
Techno-Economic Modelling of LTE Networks

**17. VDE/ITG Fachtagung Mobilkommunikation
9. - 10. Mai 2012, Osnabrück**

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Overview

- Techno-economic modelling
- Techno-economic modelling with STEM
- Deployment in a LTE project
- LTE roll-out example
 - Model aim
 - Model structure
 - Model results
- Summary

Techno-economic modelling

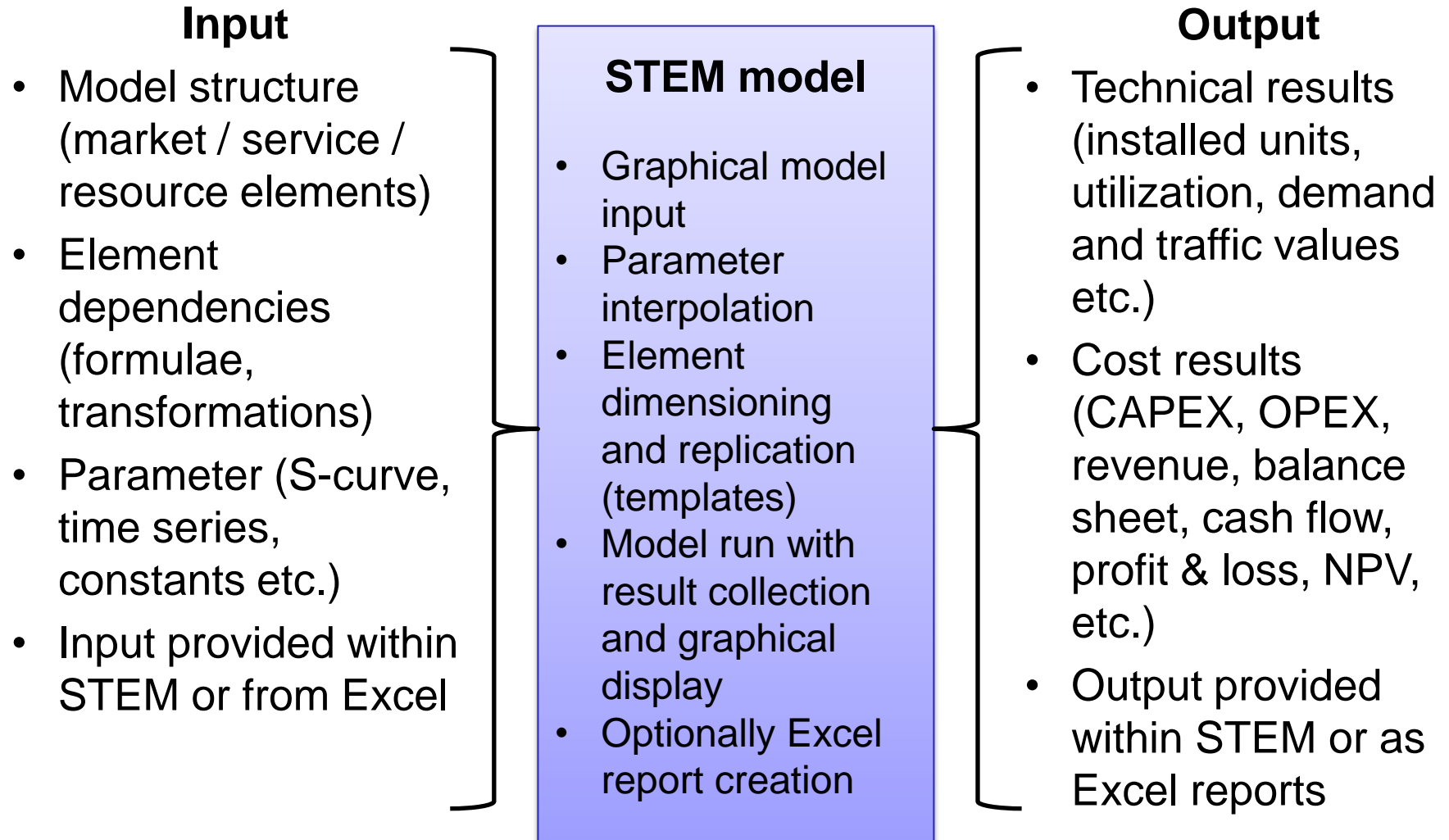
What is it?

- Business case modelling taking into account the technical dependencies and constraints during the process of cost and revenue calculations
- Long term business planning supporting strategic decisions and medium term operations and management decisions
- Periodic model runs with adopted input for result consolidation, operations controlling and decision valuation
- Sensitivity analysis reveals focus areas/elements for optimization

What is it not?

- No replacement for network planning
- Normally not inventory based
- No real-time or short term monitoring or controlling

Techno-economic modelling with STEM



(STEM ... Strategic Telecoms Evaluation Model)

Deployment in a LTE project

EU project: “MEVICO”

(Mobile Networks Evolution for Individual User Experience)



- EU Celtic Call 7 project
 - www.mevico.de
 - <http://www.celtic-initiative.org/Projects/Celtic-projects/Call7/MEVICO/mevico-default.asp>
- European consortium of about 25 partners in 10 countries
- Project Co-ordination: Nokia Siemens Networks, Finland
- Focusses on LTE EPC and Backhaul network

LTE roll-out example - Model aim

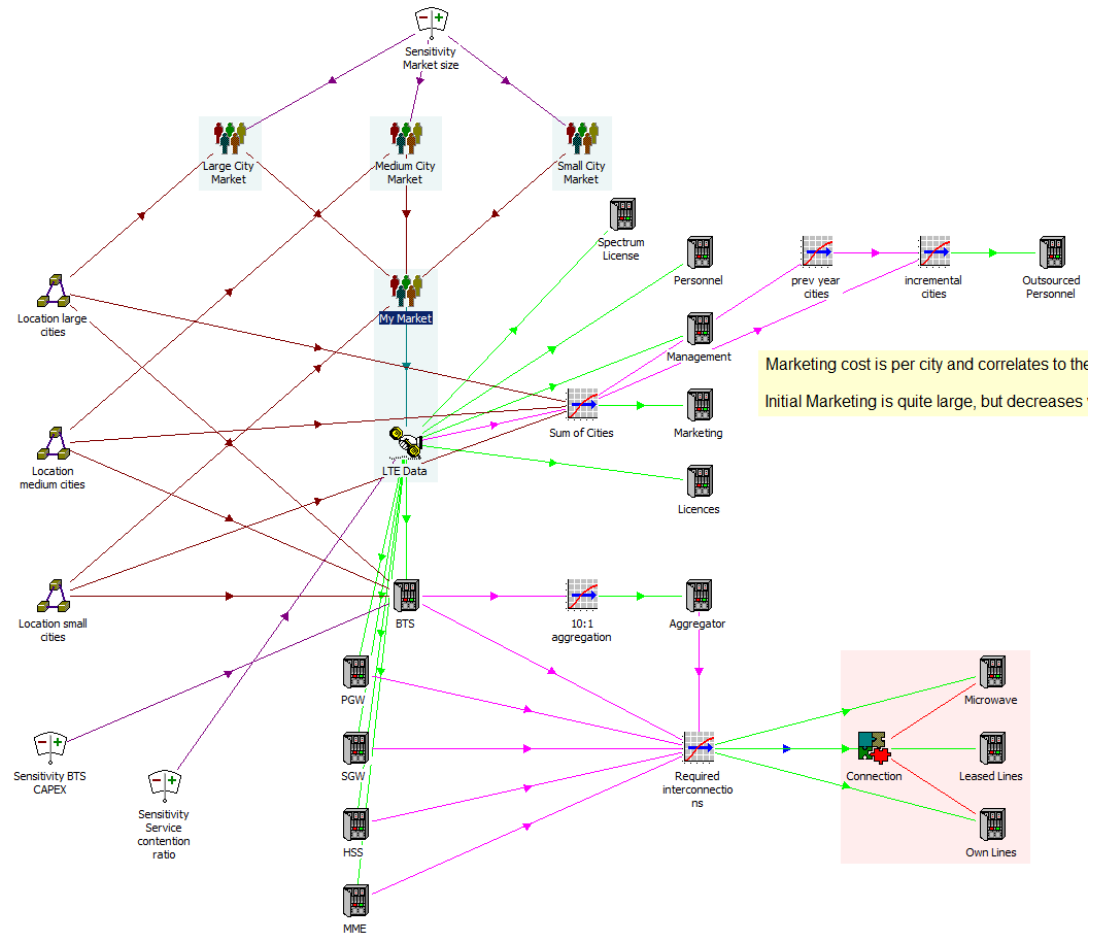
LTE business case model

- Techno-economic implications of the mobile network evolution towards LTE
- Analysis of
 - cost driving technical elements,
 - timing influence and
 - administrative and selling expenses.
- Value chain model: potential customer base, market share, service demand by active subscribers in busy hour, network equipment, transport network, human resources (employed/outsourced) licencing and marketing expenses
- Single flat-rate data service with setup fee and monthly tariff
- Revenue, profit and NPV calculation

