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Economic Evaluation of Generation Investments (Long-Term Contracting)

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Agenda

- Long-Term Contracting Authority
  - Statutory Background
  - Overview of Process
- Evaluation of Proposed Generation
  - Market Forecasts
  - Modeling Net Benefit (or Cost) of Contract Products
  - Examination of Other Economic Factors (e.g., Externalities)
- Other Long-Term Contracting Economic Evaluations
  - Cash Flow Model & Rate of Return Evaluation
    - Community-Based Renewable Contracting
  - Quantification of Economy-wide Benefits
    - Ocean Energy Contracting
- Conclusions

Competitive Electricity Generation Markets

- Generation is not economically regulated
  - Price discipline enforced through competitive marketplace
  - Only general business regulations apply
    - business regulators, not utility regulators
- Despite advantages, some potential disadvantages of Competitive Electricity Markets are
  - Price Volatility and Uncertainty
  - Limited Access to Long-Term Contracts
    - Power plant financing & development may be difficult
- Authority to enter into Long-Term contracts is a policy mechanism meant to alleviate some of these disadvantages
- A long-term contract in a competitive electrical generation market is similar in ways to buying a commodity futures contract (e.g., as a hedge)

Maine PUC Long-Term Contracting Authority

- Maine PUC Authority to Direct Utilities to Enter Into Long-Term Contracts for Energy Supply
  - Maine PUC runs bid solicitation and evaluation (other New England states have the electric utility run the bid process)
  - Maine electric utilities are involved by
    - Providing comment on proposed long-term contract terms
    - Aiding development of long-term contract of selected proposals
- Term Up to 10 Years, Unless Maine PUC Determines Longer Term in Public Interest
- Preference for New Renewable Resources
- Authority is specified in Rule, Chapter 316:
  - http://www.maine.gov/sos/cec/rules/65/407/407c316.doc

Maine PUC Long-Term Contracting Process

- Bids are evaluated based upon statutorily specified energy policy goals:
  - Lower Electricity Rates
    - Costs below long-term market projections
  - Hedge Against Price Volatility (Electricity Market Uncertainty)
  - Promote Development of New Generation Resources
    - Provide price stability for new generation resources seeking financing
    - Ensure growth in renewable energy capacity to help mitigate greenhouse gas emissions
  - Cost-Effective Substitution for Transmission
- Comment on bids is provided from the electric utilities and the Maine Office of the Public Advocate
- Bid proposals remain confidential unless selected
- Long-term contract becomes public upon execution

Economic Evaluation of Bids: Development of Market Forecasts

- First step is to get market forecasts
  - Forecasts for all proposed contract products
    - Energy, Capacity, Renewable Energy Credits (RECs)

- Maine PUC hires consultant to develop forecasts
  - Sophisticated New England energy market simulation model
    - Fuel price forecasts
      - Natural gas, oil, coal
    - Carbon price forecast
      - Regional Greenhouse Gas Initiative (RGGI) cap-and-trade program
    - Generator retirements and new entry forecasts
      - Based upon forecasted renewable portfolio standard requirements and new natural gas entry
    - Transmission forecasts
      - Both electricity and natural gas networks
    - Load forecast
  - Incorporates New England market rules, mechanisms, and physical topology
    - Forward Capacity Market
    - Electricity Transmission Network Topology
      - congestion and losses in New England “zones”

Economic Evaluation of Bids: Use of Energy Market Forecasts

- Forecast is for annual average prices at the market reference hub
  - Also on-peak and off-peak prices, and monthly resolution possible
  - 20 year forecast
- Consultant may develop multiple forecasts following different future scenarios
  - Maine PUC may develop its own additional scenarios or sensitivities
- Maine PUC applies forecasts to individual generation project proposals
  - Account for location of project
    - De-rate New England market reference hub forecast based upon estimated losses and congestion
      - Examine historic Locational Marginal Prices (LMPs) near project site (data from ISO-NE)
  - Extrapolation of forecast sometimes necessary (if proposed contract >20 years)
  - Evaluation varies by technology
    - Natural Gas facility economics hinge on relative efficiency (heat rate) compared to market
      - Because natural gas is usually the marginal unit setting the market price
    - Biomass, Hydro, and Nuclear may simply look at proposed long-term contract pricing relative to annual average price forecasted (de-rated for location)
    - Wind, Solar, and other price-taking technologies may require an hourly analysis
      - Coincidence of project output with hourly wholesale market may result in higher or lower value energy
      - Developer provides modeled expected hourly output of proposed project
      - Combine monthly resolution forecast with historic hourly LMP price pattern and project hourly output

