding appropriate methods for assessing the impacts and sustainability of bio-based material use. *For more information, please contact Tom Gloria at 1.781.676.4039.*

June 26-28

New York, NY. At the Center for Business Intelligence's (CBI) conference, **Forum on New York Power Supply**, Judah Rose of ICF Consulting will run a pre-conference workshop titled, "Acquire Financing to Build or Expand New York Power Assets." *For more information, please contact Stacey Hohenberg at 1.703.218.2504.*

June 29-July 2

Ann Arbor, MI. At the **Second International Conference for the International Society of Industrial Ecology**, ICF Consulting's Tom Gloria will present a paper titled, "Climate Change Damage Assessment Using an Input-Output Approach." Similar to Natural Resource Damage Assessments (NRDAs), the climate change damage assessment

(CCDA) method can be used to estimate the monetary cost of corrective action for damage to human and natural resources due to climate change. Damages are evaluated by identifying the functions or 'services' provided by the resources, determining the baseline level of the services provided by the injured resources, and quantifying the reduction in service levels as a result of climate change. *For more information, please contact Tom Gloria at 1.781.676.4039.*

July

July 7-8

London, UK. ICF Consulting's Abyd Karmali will be chairing the second day of **Environmental Finance's Carbon Credits in Project Finance Conference**. *For more information, please contact Sue Demmon at +44.20.7554.8730.*

July 9-10

London, UK. ICF Consulting's Simon Allen will chair the first day of **IBC Global's Conference on Opportunities in the Distressed Power Sector**. Neil Cornelius of ICF Consulting will give a presentation titled, "The Outlook for Wholesale Prices: Will Prices Incentivise Investment?" *For more information, please contact Sue Demmon at +44.20.7554.8730.*

July 22-23

Houston, TX. At **IQPC's Corporate Social Responsibility for the Energy Industry Conference**, Jane Obbagy of

ICF Consulting will give a presentation titled, "Realizing the Business Value of Sustainable Development." *For more information, please contact Stacey Hohenberg at 1.703.218.2504.*

July 23-25

Chicago, IL. At Infocast's **Buying, Selling & Investing in Energy Assets**, Judah Rose of ICF Consulting will speak on "Assessing the Salability of Merchant Assets—When Will We Hit Bottom?" *For more information, please contact Stacey Hohenberg at 1.703.218.2504.*

July 28-30

Houston, TX. At Infocast's upcoming conference, **North American LNG (Liquefied Natural Gas)**, ICF Consulting's Leonard Crook will speak on "LNG at the Tipping Point—The Role of LNG in the North American Energy Supply." *For more information, please contact Stacey Hohenberg at 1.703.218.2504.*

August

August 3-6

Chicago, IL. At the **Illuminating Engineering Society of North America Annual Conference**, Jeff Schwartz of ICF Consulting will participate in a panel session titled, "Basic Do's and Don'ts for Lighting Design and Application," which will address various application scenarios in the commercial, industrial, and institutional markets. *For more information, please contact Jeff Schwartz at 1.518.452.5986.*

September

September 14 -15

Baltimore, MD. At the **National Recycling Coalition's 22nd Annual Congress**, ICF Consulting's Tony Silva will speak on using marketing communications strategies to overcome recycling myths held among college/university students. Anne Choate and Randy Freed, both of ICF Consulting and on behalf of the U.S. Environmental Protection Agency, will present "Documenting and Demonstrating Recycling's Benefits," quantifying the life-cycle greenhouse gas benefits of recycling. *For more information, please contact Tony Silva at 1.202.862.1564.*

September 14-19

Beijing, China. At the **3rd International Methane and Nitrous Oxide Mitigation Conference**, Don Robinson of ICF Consulting will give two presentations titled, "World-wide Natural Gas Infrastructure Methane Emissions Reduction Investment Opportunities" and "Identifying Natural Gas Leaks to the Atmosphere with Optical Imaging." *For more information, please contact Stacey Hohenberg at 1.703.218.2504.*

September 19-21

New York, NY. Judah Rose of ICF Consulting will participate in a panel discussion on "Forensic Evaluation of Problem Projects" at **Infocast's Project Finance Workouts Conference**. *For more information, please contact Stacey Hohenberg at 1.703.218.2504.*

September 23-25

Seattle, WA. At the **InLCA/LCM 2003 Conference for the American Center for Life Cycle Assessment**, Tom Gloria of ICF Consulting will present the results from a workshop on "The Taxonomy of Life Cycle Impact Categories," conducted at the Society of Environmental Toxicology and Chemistry annual meeting in Hamburg, Germany. *For more information, please contact Tom Gloria at 1.781.676.4039.*