LTE roll-out example – Model structure

LTE business case model

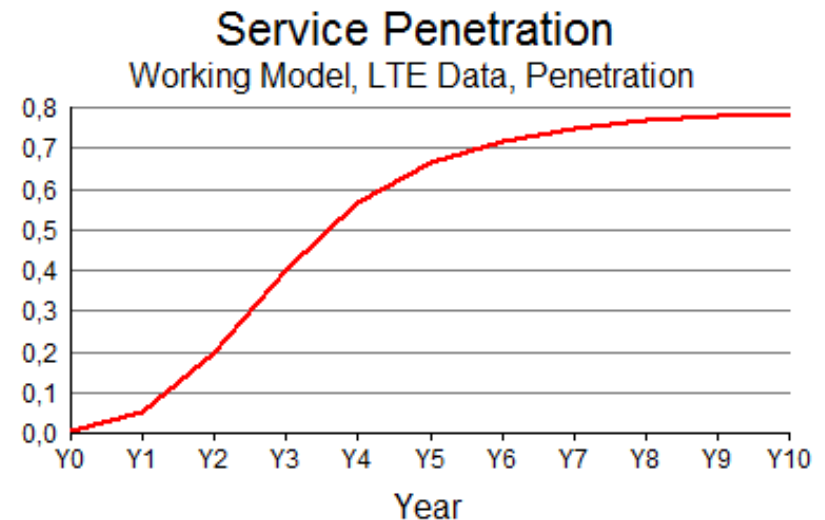
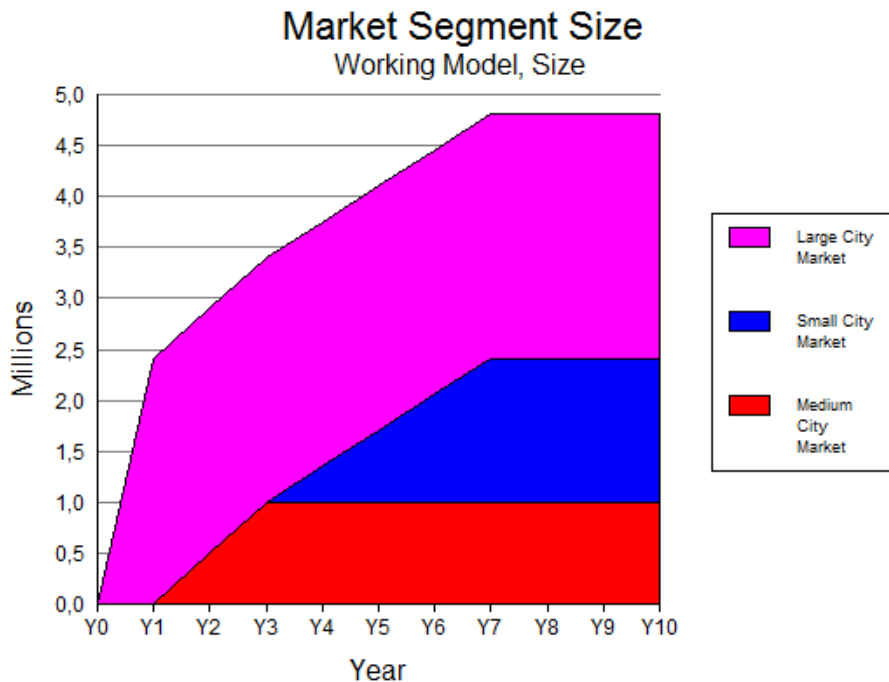
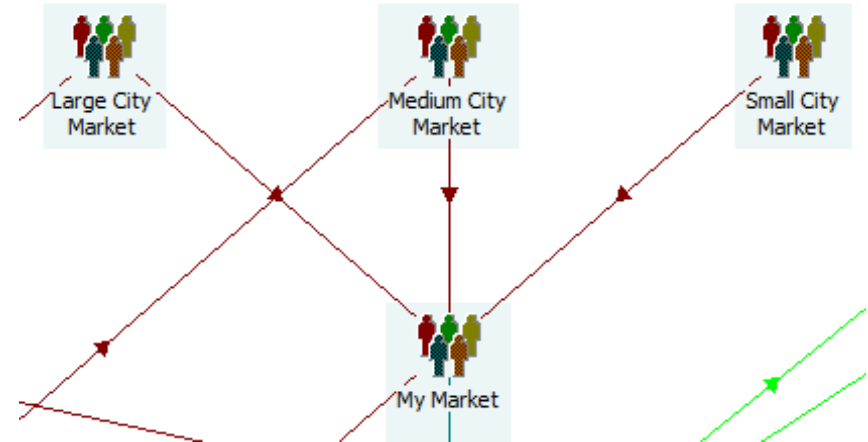
- LTE roll-out over several years in 3 types of cities
- Single flat-rate data service with setup fee and monthly tariff
- Aggregation tree in access and backhaul network
- Using different transport technologies and
- Considering extra cost (marketing, personnel, licences etc.)



LTE roll-out example – Model structure

Cumulative market structure

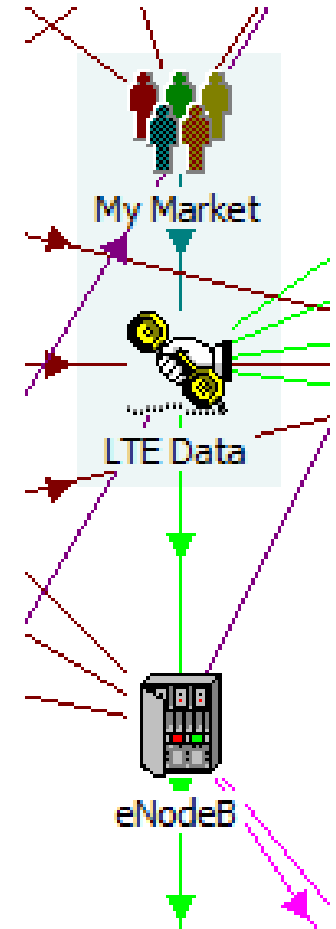
- Potential customer bases rises with the LTE roll-out progress
- Market penetration determines the resulting service demand



