ESMAP
Energy Sector Management Assistance Program

CHRISTIAN MAHLER (WORLD BANK)

Tool for Rapid Assessment of City Energy (TRACE)

Supporting cities in tapping their energy efficiency potentials





Agenda

- Introduction to TRACE
- Experience from Ukraine, Brazil, India and Kyrgyz Republic

TRACE – Tool for Rapid Assessment of City Energy

A practical tool for conducting rapid assessment of energy use in cities, that identifies and prioritizes sectors and suggests specific energy efficiency interventions…

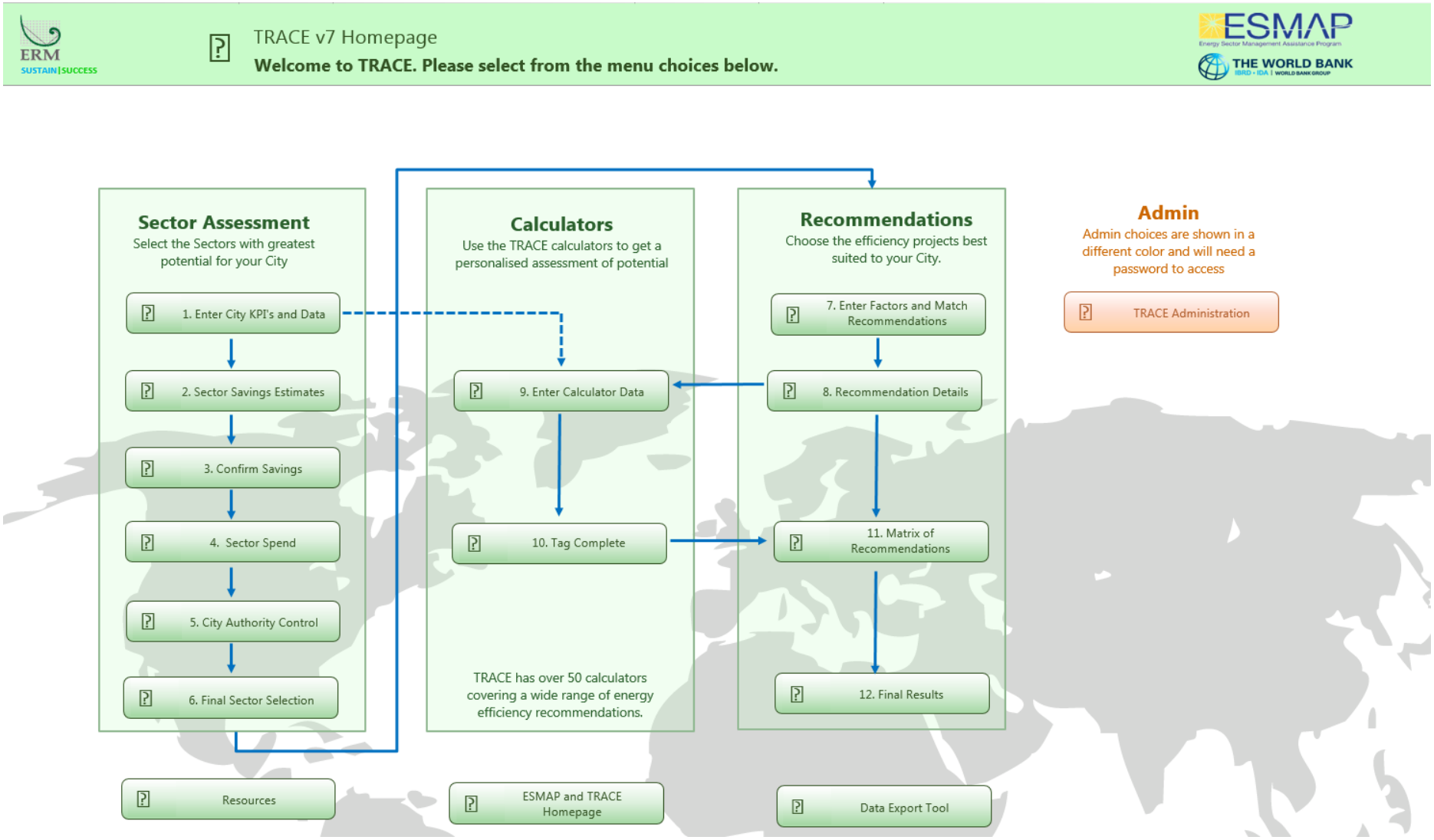
Sector coverage: transport, buildings (new: residential and commercial buildings), public lighting, water & wastewater, power & heating, solid waste, industry (new)

What's new?