October

October 8-9

London, UK. ICF Consulting's Kim Keats will speak on "European Union Renewable Energies and Implications on Reserve Requirements" at the **SMI Energy Security Conference**. *For more information, please contact Sue Demmon at +44.20.7554.8730.*

October 27-29

Vienna, Austria. ICF Consulting's Kim Keats will speak on the "Competition Between Gas and Coal in the Power Sector" at the annual **CoalTrans 2003 Conference**. *For more information, please contact Sue Demmon at +44.20.7554.8730.*

November

November 8-13

Austin, TX. As a member of the **Life Cycle Assessment (LCA) Advisory Group to the Society of Environmental Toxicology and Chemistry—North America Annual Conference**, Tom Gloria of ICF Consulting will organize LCA platform sessions at the conference. The sessions cover the following topics:

- Streamlining and Screening Tools
- Comparative LCA Impact and Risk Assessment for Metals
- LCA and Communication to Stakeholders
- GMOs and Pesticides: Optimum Environmental Choices and Sustainability
- Assessing Current Frameworks for LCA

For more information, please contact Tom Gloria at 1.781.676.4039.



powered by perspective

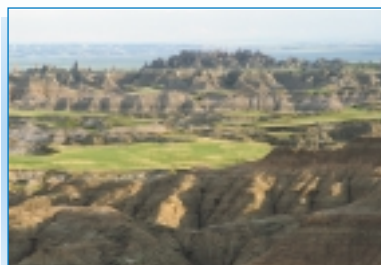
Linking Economic Development to Highway Improvements

There is a growing interest in the economic development potential of highway projects in economically disadvantaged regions of the United States. The relationship between economic development and highway investments is a complex one and, despite extensive research, there continues to be substantial disagreement over the best way to quantify economic impacts. Key analytical questions researchers grapple with include the following:

- Would economic growth have occurred if the road had not been built?
- Did the transportation investment create the development or was it the other way around?
- Did the investment merely redistribute economic activity from another region or did it actually generate new economic activity?

In addition to the problems posed by the nature of economic development analysis, traditional approaches to assessing the impacts of investments, such as conventional benefit-cost analysis, do not support this type of inquiry since they tend to focus on “user impacts” rather than economic development impacts. User impacts measure the savings to users of an improved facility and include travel time savings that are due to a reduction in congestion or construction of a more direct route; accident cost savings through improvement to a facility’s safety; and vehicle operating costs savings, such as a reduction in vehicle wear when a gravel road is paved.

Traditional approaches tend to weigh against investments in rural areas because the low traffic levels may not generate the magnitude of user benefits that can justify investments on a cost-benefit basis. However, improvements to rural highways can lead to economic development, even in cases



A portion of Badlands National Park served as the location for this study.

where road capacity is not constrained. In many cases, highway investments are exactly what is needed to diversify regional economies, increase market reach, and foster growth in economic productivity.

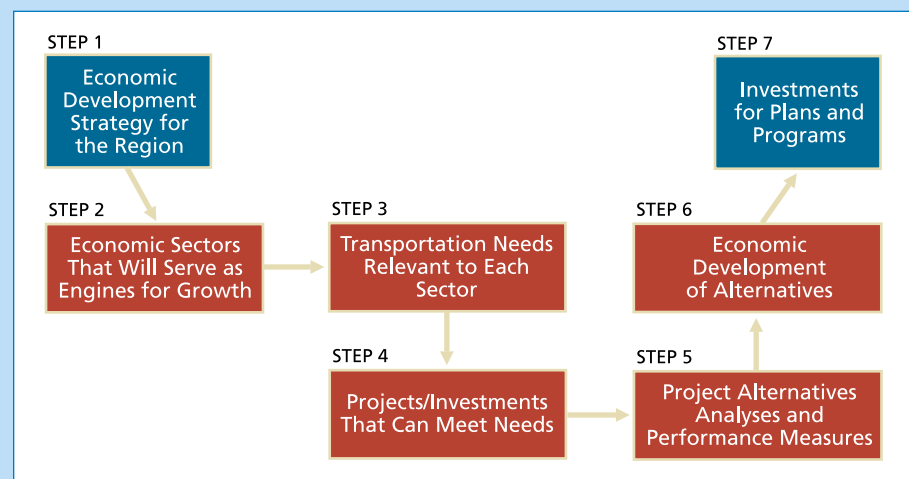
ICF Consulting is working on an alternative approach to better demonstrate the need for highway investments in economically disadvantaged areas where traffic levels are relatively low. The approach is to link a region’s economic development strategy to infrastructure needs and allow this to guide the analytical process, rather than starting with a set of pre-defined transportation improvements and estimating the associated economic benefits. Once a region has identified the sectors that will serve as the primary focal point for development (for example, agriculture, manufacturing, tourism, etc.), transportation and other infrastructure needs can be assessed; specific alternatives can be compared; and the economic development

impacts can be determined by demonstrating the reliance of specific development initiatives on highway improvements, and/or by investigating the incremental benefits accrued from investments in highways. In focusing on the local region’s socio-economic context and planning efforts, the approach offers a more sustainable and targeted solution to long-term economic development of the area.