LTE roll-out example – Model structure

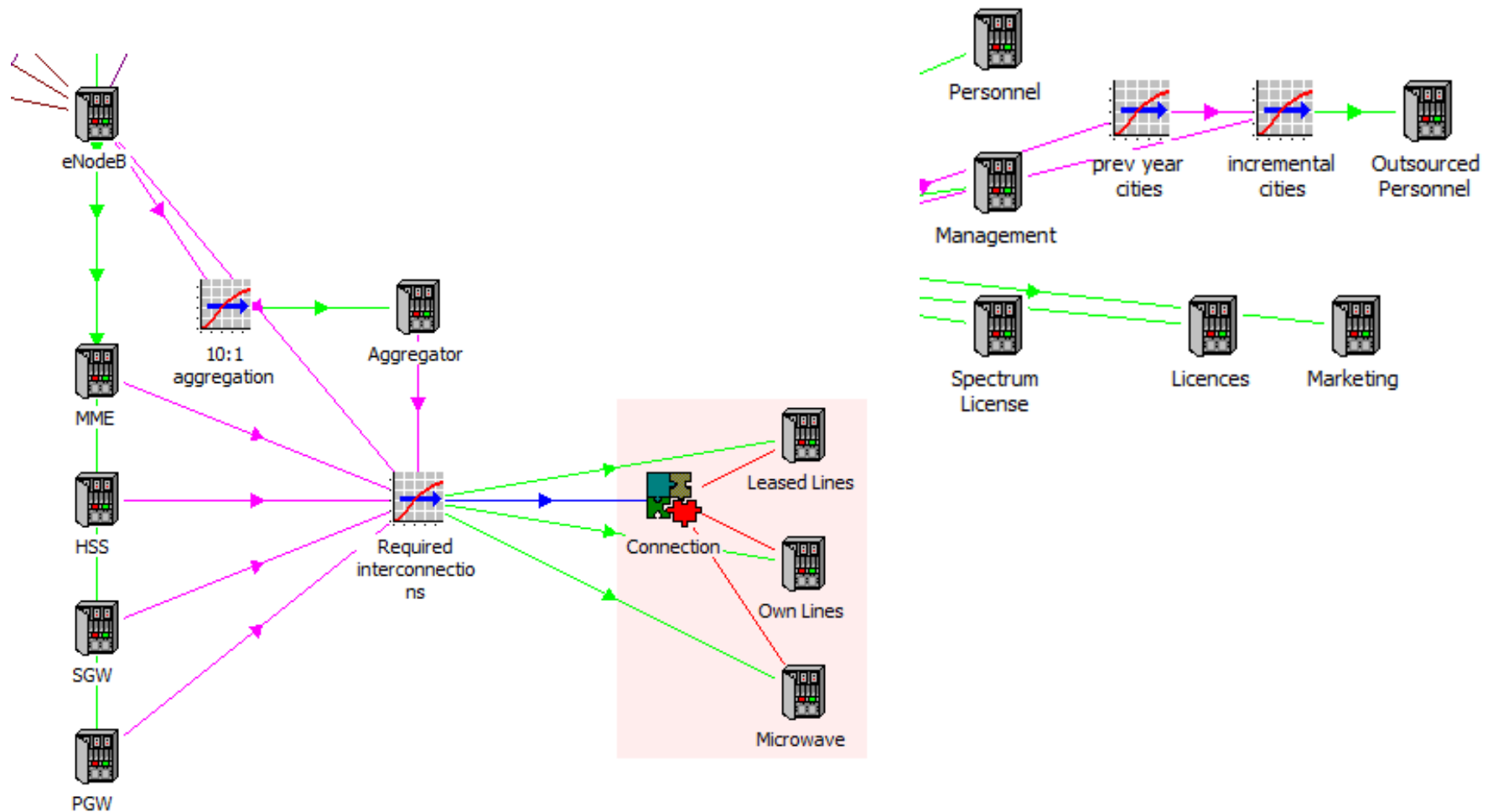
LTE data service

- Traffic demand calculation is peak driven
- Concentrates on assumed busy hour traffic given by nominal bandwidth and contention ratio
- ratio = level of overbooking between nominal bandwidth of active subscribers in the busy hour and the actually dimensioned traffic capacity of the network
- Assumption: nominal bandwidth = 30 Mbps and contention ratio = 20
- LTE data service with setup fee of 60 EUR and monthly flat rate tariff of 45 EUR



