THE CEIP IMPACT MODEL

TECHNICAL MANUAL

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CONTENTS

I. INTRODUCTION

This manual provides the technical elements of the CEIP Impact Model. Variables are listed in the order they are used in the equations. Data sources or derivations for each variable are also indicated.

Equations are listed in the order they are used in the Impact Model. Each equation is listed under a heading indicating the purpose for which the equation is used.

Copies of coding forms and the computer program used for calculations are included so that analysts may verify how the variables and equations are utilized in the Impact Model.

II. LIST OF VARIABLES

BLR_t ..... baseline revenues, excluding revenues derived from borrowing or project-related grants

source: t=1,...,10 Schedule 4.1 data
t=11,...,30 Equation 3 forecast

BLR_{t-1} ..... baseline revenues, as above, lagged one year

Y_t ..... per capita income for specific locality (or its county area)

source: t=1,...,10 Schedule 3.4 data
t=11,...,30 Equation 1 forecast

P_t ..... local population

source: t=1,...,10 Schedule 3.4 data
t=11,...,30 Equation 2a forecast

S_t ..... number of students

source: t=1,...,10 Schedule 3.7 data
t=11,...,30 Equations 2a and 2b

ΔP_t ..... defined as $P_t - P_{t-1}$

ΔY_t ..... defined as $Y_t - Y_{t-1}$

BLX_t ..... baseline expenditures, excluding expenditure of project grants or borrowed funds

source: t=1,...,30 Equation 4

ε_{it} ..... disturbance term of i^{th} equation

t ..... time, range 1 to 30. Year 10 is PRESENT YEAR

$\hat{c}_3$ ..... estimated coefficient (from Equation 3) of the effect of a change of one person on revenues collected, i.e.,

$$\partial BLR_t / \partial \Delta P_t = \hat{c}_3$$

source: Equation 3

CFE_t ..... construction employment

source: t=11,...,30 Schedule 1.1 data

OFE_t ..... operating employment

source: t=11,...,30 Schedule 2.1 data

$ICFE_t$ ..... indirect construction facility employment

source: t=11,...,30 Schedule 1.1 data

$IOFE_t$ ..... indirect operating facility employment

source: t=11,...,30 Schedule 2.1 data

FE_t ..... total facility employment

source: t=11,...,30 Equation 5c

DFE_t ..... direct facility employment

source: t=11,...,30 Equation 5a

IFE_t ..... indirect facility employment (new employees in local businesses supplying the energy facility)

source: t=11,...,30 Equation 5b

FEG_t ..... facility employment in local jurisdiction

source: t=11,...,30 Equation 6

DIST ..... distance from energy facility site to population center of government

source: Schedule 3.1 data

Z ..... gravity distance

source: Equation 6a

POPJ ..... population within the J^{th} ring
J = 1, 2, 3, 4, 5, 6 (e.g. POP30=population within the 20 to 30 mile ring)

source: Schedule 3.1 data

POPG ..... population within the government for gravity model year

source: Schedule 3.1 data

SUMY ..... calculation for gravity model

source: Equation 6b

J ..... jobs within the local community

source: Schedule 3.3 data

k ..... employment multiplier

source: Equation 7

RFE_t ..... residential employment from facility

source: Equation 8

U ..... unemployment

source: Schedule 3.3 data

e ..... "labor market tightness" coefficient

source: Equation 9

PNat'l ..... population nationally

source: use 215,396,000

ENat'l ..... employment nationally

source: use 96,817,000

E ..... employees residing in local jurisdiction (may work elsewhere)

source: Schedule 3.3 data

$NRFE_t$ ..... new residential facility employment

source: t=11,...,30 Equation 10

NP_t ..... new population associated with the energy facility

source: t=11,...,30 Equation 11

WP_t ..... total population with the energy facility

source: t=11,...,30 Equation 12

s ..... student-population multiplier

source: use .25

NS_t ..... new student population

source: t=11,...,30 Equation 12a

RPT_t ..... residential property tax revenues

source: t=11,...,30 Equations 13a, c, d

m ..... proportion of taxes exported

source: Schedule 4.7 data

q ..... proportion of taxes from residential property tax

source: Schedule 4.5 data

h_t ..... adjustment for property tax base lag with large population growth

source: Equation 13b

L_t ..... value of land purchased for energy facility in given year t OR value of completed physical facility in year subject to property tax (if both occur, then the sum)