ICF Consulting used this approach to investigate the relationships between transportation investments and economic development in Pine

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Linkages Between Economic Development Strategy and Transportation Needs Assessment



Linking Economic Development... (cont. from page 8)

Ridge Indian Reservation, which is situated in the southwestern region of South Dakota. Home to the Oglala Sioux Tribe, the reservation boasts a rich culture and history, as well as stunning natural scenery, including the South Unit of Badlands National Park. Despite the cultural and natural assets of the reservation, socio-economic indicators demonstrate a profound need for economic development. Pine Ridge suffers from elevated levels of unemployment and poverty and a lack of investment. The local transportation infrastructure does not support economic development in that it lacks internal connectivity and accessibility, suffering from inadequate construction and maintenance funding.

By focusing on the economic development opportunities offered by tourism, ICF Consulting identified the transportation investments that potentially would support the accrual of full economic benefits associated with a mature tourism sector. We found that, assuming implementation of a suite of supportive initiatives, a mature tourism sector at Pine Ridge could attract more than one million visitors each year, translating into an estimated total economic impact of \$153 million over a 15-year period. By year 15, these tourists would generate more than one million auto

trips per year, with a peak average daily traffic of 5,200 vehicles. The local transportation infrastructure enhancements that would be needed to provide adequate levels of service include both upgrading the functional class of key roads and performing adequate maintenance throughout the lifecycle of the improved roads. The costs of these transportation investments were estimated at \$73.3 million.

The work at Pine Ridge Reservation is part of the Economic Development Highway Corridors Study. Directed by Congress and overseen by the U.S. Department of Transportation Federal Highway Administration (FHWA), this study seeks to better understand the relationship between economic development and transportation investments in 12 rural corridors throughout the United States.

An expanded summary of the study can be viewed at www.fhwa.dot.gov/planning/econdev/pineridge.htm

For more information on ICF Consulting's capabilities in the transportation arena, please visit www.icfconsulting.com/transportation

Due Diligence in Mergers and Acquisitions... (cont. from page 5)

extent of potential contamination identified at a small number of the seller's facilities.

ICF Consulting provided a comprehensive report covering economic, energy, and EHS issues that strongly influenced the client's bid package. Options included walking away from the deal if the potential for liabilities was high, requiring that the seller remediate as many adverse site conditions as possible, adjusting their purchase price based on potential liabilities or costs of corrective action, or redefining the assets being acquired.

Ultimately, ICF Consulting found that the seller had numerous potential liabilities from their previous activities, however, the company had implemented a series of

effective EHS management systems that greatly reduced EHS liabilities from current operations. Further, while some plants owned by the seller were not in complete compliance with applicable regulations, most were in excellent condition and, overall, required little capital investment to ensure compliance. Additionally, the variety of generation technologies, locations, and markets mitigated exposure to changing pollution control policies and volatility in power markets. Based on this information, our client submitted an informed bid package that accounted for these potential liabilities and business risks.

For more information on ICF Consulting's due diligence and analytical capabilities, please visit www.icfconsulting.com/enviromanagement

Measuring the Economic Costs of Terrorist Attacks... (cont. from page 1)

As part of this effort, we modeled economic changes resulting from two hypothetical terrorist attack scenarios. In the first, the impacts of a coordinated attack on the electricity transmission grid in California, resulting in a sizeable loss in electricity supplied to the State, were analyzed. In the other scenario, the economic losses resulting from a deliberate spreading of the devastating virus for Foot and Mouth Disease (FMD) in a predominantly agricultural state, such as Iowa, were reviewed.

The modeling focused on the economic damages resulting from these attacks, avoiding issues related to measuring the cost of the human toll. ICF Consulting examined the scenarios to estimate direct costs on affected industries and calculated the ripple effects on other industries and the economy as a whole. This study revealed the magnitude of the losses, and helped determine the best strategies for policymakers to prepare for and mitigate damages.