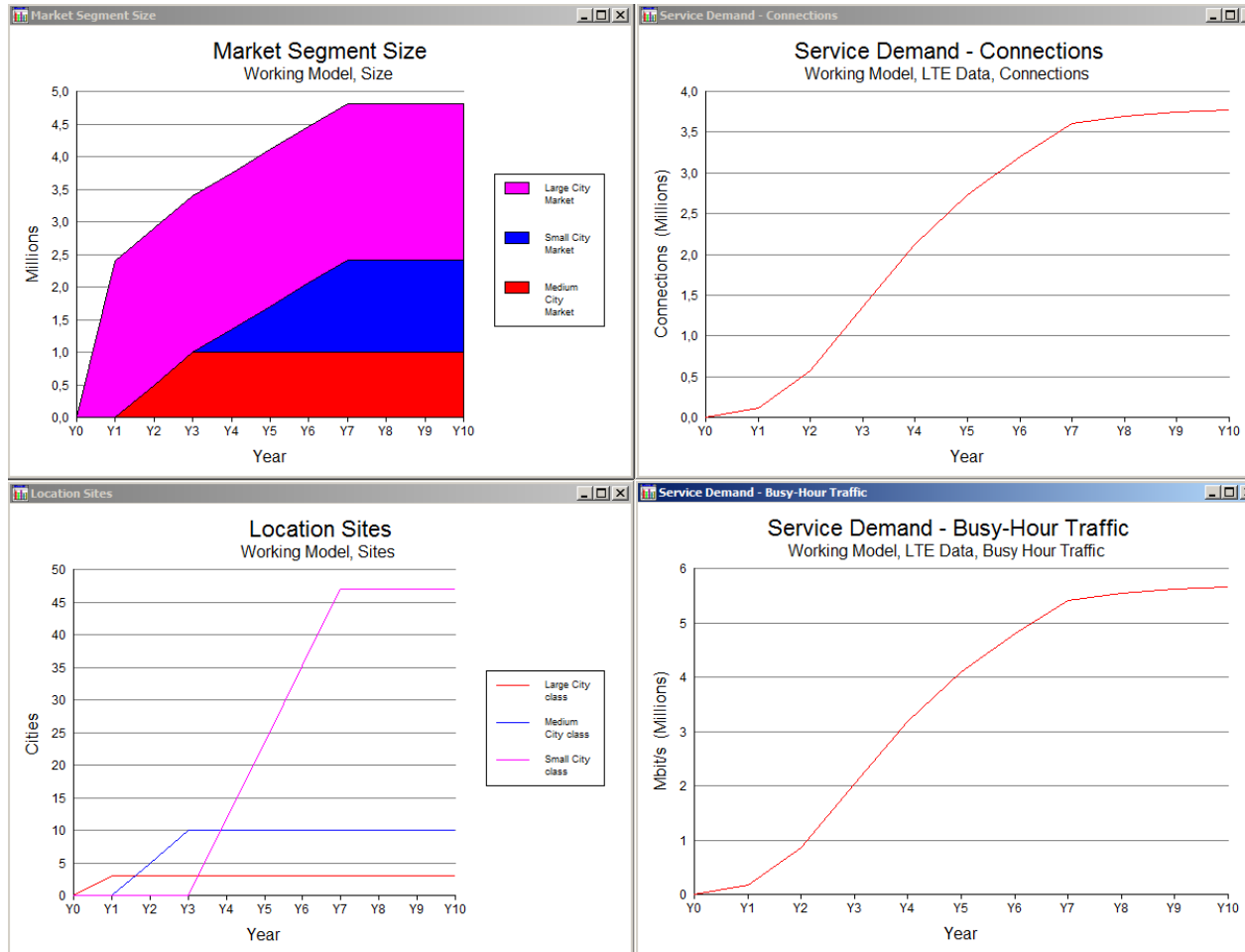
LTE roll-out example – Model structure

LTE elements, transport resources and general expenses



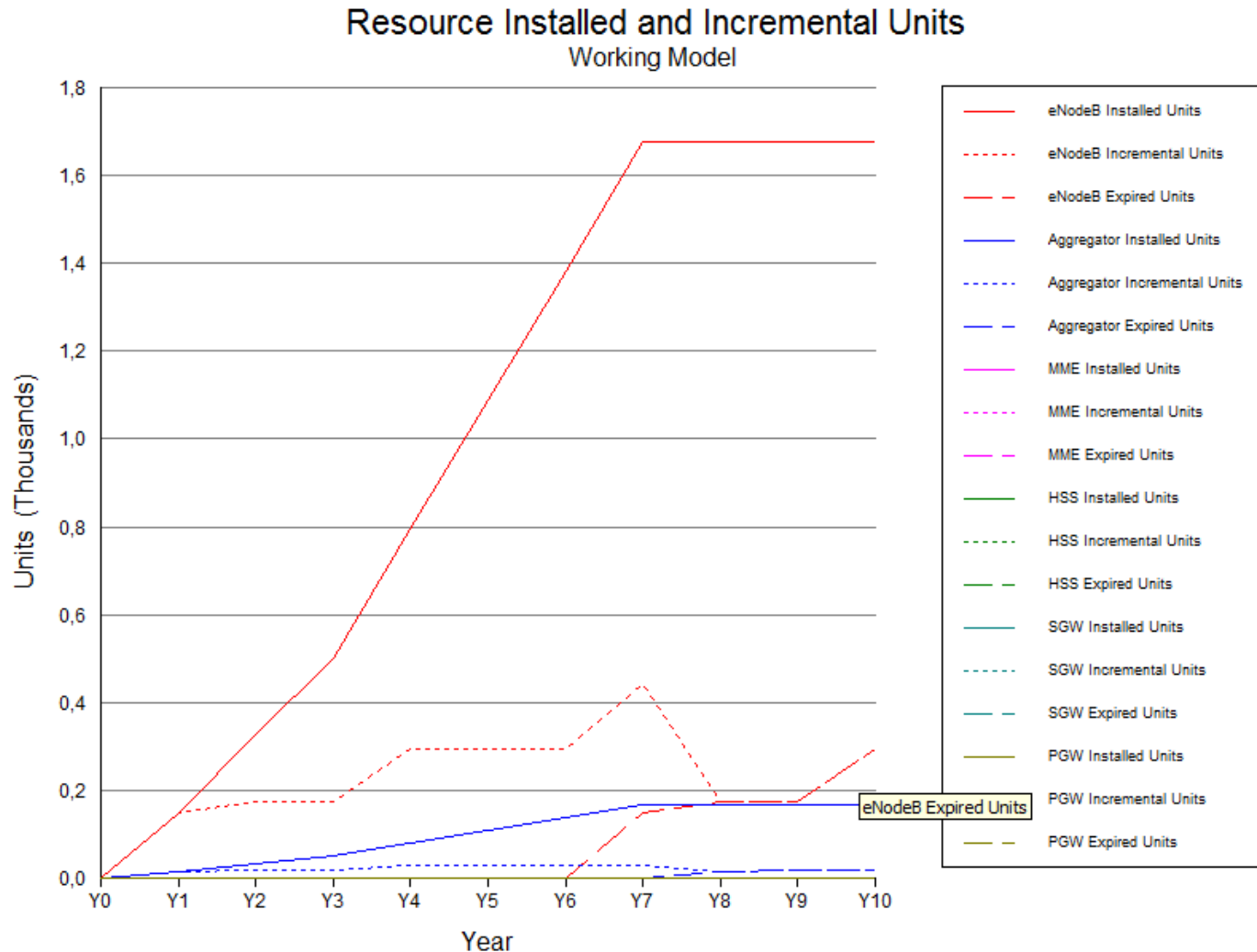
LTE roll-out example – Model results

Market and Demand figures



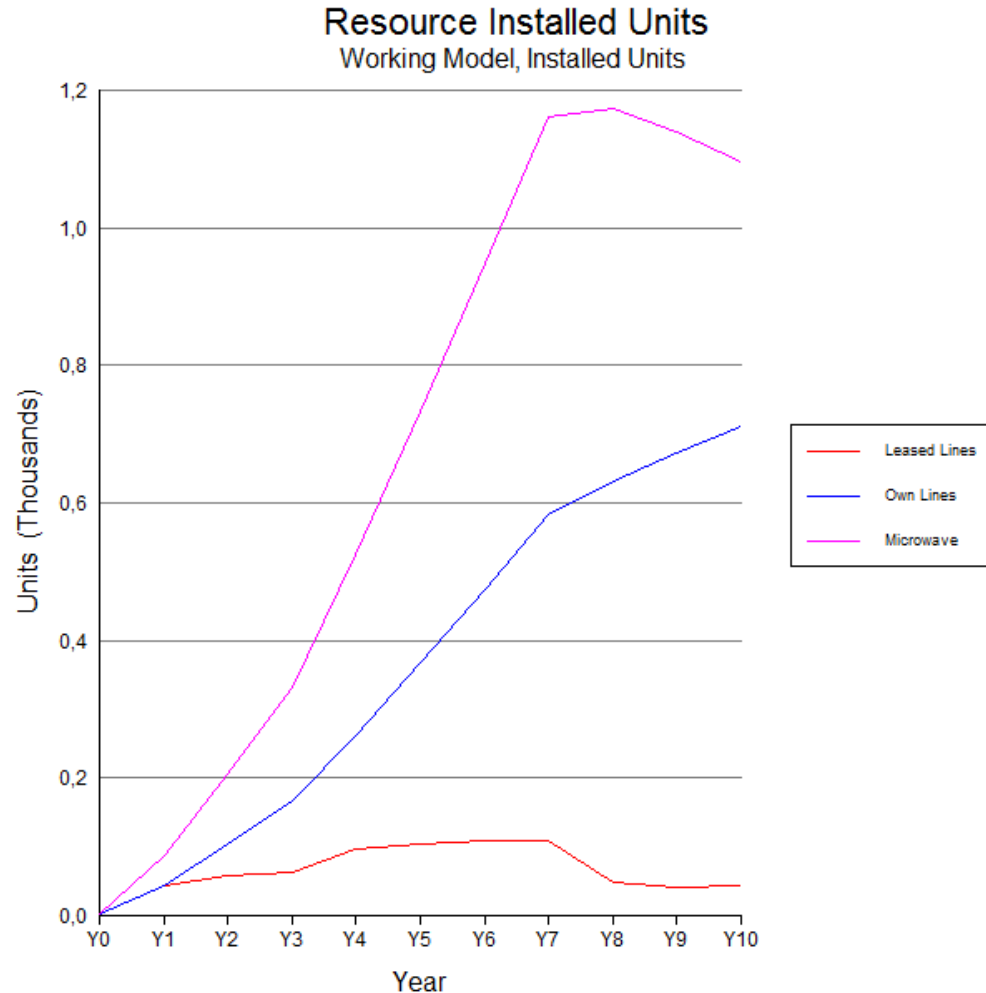
LTE roll-out example – Model results

Resources - Installed Units



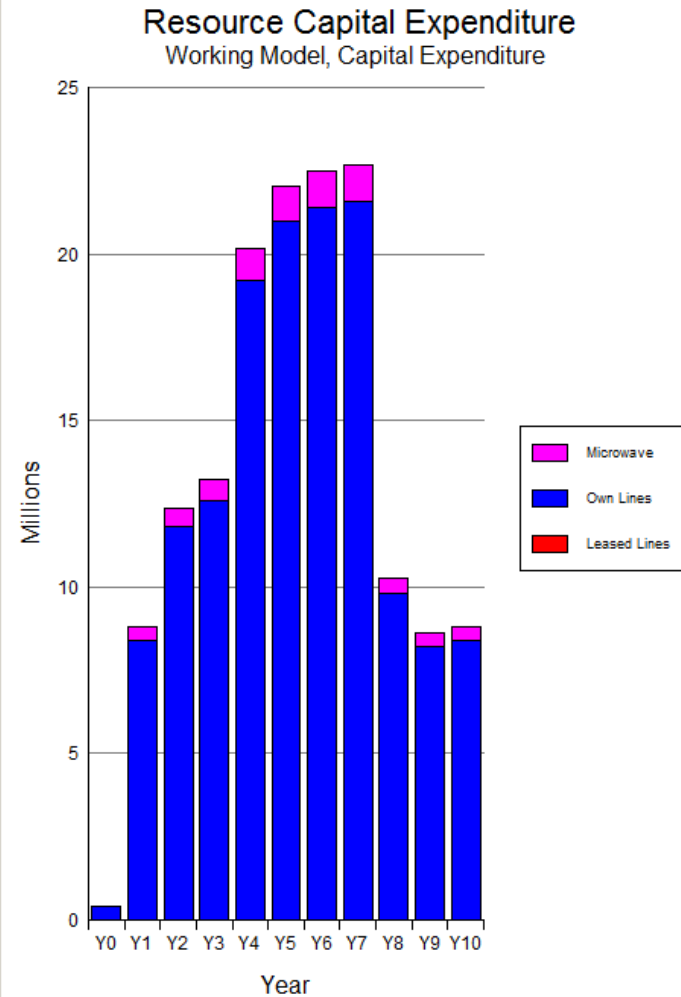
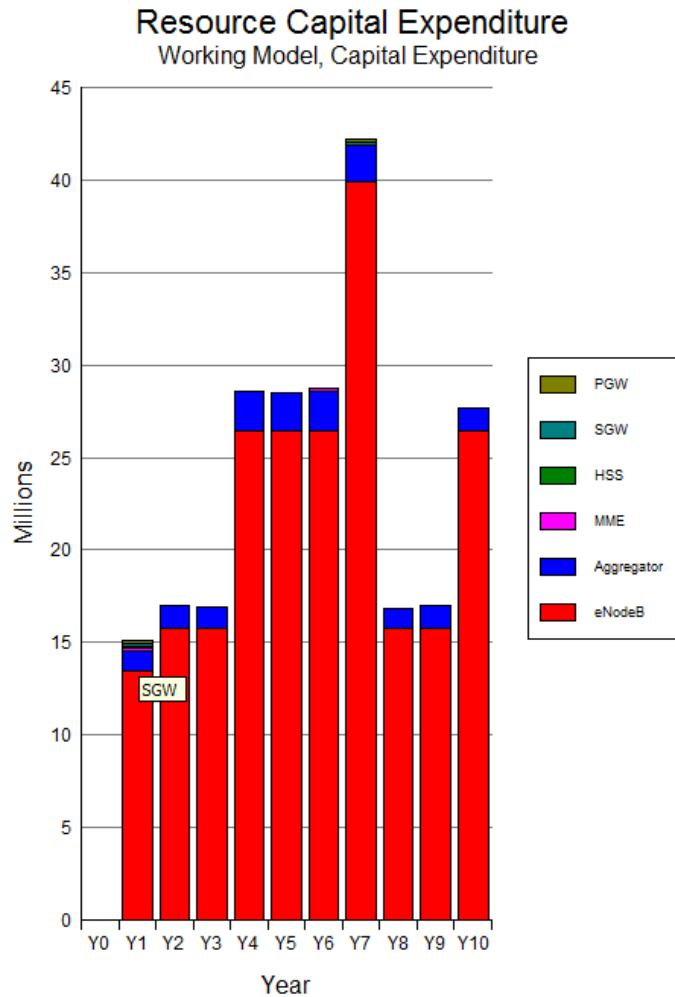
LTE roll-out example – Model results