source: t=11,...,30 Schedule 1.2 data

g ..... assessment ratio for business property

source: Schedule 4.4 data

$T_{1,t}$ ..... business property tax rate

source: t=11,...,30 Schedule 4.2 data

BPT_t ..... business property taxes

source: t=11,...,30 Equations 14a, 14b

RET_t ..... real estate transfer taxes

source: t=11,...,30 Equation 15

$T_{2,t}$ ..... real estate transfer tax rate

source: t=11,...,30 Schedule 4.2 data

ST_t ..... sales taxes

source: t=11,...,30 Equation 16

$T_{n,t}$ ..... other tax rates
n=3,...,J where J is the total number of taxes

source: t=11,...,30 Schedules 4.2 and 4.6b data

BT_n ..... other tax bases
n=3,...,J (e.g., sales tax base, etc.)

source: Schedules 1.3 and 2.2 data

UT_t ..... user charges, in appropriate year

source: t=11,...,30 Schedule 4.8 data

OT_t ..... other revenue sources from taxation, not explicitly covered in property tax, sales tax, etc.

source: Schedule 4.9 data

OBT_t ..... other business taxes

source: t=11,...,30 Equation 17

WX_t ..... expenditures with the energy facility impact

source: t=11,...,30 Equation 18

WR_t ..... revenues with the energy facility impact

source: t=11,...,30 Equation 19

NFI_t ..... net fiscal impact

source: t=11,...,30 Equation 20

III. EQUATIONS AND CALCULATIONS

SECTION I. BASELINE FORECASTS

Forecast BLR_t, Y_t, P_t, and BLX_t for t = 11,...,30.

Use ordinary least squares to estimate Equations 1, 2a and 3. Then apply the estimated equations to predict the above variables for t = 11, 30.

Equation 1. Forecast per capita income, t=11,...,30.

(1) $\ln Y_t = a_1 + b_1 t + \varepsilon_{1t}$

Equation 2a. Forecast population, t=11,...,30.

(2a) $\ln P_t = a_2 + b_2 t + \varepsilon_{2t}$

Equation 2b. Forecast student enrollments.

(2b) $S_t = P_t$ in Equations 2a and 3.

Equation 3. Forecast baseline revenues, t=11,...,30, given above forecasts for the independent variables:

(3) $BLR_t = a_3 + b_3 BLR_{t-1} + \hat{c}_3 \Delta P_t + d_3 \Delta Y_t + \varepsilon_{3t}$

Equation 4. Forecast baseline expenditures, t=11,...,30.

(4) $BLX_t = BLR_t$

(NOTE: Save estimated coefficient above)

SECTION II. WITH IMPACT FORECASTS (CALCULATIONS)

Step 1. Forecast new population (impact) as result of energy installation:

Equation 5. Total facility employment.

(5a) $DFE_t = CFE_t + OFE_t$ definition

(5b) $IFE_t = ICFE_t + IOFE_t$ definition

(5c) $FE_t = DFE_t + IFE_t$ definition

Equation 6. Allocate new employment to the local jurisdiction. Allocation by gravity model and given data:

(6a) $$Z = \begin{cases} DIST \text{ if } DIST \leq 20 \\ [20 + 3(DIST - 20)] \text{ if } DIST > 20 \end{cases}$$

(6b) $$SUMY = (POP10/5) + (POP20/15) + (POP30/35) + (POP40/65) + (POP50/95) + (POP60/125) + (POPG/Z)$$

(6c) $$FEG_t = \left[\frac{POPG/Z}{SUMY}\right] FE_t$$

Equation 7. Employment multiplier.