Attack Simulated on a California Transmission Grid

Based on ICF Consulting's expertise in the energy transmission and homeland security sectors, it was hypothesized that the simulated attack on the electric grid caused

a severe disruption in the power supplied to California and led to a 25 percent reduction in available power. This initial loss resulted in significant economic damages, but for a very short period of time. During the day of the attack, authorities were able to re-optimize the grid and restore power to certain prioritized sectors. This incomplete restoration led to rolling blackouts for an extended period of time. The gradual ramp-up was assumed to continue for two weeks, after which the system was back to its pre-attack state. The economic damages from this attack were calculated for this two-week period.

Economic Costs of a Simulated Attack on the California Electric Grid

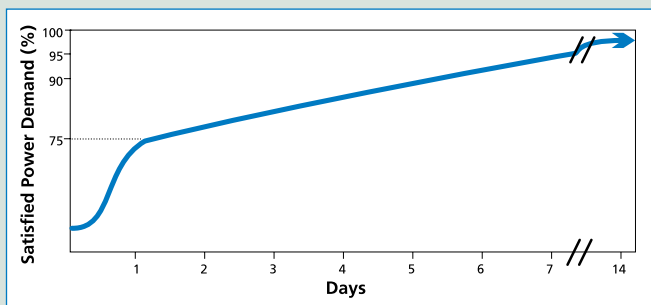
| Industry Sector Costs | \$ MM | % of Sectoral Product |
|----------------------------------|----------------|-----------------------|
| Manufacturing | 592 | 0.31% |
| Wholesale/Retail Trade | 597 | 0.29% |
| F.I.R.E. | 839 | 0.29% |
| Mining | 26 | 0.29% |
| Services | 877 | 0.27% |
| Others | 544 | 0.17% |
| Lost Tourism | 5,800 | 7.7% |
| Other Long-Term Costs | | |
| Backup Generation | 100 | |
| Bus Int Insurance Prem. | 1,390 | |
| Aggregate Direct Costs | 10,764 | 0.8% |
| Aggregate Indirect Costs | 6,737 | 0.5% |
| TOTAL COST (in \$ MM) | 17,501 | 1.3% |
| TOTAL COST (in lost jobs) | 122,200 | |

Significant damages were borne by sectors that depend heavily on electricity for their operations, like manufacturing, wholesale and retail trade, finance, insurance and real estate (FIRE), mining, and the service sector. Over half the total burden was on the tourism industry as lost revenue. Other, more long-term costs were due to voluntary decisions by businesses to better prepare for the future—by increasing their backup generation by about 2 Gigawatts and paying higher premiums for improved business interruption insurance coverage.

Significant damages resulted from this terrorist attack, leading to a total direct cost of approximately \$11 billion. These initial direct damages had a ripple effect and led to another \$7 billion in secondary impacts on the State's economy. The total impact of about \$18 billion was approximately 1.3 percent of the Gross State Product of California. These significant negative shocks led to more than 122 thousand job losses for the State's economy.

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The Road to Recovery After a Simulated Attack on the California Electric Grid



The attack led to a dramatic initial reduction in available electricity to residents. By the end of Day 1, power had been restored to meet 75 percent of the demand. From Day 2, there was a gradual increase in the amount of electricity available. By the end of Week 1, more than 90 percent of the power was restored and 95 percent of power was restored by the middle of Week 2. The State was back to full capacity by the end of the second week.

A Simulated FMD Outbreak in Iowa

In another scenario, we hypothesized a deliberately caused outbreak of FMD in Iowa. This scenario inflicted significant economic damages, not only on the agricultural sector, but also on those sectors intricately connected with agriculture. FMD is easy to spread and has a relatively

Economic Costs of an FMD Attack in Iowa

| Short-Term Cost Categories | \$ MM |
|----------------------------------|---------------|
| Depopulation Cost | 155 |
| Government Spending | 204 |
| Livestock Price Effect | 1,470 |
| Lost Tourism | 267 |
| Other Long-Term Costs | |
| Decrease Export | 1,937 |
| Aggregate Direct Costs | 4,033 |
| Aggregate Indirect Costs | 1,934 |
| TOTAL COST (in \$ MM) | 5,967 |
| TOTAL COST (in lost jobs) | 37,690 |

Depopulation cost of slaughtering the livestock to contain the disease and government spending to dispose of carcasses and enforce quarantines are two relatively small portions of the total cost estimate. Reduction in demand for animal products would lead to a substantial reduction in price, leading to a significant loss due to this "price effect." Lost revenue for the tourism industry is another small component of the total direct damages. A significant portion of the total cost is due to the long-term impact on export market shares, as most countries stopped importing meat products from Iowa for an extended period of time. We assume export losses for two-and-half years, an extremely conservative assumption.

short incubation period, resulting in disastrous consequences for the State's cattle and other livestock population. The total direct cost from this scenario was estimated to be more than \$4 billion, or about 32 percent of the total output of the agricultural sector in Iowa (excluding lost tourism, since it is not a burden on the agricultural sector). Secondary effects resulting from this outbreak led to another \$2 billion in costs to the Iowa economy. The total damages of approximately \$6 billion are equal to about 6.7 percent of the Gross State Product of the Iowa economy. Again, these negative shocks resulted in close to 38 thousand job losses for the State's economy.