Resources - Installed Units



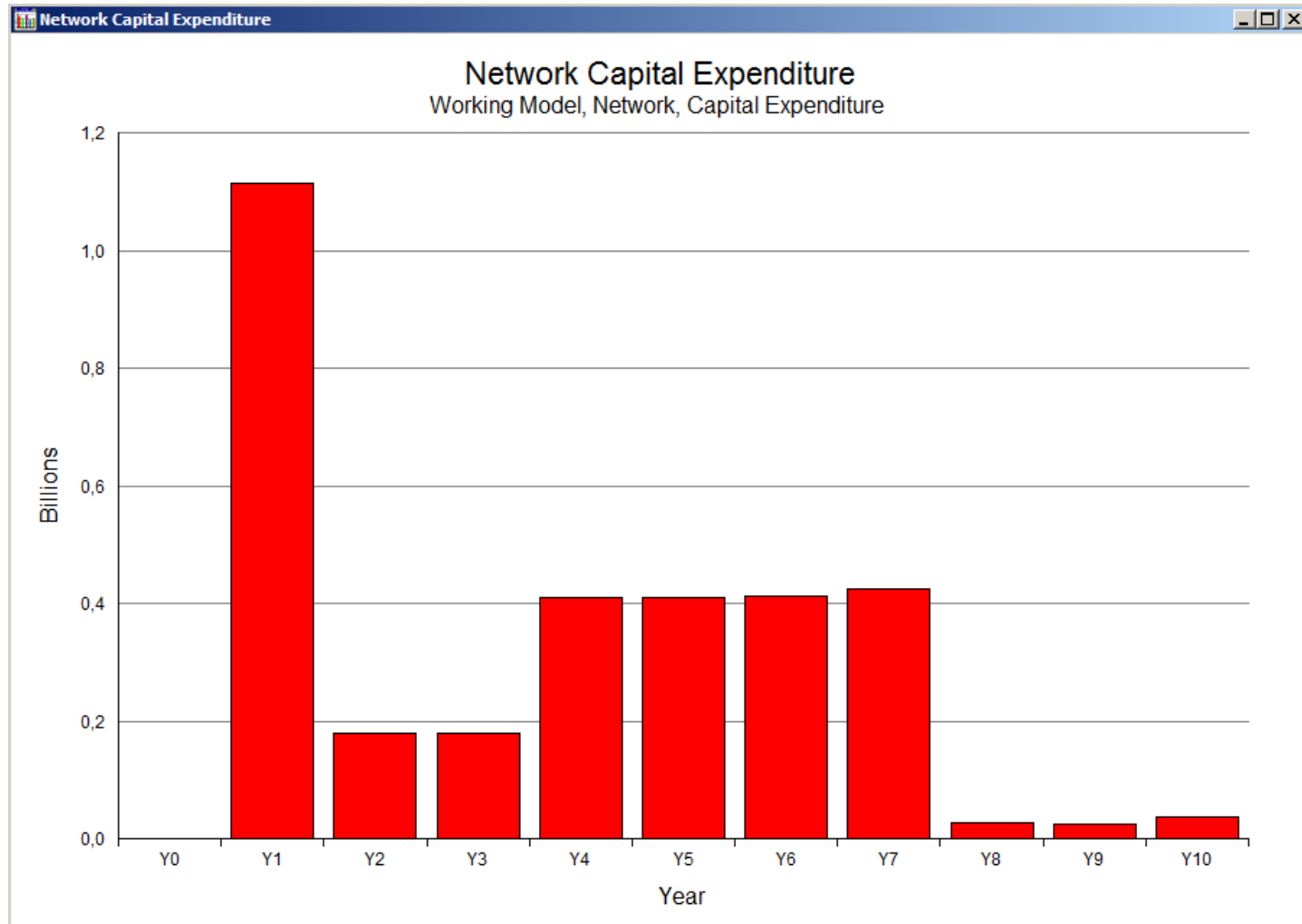
LTE roll-out example – Model results

CAPEX figures



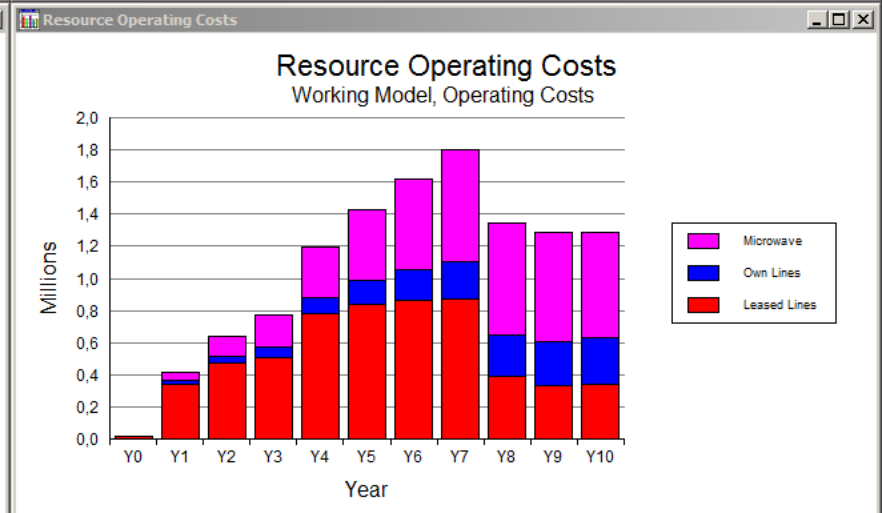
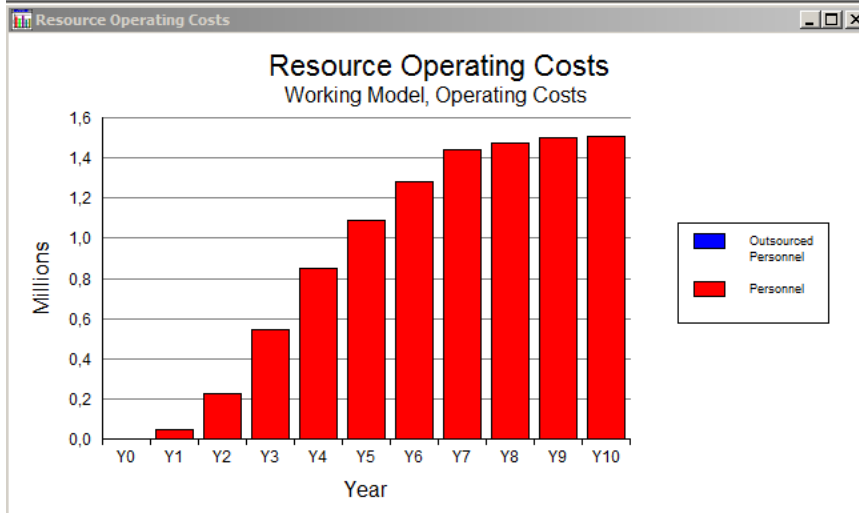
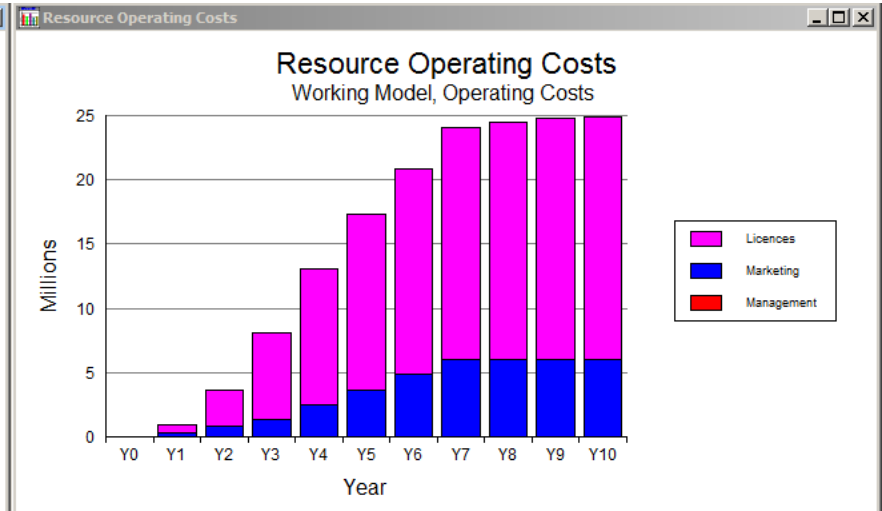
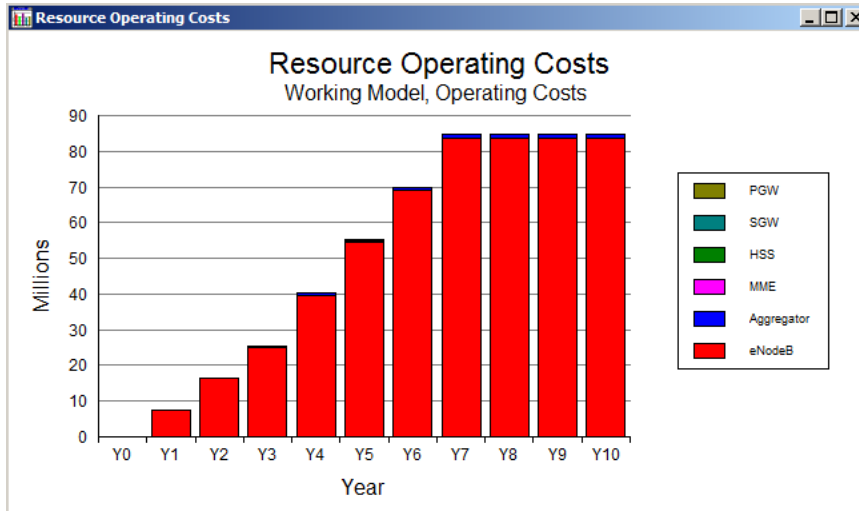
LTE roll-out example – Model results