Economic Evaluation of Bids: Use of Capacity Market Forecasts

- Forecast is for annual average clearing price of Forward Capacity Market
  - 20 year forecast
  - First few years prices are already known (capacity commitments are 3-year forward-looking)

- Maine PUC applies forecast to individual generation project proposals
  - Account for location of project
    - Some areas in Maine are transmission constrained = not eligible for capacity payments
  - Extrapolation of forecast sometimes necessary (if proposed contract >20 years)
  - Evaluation varies by technology
    - Use ISO-NE guidelines for likely amount of qualifying capacity (varies by technology)
    - Capacity quantity a function of the expected capacity factor at the time of system summer and winter peaks
      - For example, for summer qualified capacity
        - » Solar = qualifying capacity higher than suggested by average capacity factor
        - » Wind = qualifying capacity lower than suggested by average capacity factor

Bid Price Evaluation: Hypothetical Example

Wind Long-term Contract

Bid Analysis - Initial Bid

Net Benefit **NPV@7%** ***$12,931,184***

	Nameplate Capacity	2014	2015	2016	2017	2018	2019	2020	2021	2022
Wind	100 MW	est. capacity factor	30.2 %							
			2.50% Price Escalator							
Contract Quantities, Costs										
Contract Year			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Capacity (Summer Qualified MW)			0.0	0.0	0.0	0.0	0.0	15.1	15.1	15.1
Energy (MWh)			264,552	264,552	264,552	264,552	264,552	264,552	264,552	264,552
RECs (MWh)			264,552	264,552	264,552	264,552	264,552	264,552	264,552	264,552
Proposed Energy & Capacity Price ($/MWh)			**55.00**	56.38	57.78	59.23	60.71	62.23	63.78	65.38
Proposed REC Price ($/MWh)			**15.00**	15.38	15.76	16.15	16.56	16.97	17.40	17.83
Contract Cost ($)			18,518,640	18,981,606	19,456,146	19,942,550	20,441,114	20,952,141	21,475,945	22,012,844
Contract Value										
Energy Forecast ($/MWh)			49.00	50.47	51.98	53.54	55.15	56.80	58.51	60.26
Capacity Forecast ($/kW-mnth)			3.43	3.15	7.03	6.48	6.95	7.16	7.38	7.60
REC Forecast ($/MWh)			30.00	29.10	28.23	27.38	26.56	25.76	24.99	24.24
Total Contract Value ($/MWh)			79.00	79.57	80.21	80.92	81.71	87.47	88.55	89.71
Total Contract Value ($)			20,899,608	21,050,403	21,220,007	21,408,557	21,616,204	23,140,874	23,426,176	23,732,306
Benefit										
Net Benefit ($)		0	2,380,968	2,068,797	1,763,861	1,466,007	1,175,091	2,188,732	1,950,231	1,719,462
Benefit ($/MWh)			9.00	7.82	6.67	5.54	4.44	8.27	7.37	6.50

Discounted to 2014$

Benefit Nominal (NPV @ 0%)	Benefit (NPV @ 7%)	Benefit (NPV @ 10%)
$ **$20,096,574**	$ **$12,931,184**	$ **$10,936,036**
Levelized Annual Benefit	**Levelized Annual Benefit**	**Levelized Annual Benefit**
$1,004,829	**$646,559**	**$546,802**
$3.8 per MWh	**$2.4 per MWh**	**$2.1 per MWh**

Economic Evaluation of Bids: Net Benefit or Cost Result

- Apply discount rate to annual costs or benefits of proposed pricing
  - 7%, 10%
  - Present Value Benefit or Cost
- Levelize (normalize) to MWh output
  - Helps to compare present value benefit or cost across different size projects
- Examine results from different forecast scenarios
- May negotiate back and forth with bidder on proposed pricing depending upon analysis results

Economic Evaluation of Bids: Externalities and Other Factors

- External Benefits and Costs
  - Marginal Benefits
    - Market suppression effect
    - Hedge value
    - Carbon emission avoidance (social cost of carbon)
  - Marginal Costs
    - System integration
    - Capacity market
- Financial strength of developer
  - Ability to obtain financing
  - Ability to execute project

Long-Term Contracting Results

- Three solicitations have been run (in 2009, 2010, 2013), with a fourth solicitation open now for new renewable resources only
  - Statute requires solicitations be run no less than every three years

- Two Long-Term Contracts
  - Rollins Wind Power Project
    - Energy, Capacity
    - Twenty Years
    - 60 MW
  - Verso Paper Biomass Project
    - RECs, Capacity
    - Five Years, Additional Five Year Option
    - 20 MW Capacity, 30 MWh/hr RECs