What Can We Do to Better Prepare Ourselves?

Although it is practically impossible to predict such an attack, it is possible to examine options to minimize the economic damages and better prepare for such an occurrence.

For example, it was concluded that the following options could be helpful to cushion the fallout from an attack on the electric grid:

- Build increased redundancy through more "reserve equipment"
- Improve demand management capabilities
- Increase distributed generation to relieve transmission bottlenecks
- Improve federal government initiatives to cope with the resulting complications of increased unemployment and insurance industry ramifications

Similarly, the following options could be helpful to support a resilient economy that is better prepared to deal with an FMD attack:

- Increase the number of testing facilities
- Analyze whether vaccination as a preventive measure is an effective strategy
- Improve channels for disseminating information to avoid mass panic and enforce proper quarantine restrictions
- Explore better compensation programs to assist those affected, particularly in the non-farming sectors
- Explore ways to improve loan programs and unemployment benefits for those directly affected by the attack

These are some of the conclusions reached as a result of the joint effort between ICF Consulting and REMI on modeling the economic costs of terrorist attacks. For more information on our expertise on homeland security issues, please visit us at www.icfconsulting.com/homelandsecurity

An IT Solution to a Complex Problem... (cont. from page 3)



The Department of Justice realized that it needed a comprehensive, Web-based information system to provide grantees with quick and reliable access to program and funding information and to provide staff with the tools to more efficiently process grant applications. OJP envisioned that this system would be

accessible to its entire grantee community, provide timely and accurate information, and support the diverse and evolving requirements of OJP and all of its grant programs. In addition, it would need to be secure; scalable to accommodate increases in use, data volume, and functionality over time; and able to interact with the legacy grants management and financial systems.

ICF Consulting partnered with OJP to develop the Grants Management System, leading significant efforts in application architecture, requirements analysis, database design, systems design and development, objective systems analysis and studies (including vendor information, legacy systems, and grant document image management).

Numerous issues need to be addressed when developing a grants management system. It is important to define, implement, and adhere to standards including program, data, business process, and technology standards. Also, while you might wonder whether grants processes drive the information technology (IT) development or if standardizing an IT system would drive the grants business process—you need to be prepared for both.

There are also critical technical issues related to the system's architecture, functionality, scalability, and interoperability that should be addressed. Using an enterprise architecture helps to integrate the mission, objectives, and business processes to drive IT decision-making. ICF Consulting discourages investments outside the architecture, which might complicate interoperability and performance. A limited, rigid grants system also will fail or be

costly to maintain. The system's technology must be scalable and its functionality extensible to accommodate the peak of grant season and future changes in grant programs. Furthermore, for the system to be most effective, the various enterprise systems (e.g., grants, finance, enterprise portal, customer relationship management, help desk, Web site, etc.) must interact.

The Grants Management System (in production since 1999 and fully re-architected during the past 18 months) now offers instant, nationwide access to OJP's constituents for submitting and reviewing applications, awards, and payment information, reducing paperwork requirements, and providing electronic access to funds. All of this effort reduces total cycle time for processing grants and increases customer satisfaction in the grant-making process.

As a testimony to the system's robustness, when the newly formed Department of Homeland Security distributed the "first responder grants," they chose OJP's Grants Management System to dispense funds quickly and effectively. OJP's system was recently recognized as a 2003 eGov Explorer Award winner for best practices in the U.S. government.

For more information about ICF Consulting's information technology capabilities, please visit www.icfconsulting.com/it



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ICF Consulting is a leading management, technology, and policy consulting firm. Drawing upon its extensive industry knowledge, credentialed professionals, and innovative analytics, it develops solutions to complex energy, environment, emergency management, community development, and transportation issues. ICF Consulting's approach to these issues is strengthened by its expertise in information technology, organizational improvement, program management, and communications. Since 1969, ICF Consulting's 1,000 employees have served major corporations, government at all levels, and multinational institutions from key business centers in the Americas, Europe, and Pacific Asia.

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