CAPEX figures



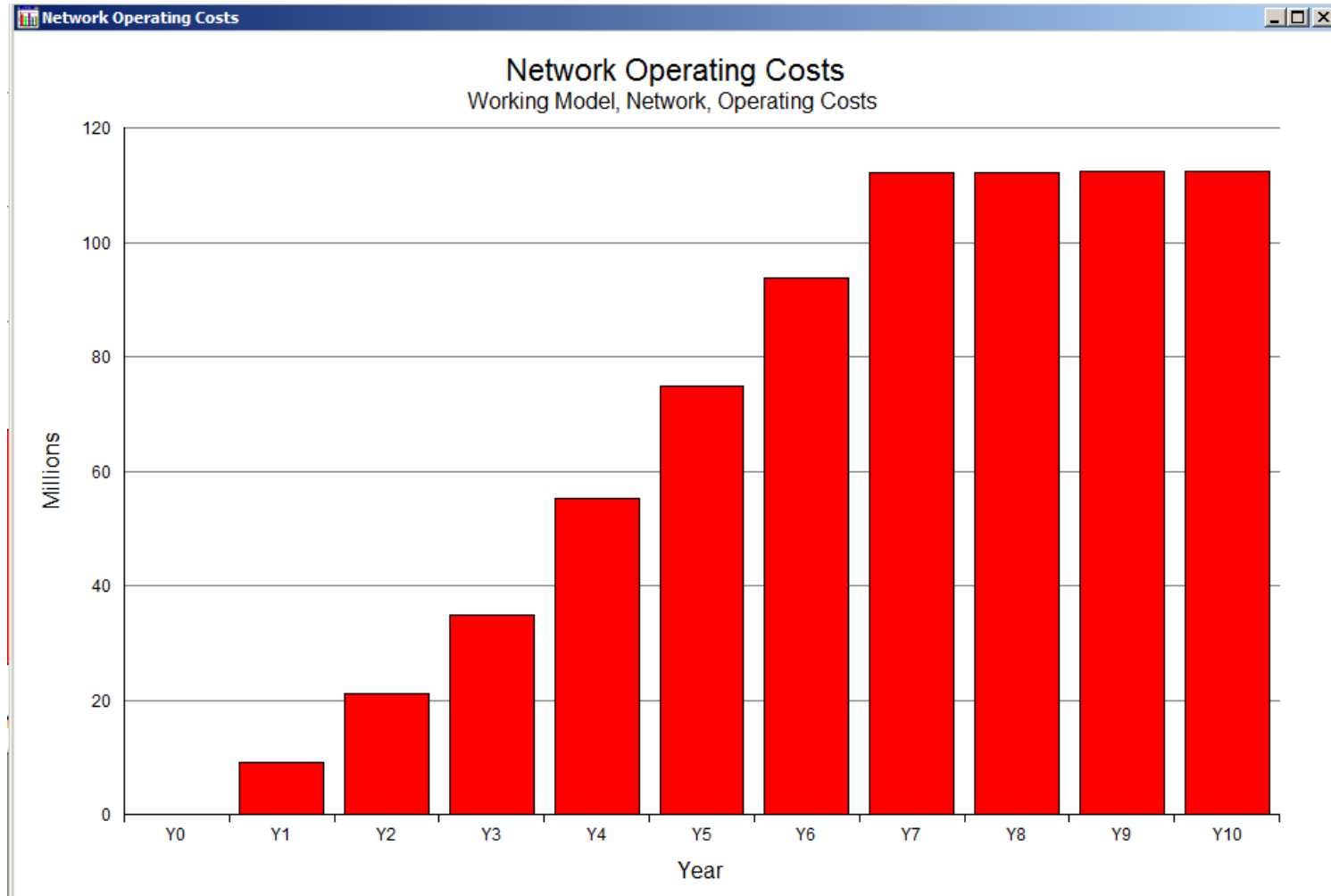
LTE roll-out example – Model results

OPEX figures



LTE roll-out example – Model results

OPEX figures



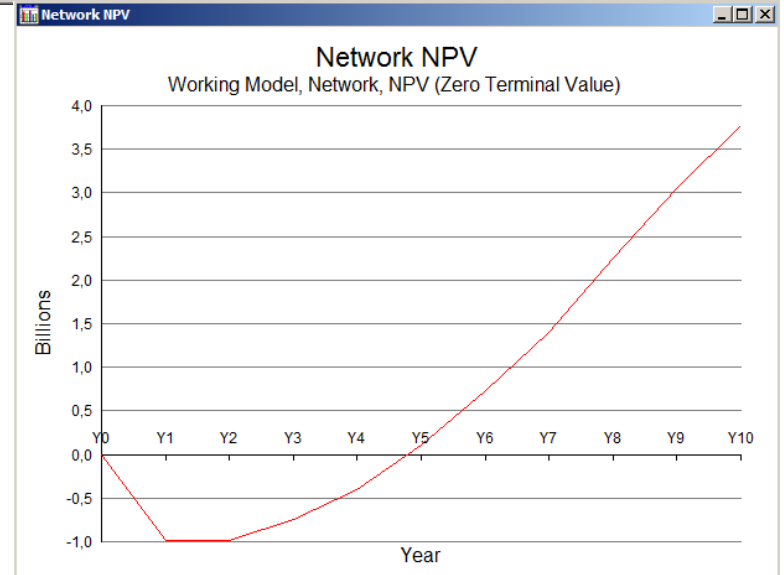
LTE roll-out example – Model results

Financial statements

Millions	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Cash	0	1	2	3	5	6	8	9	9	9	9
Cash Deposits	0	0	0	0	346	1.175	2.276	3.584	5.411	7.281	9.163
Debtors	0	3	18	47	81	110	134	153	162	165	167
Current Assets	0	4	19	50	431	1.291	2.418	3.746	5.583	7.456	9.339
Net Tangible Assets	0	21	43	61	92	117	136	162	148	133	128
Net Intangible Assets	0	933	867	800	733	667	600	533	467	400	333
Investments	0	0	0	0	0	0	0	0	0	0	0
Long-Term Assets	0	954	909	861	825	784	736	695	615	533	461
Total Assets	0	958	929	911	1.256	2.075	3.154	4.441	6.198	7.989	9.800
Overdraft	0	0	0	0	0	0	0	0	0	0	0
Long-Term Borrowing Payable	0	96	93	28	0	0	0	0	0	0	0
Creditors	0	1	2	3	5	6	8	9	9	9	9
Tax Payable	0	0	0	0	0	0	0	0	0	0	0
Dividends Payable	0	0	0	0	0	0	0	0	0	0	0
Current Liabilities	0	97	95	31	5	6	8	9	9	9	9
Borrowing Payable after One Yr.	0	383	371	112	0	0	0	0	0	0	0
Total Liabilities	0	480	466	143	5	6	8	9	9	9	9
Share Capital	0	608	624	624	624	624	624	624	624	624	624
Retained Earnings	-0	-130	-162	144	627	1.444	2.522	3.807	5.565	7.355	9.166
Equity	0	478	463	768	1.252	2.069	3.146	4.432	6.189	7.980	9.791
Total Liabilities plus Equity	0	958	929	911	1.256	2.075	3.154	4.441	6.198	7.989	9.800