(7)

If	$J_t < 50$	then	$k = 1.0$
If	$50 \leq J_t < 200$	then	$k = 1.1$
If	$200 \leq J_t < 500$	then	$k = 1.2$
If	$500 \quad J_t < 2000$	then	$k = 1.3$
If	$2000 \leq J_t < 5000$	then	$k = 1.4$
If	$J_t \geq 5000$	then	$k = 1.5$

Equation 8. Residential employment from facility.

(8) $RFE_t = k\ FEG_t$

Equation 9. Labor market tightness coefficient.

(9) If

(P/E)/(PNat'l/ENat'l)	< 1	then $e = 0$
	$\geq 1, < 1.05$	then $e = 0.005$
	≥ 1.05	then $e = 0.01$

Equation 10. New residential facility employment.

(10) $NFRE_t = RFE_t - 0.3U - eP_t$

Equation 11. New population.

(11) $NP_t = NRFE_t(PNat'l/ENat'l)$

Equation 12. Total population with the energy facility:

(12) $WP_t = P_t + NP_t$

(12a) In the case of school districts, then

$NS_t = sNP_t$

Step 2. Forecast new residential property tax revenues (RPT_t):

Equation 13. Property tax revenues.

Equation 13a. Property tax revenues, first year:

(13a) $t = 11$: $RPT_{11} = NP_{11}(1-m-q)BLR_{11} / P_{11}$

Equation 13b. Define proportion of new residents paying property tax coefficient (h):

(13b) If $\left\{\frac{WP_{t+1} - WP_t}{WP_{t+1}}\right\}$ $< .1$ then $h = q$
$.1$ to $.2$ then $h = .8\ q$
$.2$ to $.4$ then $h = .6\ q$
$> .4$ then $h = .4\ q$

Equation 13c.1. If property tax receipts in next fiscal year, use Equation 13a for RPT_{12} (derive from data), and subsequently, for t=13,...,30 use Equation 13d for RPT_t (t=13,...,30).

Equation 13c.2. If property tax receipts in same fiscal year, use for t=12,...,30.

$$RPT_t = NP_t(1-m-q)BLR_t / P_t + NP_{t-1} \cdot h \cdot BLR_t / P_t$$

Equation 13d. If property tax receipts following fiscal year, in third year and later, use following equation (t=13,...,30). See note at Equation 13c.1.

(13d) $RPT_t = NP_t(1-m-q)BLR_t / P_t + (NP_{t-2})\ h\ (BLR_t / P_t)$

Step 3. Forecast (calculate) energy facility business property taxes.

Equation 14a. Business property taxes if tax revenues received in SAME fiscal year (data), t=11,...,30.

(14a) For $t = 11$, $BPT_{11} = 0.5L_t \; (g)(T_{1,11})$

for $t = 12,...,30$

$$BPT_t = \left[\left(\sum_{i=11}^{t-1} L_i \right) + 0.5L_t \right] \quad (g)(T_{1,\,t})$$

Equation 14b. Business property taxes if tax revenues received in following fiscal year (data), t=11,...,30.

(14b) For $t = 11$ $BPT_{11} = 0$

for $t = 12$ $BPT_{12} = 0.5L_{11}(g)(T_{1,\,12})$

for $t = 13,...,30$

$$BPT_t = \left[\left(\sum_{i=11}^{t-2} L_i \right) + 0.5L_{t-1} \right] \quad (g)(T_{1,\,t})$$

Step 4. Other business taxes.

Equation 15. Real estate transfer taxes (if applicable).

(15) $RET_t = L_t \cdot T_{2,\,t}$

Equation 16. Sales and other such taxes.

(16) $ST_t = \sum_{n=3}^{J} T_{n,\,t} \cdot BT_{nt}$

where n is the type of tax, and J is total number of such taxes + 2.

Equation 17. All non-property taxes.

(17) $OBT_t = RET_t + ST_t + UT_t + OT_t$

(Note: UT is user charges, and OT other taxes. This data given in schedules.)