- One pending Long-Term Contract
  - Apex Downeast Wind Power Project
    - Energy, Capacity
    - Twenty Years
    - 90 MW

Economic Evaluation in Other Maine Programs

- Other Incentive Programs
  - Long-term contracting for ocean energy pilot projects
  - Long-term contracting for community-base renewable energy projects
- Generally, similar economic evaluation approach
  - Obtain and develop market forecasts
  - Assess net contract product costs, on present value basis, of projects
- Some differences because above-market contracts
  - May examine developer “pro forma” (project cash flow model)
    - Assess reasonableness of financing sources and expected rate of return
  - May examine macroeconomic impacts of project
    - Modeling net job creation, addition to State economic output

Community-Based Renewable Energy Pilot Program Overview

- Encourage development of community based renewable energy resources
- Incentive based program providing either
  - Renewable Energy Credit (REC) multiplier of 150%
  - Long-Term Contract (feed-in tariff) capped at 10 cents / kWh
- Overall program capacity limitation of 50 MW
- Individual utility service territory limitations
- Details of Program specified in Rule, Chapter 325:
  - http://www.maine.gov/sos/cec/rules/65/407/407c325.doc

Community-based Project Eligibility

- Eligible Resources
  - Fuel cells, tidal power, solar installations, wind power, geothermal, hydroelectric, biomass
- Capacity Limitations
  - May not exceed 10 MW
- Community-Based
  - Maine residents, municipalities, nonprofits, Indian tribes or corporations at least 51% owned by Maine residents
- Local Support
  - Resolution of support from municipal legislative body
- Grid Interconnection
- In-Service Date
  - Within three years of certification

Economic Evaluation: Community-based Long-Term Contracts

- Program Cost Containment Provisions
  - May not exceed 10 cents/kWh
  - May not exceed project cost and reasonable rate of return
  - Contract term may not exceed 20 years
  - 50 MW limit in program participation
- Evaluate bid prices versus market forecasts
  - Similar to regular long-term contracting evaluation
  - However, may exceed market value (contract can be a net cost), but not exceed 10 cents/kWh
- Evaluate “pro forma” (cash flow model)
  - Assess viability of financing sources
  - Assess for reasonable rate of return

Additional Economic Evaluation of Community-Based Energy: Cash Flow Model

- Developers provided “pro forma” (project cash flow model)
  - Confidential (protective order)
  - Yearly cash flows
    - Costs
      - Capital Expenditures
      - Operational Expenditures
      - Financing costs (debt, equity)
    - Revenues
      - Long-term contract sales
      - tax credits
      - grants

Cash Flow Model: Hypothetical Example

Project Location: Moldova, Maine		*Wonderland Hydro Project*					Energy Price	9	cents/kWh												
Cash Flow Projection		nameplate capacity		1	MW		REC Price	3	cents/kWh				IRR	11%							
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Construction Year	1																				
Operating Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Initial Capital Costs ($000)	($3,000)																				
Revenue ($000)																					
Power Sales (40% capacity factor)		315.4	315.4	315.4	315.4	315.4	315.4	315.4	315.4	315.4	315.4	315.4	315.4	315.4	315.4	315.4	315.4	315.4	315.4	315.4	315.4
Capacity Payments		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
REC Sales		105.1	105.1	105.1	105.1	105.1	105.1	105.1	105.1	105.1	105.1	105.1	105.1	105.1	105.1	105.1	105.1	105.1	105.1	105.1	105.1
Total		**426**	**426**	**426**	**426**	**426**	**426**	**426**	**426**	**426**	**426**	**426**	**426**	**426**	**426**	**426**	**426**	**426**	**426**	**426**	**426**
Expenses ($000)																					
Depreciation ($5M @ 5% for 20 yrs)		150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
O&M (at inflation rate)		96.0	98.4	100.9	103.4	106.0	108.6	111.3	114.1	117.0	119.9	122.9	126.0	129.1	132.3	135.6	139.0	142.5	146.1	149.7	153.5
Legal & Environmental		1.1	1.1	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.6	1.6	1.6	1.7	1.7	1.8
Property Taxes & Insurance		1.6	1.6	1.7	1.7	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.1	2.2	2.2	2.3	2.3	2.4	2.4	2.5	2.6
Total		**249**	**251**	**254**	**256**	**259**	**262**	**264**	**267**	**270**	**273**	**276**	**280**	**283**	**286**	**289**	**293**	**297**	**300**	**304**	**308**
Net Cash Flow ($M)	($3,000)	$178	$175	$173	$170	$168	$165	$162	$159	$156	$153	$150	$147	$144	$140	$137	$134	$130	$126	$123	$119