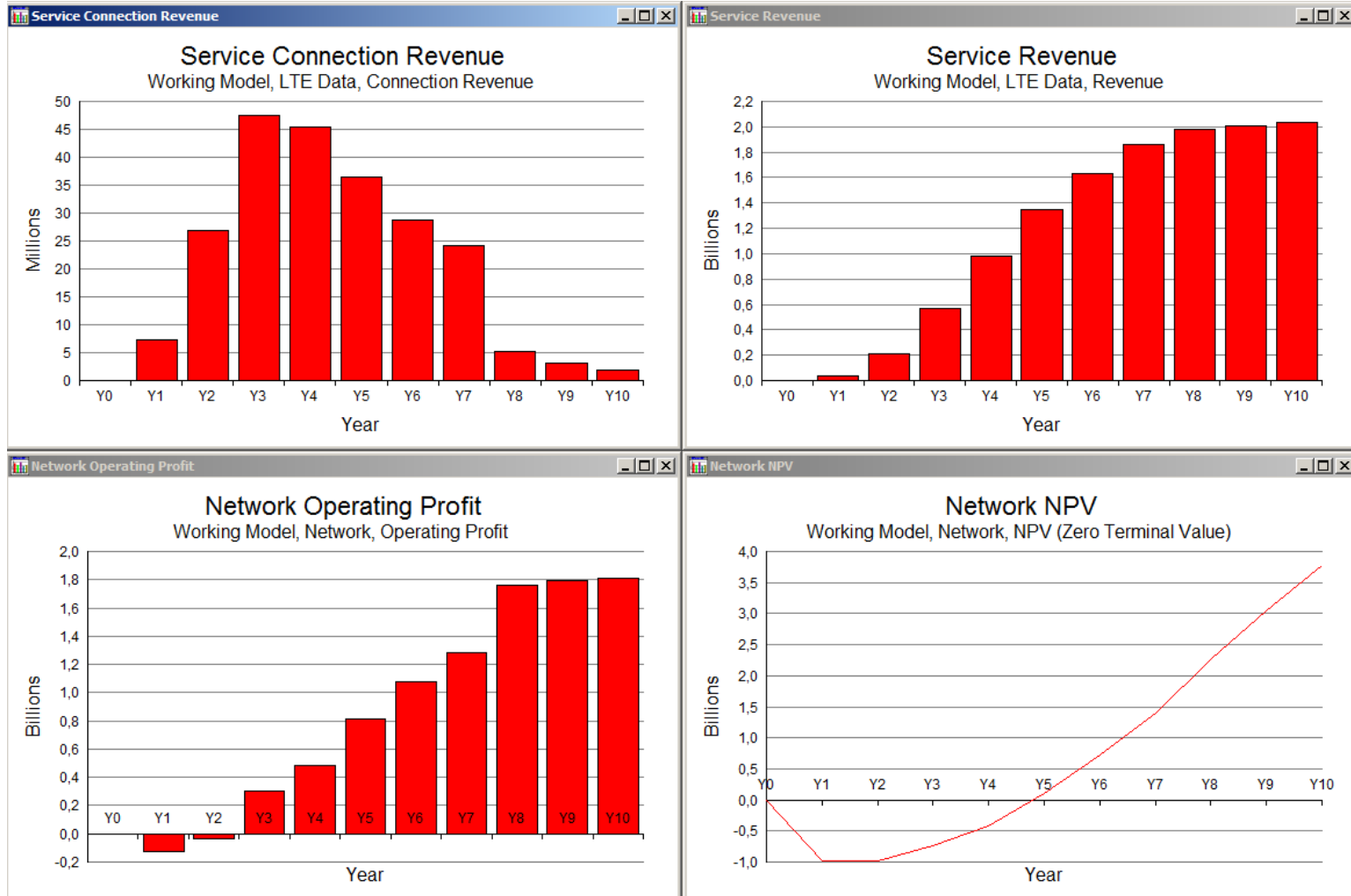
Millions	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Pre-Tax Profit	-0	-129	-32	305	484	817	1.078	1.286	1.757	1.791	1.811
Depreciation	0	93	157	162	378	385	392	399	40	41	42
Amortisation	0	67	67	67	67	67	67	67	67	67	67
Profit on Sale of Assets	0	0	0	0	0	0	0	0	0	0	0
Ch. in Debtors less Creditors	0	3	13	28	32	28	22	18	9	3	2
Tax Paid	0	0	0	0	0	0	0	0	0	0	0
Cashflow from Operations	-0	28	179	505	896	1.241	1.514	1.734	1.855	1.896	1.918
Cap. Ex. - Tangible	0	114	179	180	409	411	411	425	27	26	36
Cap. Ex. - Intangible	0	1.000	0	0	0	0	0	0	0	0	0
Proceeds from Sale of Assets	0	0	0	0	0	0	0	0	0	0	0
Change in Investments	0	0	0	0	0	0	0	0	0	0	0
Cashflow before Financing	-0	-1.086	-1	325	488	830	1.103	1.309	1.828	1.870	1.881
Change in Total Borrowing	0	479	-15	-324	-140	0	0	0	0	0	0
Change in Share Capital	0	608	16	0	0	0	0	0	0	0	0
Dividends Paid	0	0	0	0	0	0	0	0	0	0	0
Cashflow after Financing	0	1	1	1	347	830	1.103	1.309	1.828	1.870	1.881
Ch. in Cash plus Cash Deposits	0	1	1	1	347	830	1.103	1.309	1.828	1.870	1.881

Millions	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Revenue	0	40	213	568	984	1.344	1.630	1.864	1.976	2.011	2.032
Depreciation	0	93	157	162	378	385	392	399	40	41	42
Amortisation	0	67	67	67	67	67	67	67	67	67	67
Operating Costs	0	9	21	35	55	75	94	112	112	112	113
Operating Profit	-0	-129	-32	305	484	817	1.078	1.286	1.757	1.791	1.811
Profit on Sale of Assets	0	0	0	0	0	0	0	0	0	0	0
Interest Income	0	0	0	0	0	0	0	0	0	0	0
Interest Expense	0	0	0	0	0	0	0	0	0	0	0
Debt Fees	0	0	0	0	0	0	0	0	0	0	0
Pre-Tax Profit	-0	-129	-32	305	484	817	1.078	1.286	1.757	1.791	1.811
Tax Charge	0	0	0	0	0	0	0	0	0	0	0
Net Profit	-0	-129	-32	305	484	817	1.078	1.286	1.757	1.791	1.811
Dividends Declared	0	0	0	0	0	0	0	0	0	0	0
Retained Profit	-0	-129	-32	305	484	817	1.078	1.286	1.757	1.791	1.811