Step 5. Calculate expected tax revenues and expenditures with the impact of the energy facility.

Equation 18. Expected expenditures with the energy facility.

(18) $WX_t = BLX_t + c_3NP_t$

Equation 19. Forecast expected revenues with energy facility.

(19) $WR_t = BLR_t + RPT_t + BPT_t + OBT_t$

Equation 20. Net fiscal impact.

(20) $NFI_t = WR_t - WX_t$

IV. COMMENTS

The general description of forecasting procedures is contained in the Technical Assistance Materials along with the data schedules. The comments presented here are supplementary to clarify certain technical aspects of the model.

BASELINE FORECASTS

Data limitations prevent making independent estimates of baseline revenues and baseline expenditures. Hence the baseline revenues are estimated as a function of revenues the previous period, changes in population and changes in per capita income. Revenues from borrowing or project related grants are excluded. Baseline expenditures, excluding expenditures of borrowed funds or project related grants, are then assumed to equal baseline revenues. This assumption is warranted in that after "lumpy" expenditures and revenues are eliminated, revenues generally come very close to equaling expenditures for local government units.

The CEIP Impact Model uses only a simple continuation of trends in forecasting per capita income and population. If alternative estimates are available they should be utilized.

IMPACT FORECASTS

The impact forecasts are a series of calculations which are added to the baseline revenue forecasts. Assumptions and calculations underlying four of the more important steps in the impact forecast are explained below.

1) Gravity Model - The gravity model is based on previous empirical work. The assumptions are that the residential location of facility employees varies directly with the existing population in an area and inversely with the distance from the facility to the local area. The decline in relation to distance is direct up to 20 miles and three times the additional distance beyond 20 miles. This formulation may overstate the number of employees close to the facility and understate the number of employees distant from the facility during its initial years. This is because new employees will commute longer distances until they feel their jobs are permanent, after which they move closer to the facility.

2) After the number of "new" jobs within the local government area are estimated with the gravity model and multiplier, an attempt is made to determine how many holders of new jobs will be new residents. The adjustment for labor market tightness (Equation 9) assumes no new entrants to the labor force if the population-employment ratio in the local area is lower than the national

average. If the local population-employment ratio is up to 5 percent higher than the national average, .5 percent of the existing residential population are assumed to be new entrants to the labor force filling energy facility related jobs. If the local population-employment ratio is more than 5 percent higher than the national average, one percent of the existing residential population is assumed to join the labor force in energy facility related jobs. A second adjustment is made by assuming that 30 percent of the currently unemployed in the community find jobs. These calculations reduce the need for new residents in the community to fill energy facility jobs, and hence reduce the new population impact from the facility.

3) Property Tax Lags - It is assumed that no new residential property tax revenues accrue during the first year of energy facility activity. Beginning in the second year new residents pay the same amount of residential property tax as old residents if a) property taxes are collected in the same year as they are assessed and b) the rate of new population growth was less than 10 percent. If there is a one year lag between assessments and collections, new residential property taxes do not accrue until year three. If population increases are large, the amount of residential property tax paid by new population is decreased by the factors indicated in Equation 13b, i.e., if growth is between 10 and 20 percent, new residents only pay 80 percent as much property tax as old residents.

Business property tax receipts from the energy facility are also lagged if there is an assessment-collection lag. In addition, during the first year of a new business property tax assessment, only 50 percent is estimated to accrue. This is an "expected value" in that if the facility is in place early in the year, the amount would be 100 percent but if in place only at the end of the year, the amount could be 0. This 50 percent assumption can be modified to be either 0 or 100 percent by substituting 0 or 1 for .5 in Equations 14a and 14b.

4) Tax Rates for Estimating Energy Facility Revenues - In Schedule 4.2 local officials are asked to indicate current tax rates and tax rates 5, 10 and 15 years in the future for major taxes. Revenues from the energy facility will be sensitive to future tax rate estimates so it may be desirable to run the model more than once with a different estimate for rates for taxes in the future.