Community Renewables Pilot Program Results

- Certified projects
  - Long-term contracts
    - Exeter Agri-Energy (980 kW)
    - Jonesport Wind (9.6 MW)
    - Pisgah Mountain Wind (9 MW)
    - Goose River Hydro (375 kW)
    - Maine Wood Pellets (7.1 MW)
    - Shamrock Wind (10 MW)
  - Potential Long-term contract
    - Clinton Agri-Energy (5.86 MW)
  - REC Multiplier
    - Fox Island Wind (4.5 MW)
    - Good Will Hinckley School Solar (26 kW)
    - ReVision Solar-Unity College (37 kW)
    - Revision Solar- Riding to the Top (34 kW)
    - Lewiston-Auburn Water Authority biodigester (460 kW)
  - 50 MW program cap / <10 MW per project cap
    - Program is fully subscribed

Ocean Energy Long-Term Contract Solicitation: Overview

- Qualifying Projects
  - Deep-Water Offshore Wind Energy Pilot
    - Located in Gulf of Maine
    - Connected to Transmission System in Maine
    - Employs Floating Turbines
    - 300 Feet or Greater Depth
    - No Less than 10 Nautical Miles from Land Area
  - Tidal Energy Demonstration
    - Tidal Action as Source of Electrical Power
    - Primary Purpose Testing Tidal Energy Technology

- Solicitation Requirements
  - Long-Term Contracts
    - Up to 20 Years
    - No More than 30 MW
    - Energy, Capacity, Renewable Energy Credits
  - Price Mitigation
    - Take Advantage Federal Support and other State funds
    - Limitation on Electric Rate Impact
      - No More Than 0.145 cents per kWh ($1.45 / MWh)

Ocean Energy Long-Term Contract Evaluation

- Statutory Evaluation Criteria
  - Technical and Financial Capability
  - Tangible Economic Benefits
  - Relevant Experience
  - Commitment to Invest in Manufacturing Facilities
  - Federal Support
  - Project Information
    - Size, Location, Technology, Cost
    - Permitting Status

- Long-Term Contract Economic Evaluation
  - Assess proposed product pricing compared to market forecasts
  - examine developer “pro forma” (project cash flow model)
  - examine macroeconomic impacts of project

Additional Economic Evaluation of Ocean Energy: Economic Impacts

- Examine macroeconomic impacts of project
  - Models of economic output
    - JEDI model
      - **J**obs and **E**conomic **D**evelopment **I**mpact
      - Department of Energy, National Renewable Energy Lab (NREL)
    - REMI model
      - **R**egional **E**conomic **M**odels, **I**nc.
    - IMPLAN model
      - **IM**pact analysis for **PLAN**ning
      - MIG, Inc.
  - Economic impact is defined as
    - Output (i.e., sales revenue) & employment and labor income (e.g., wages and salaries)
    - Jobs created
  - Direct and indirect impacts
    - multiplier effects

- Issues
  - Gross vs. Net Impacts
  - Methodological Assumptions
    - Geographic, temporal, and sector resolution

JEDI Model

- Uses project-specific data or default inputs (derived from industry norms)
  - Users can specify
    - Construction Costs, Equipment Costs, Annual Operating and Maintenance Costs, Financing Parameters, Other Costs
- Estimates:
  - Jobs
  - Earnings
  - Output
- Impacts distributed across three categories:
  - Project Development and Onsite Labor
  - Local Revenue and Supply Chain Impacts
  - Induced Impacts
- JEDI model defaults are based on interviews with industry experts and project developers.
- Economic multipliers contained within the model are derived from IMPLAN and state data files

JEDI Model Output: 5 MW ORPC Tidal Project

- Construction phase
  - $8.1 million in earnings
  - $22 million in economic output
  - 125 full-time equivalent jobs in Maine
    - 23 direct
    - 67 inter-industry or supply-chain
    - 33 induced (resulting from increases in household spending)

- Operating phase
  - $0.7 million per year in earnings
  - $1.1 million per year in economic output
  - 19 new full-time equivalent jobs annually in Maine
    - 15 direct
    - 2 supply chain
    - 1 induced

REMI Model

- Incorporates aspects of four major modeling approaches:
  - Input-Output
    - Captures industry structure of a particular region (e.g., Maine)
  - General Equilibrium
    - reached when supply and demand are balanced.
    - tends to occur in the long run, as prices, production, consumption, imports, exports, and other changes occur to stabilize the economic system
  - Econometric
    - underlying equations and responses are estimated using advanced statistical techniques
    - estimates are used to quantify the structural relationships in the model
  - Economic Geography
    - productivity and competitiveness benefits of labor and industry concentrations (agglomeration economies)
      - modeled in the economic geography equations