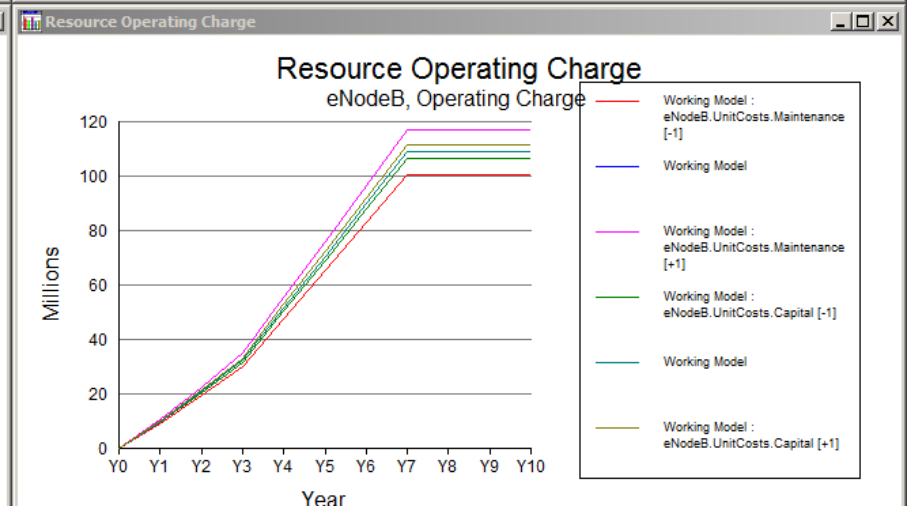
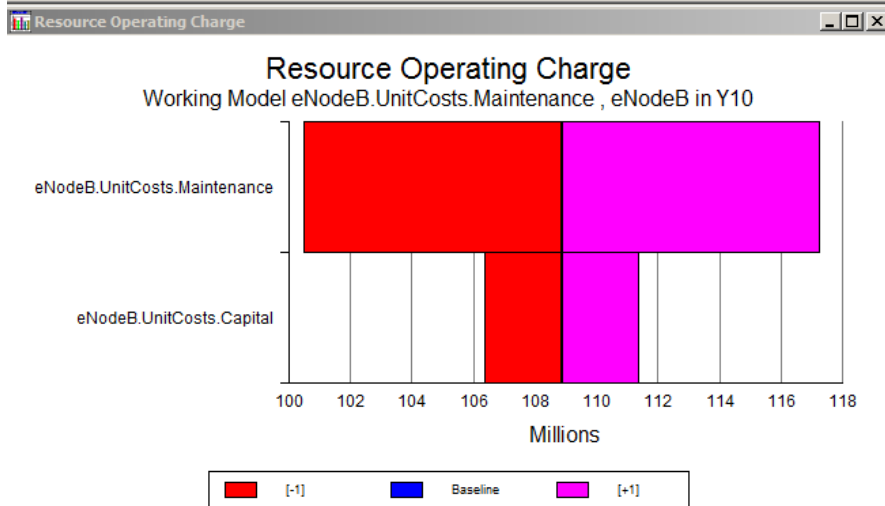
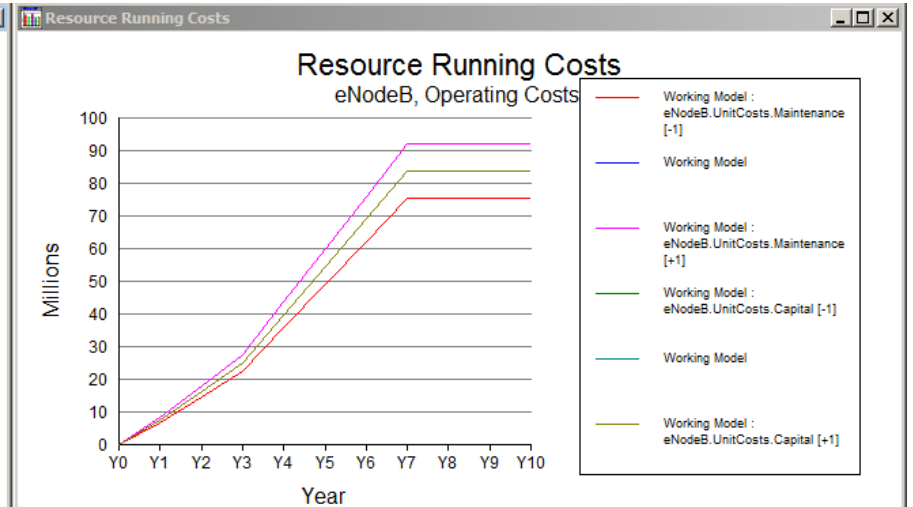
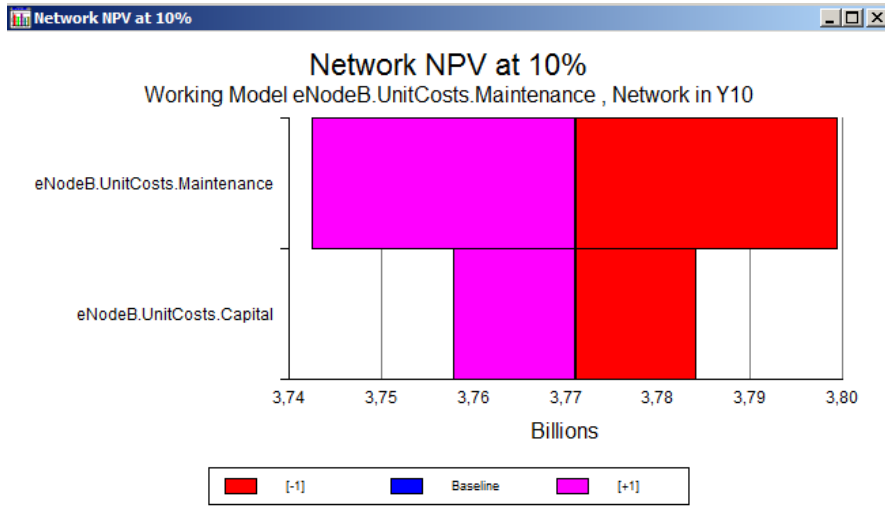
LTE roll-out example – Model results

Revenue and Profit



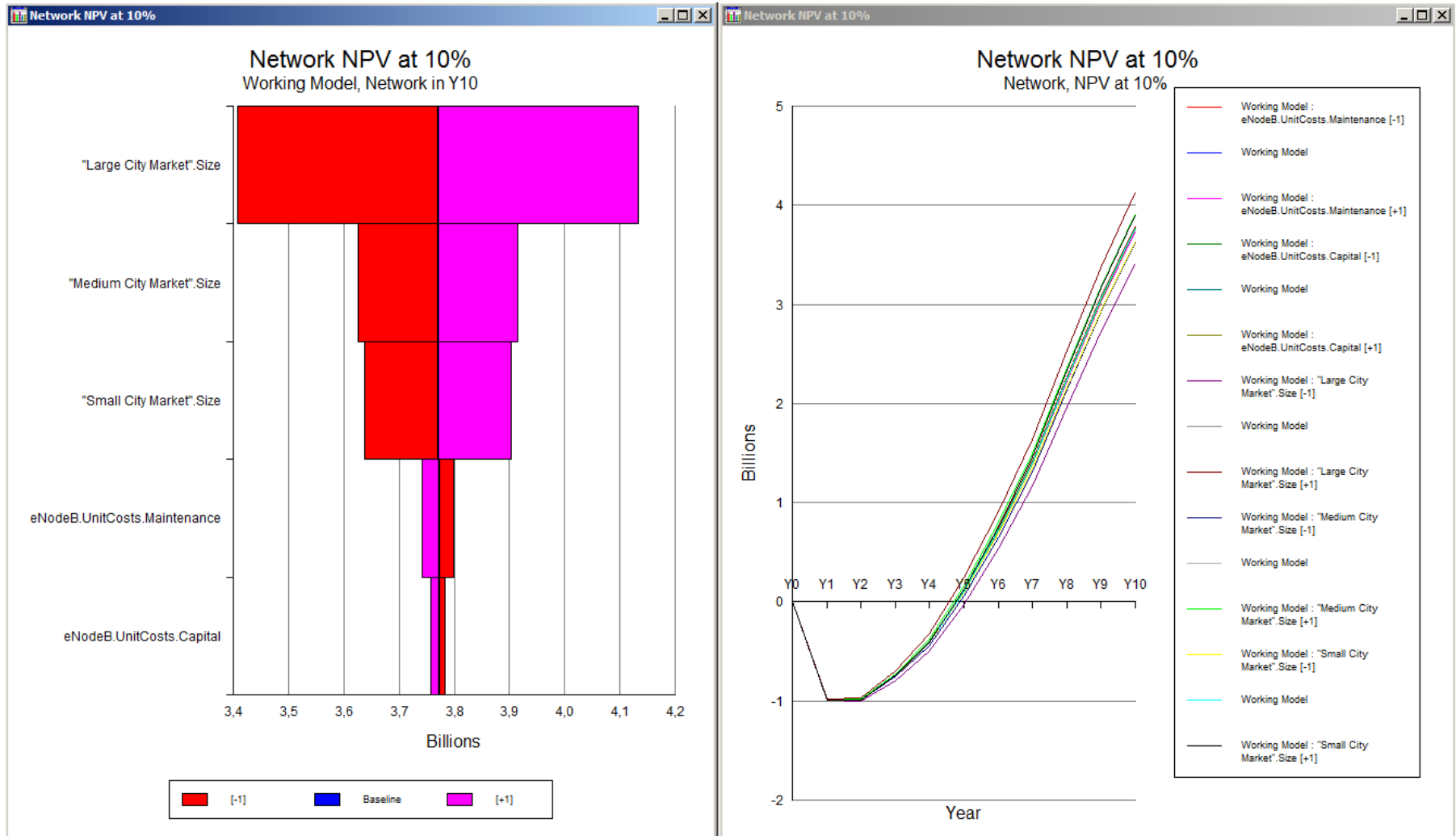
LTE roll-out example – Model results

Sensitivity analysis / Tornado graph



LTE roll-out example – Model results

Sensitivity analysis / Tornado graph



Summary

- Complex ventures (even this 3 stage LTE roll-out) requires techno-economic modelling
- Modelling reveals internal dependencies and cost drivers
- Modelling results depict investment cycles and allow for financial planning
- STEM covers CAPEX, OPEX, Financial Statements and Sensitivity analysis at once
- Detailed sub-models for equipment, transport and energy cost structures are currently developed.
- Study items:
 - Centralized vs. Decentralized EPC architecture
 - Influence of IXP placement
 - Influence of traffic demand mix changes