REMI Model Output: Statoil 12 MW Maine Hywind

Table 1 – Direct and Indirect Employment

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6+
Direct Employment	10	21	19	233	233	20
Indirect Employment	6	12	12	59	58	10
Total	**16**	**32**	**31**	**292**	**291**	**30**

Table 2 – Estimated Total Earnings Generated in Maine

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6+
Employment	16	32	31	292	291	30
Wages & Salaries (Thousands Nominal $)	$660	$1,410	$1,440	$6,570	$7,360	$1,777
Regional Output (Thousands Nominal $)	$1,020	$2,060	$1,940	$8,890	$9,200	$2,011

IMPLAN Model

- input-output framework that traces the flows of expenditures and income through the Maine economy
- uses a complex system of accounts that are uniquely tailored to the region
  - version 3.0 of IMPLAN model has information on 440 sectors of the economy
  - information regarding
    - transactions occurring among businesses located in Maine
    - the spending patterns of households
    - transactions occurring between Maine entities and the world

IMPLAN Model Output: 12 MW Maine Aqua Ventus

Table 4. Annual Statewide Economic Impact of a 12 MW Offshore Wind Power Project in Maine: 3-Year (2015-2017) Planning and Construction Period (Assuming $166.7 Million in Capital Expenditures)

	Direct Impact	Multiplier Effects	Total Impact
Output	$31,657,480 Per year	$20,290,125 Per year	$51,947,605 Per year
Employment	294 Per year	181 Per year	475 Per year
Income	$12,041,889 Per year	$6,895,909 Per year	$18,937,798 Per year
Output	$94,972,440 Entire project	$60,870,375 Entire project	$155,842,815 Entire project
Employment	294 Average jobs	181 Average jobs	475 Average jobs
Income	$36,125,667 Entire project	$20,687,727 Entire project	$56,813,394 Entire project
Job-Years	882 Job-years	543 Job-years	1,425 Job-years

Ocean Energy Long-Term Contract Solicitation: Results

- Contract entered into with Ocean Renewable Power Company (ORPC) for ~5 MW of hydrokinetic tidal power
  - $215 / MWh @ 2% yearly escalation
- Maine PUC approves the terms of a contract with Statoil for 12 MW Maine Hywind Pilot Project
  - $270 / MWh @ 1% plus load growth yearly escalation
- Legislature revises statute so that a 2nd solicitation must be run
  - Statoil pulls out of its Hywind Maine project in the Fall of 2013
- Maine PUC approves terms of a contract with Maine Aqua Ventus I GP LLC for 12 MW Maine Aqua Ventus Pilot Project
  - $230 / MWh @ 2.25% yearly escalation

Summary

- Economic evaluation for new generation is market forecast focused
  - Develop robust market forecasts and scenarios
  - Analyze individual project characteristics
    - Location, energy output characteristics
  - Assess results
    - Factor in externalities and other factors
  - For above-market projects
    - May also evaluate
      - assumed financing sources and rates of return
        - » Cash flow model
      - economy-wide impacts
        - » Economic impact models

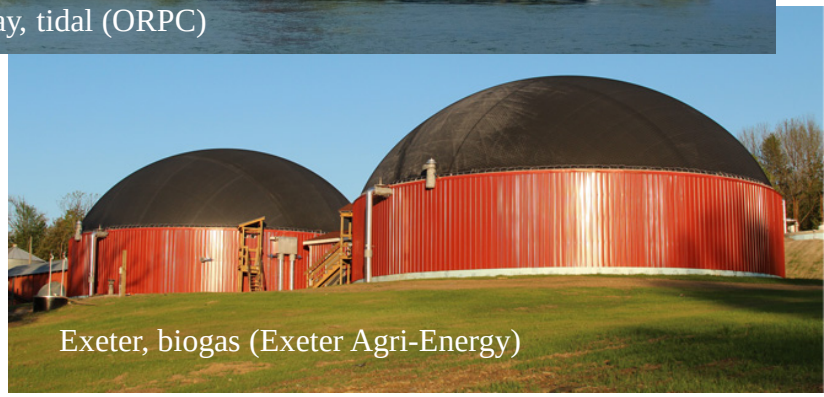

Rollins Mountain, wind (First Wind)

Questions?

Contact: Jason.Rauch@maine.gov


Cobscook Bay, tidal (ORPC)


Bucksport, biomass (Verso)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