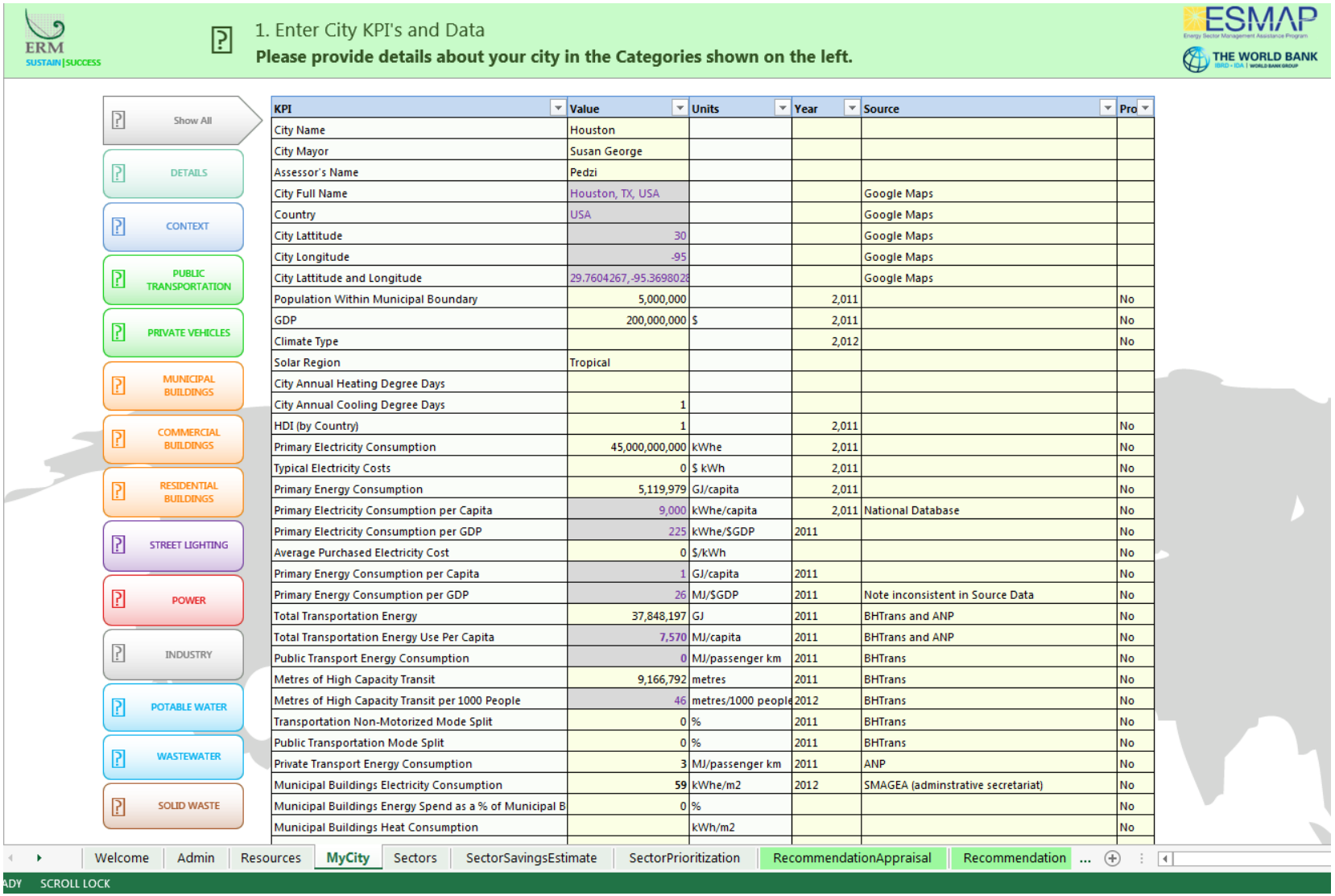
The update takes stock of the lessons learnt from over 60 TRACE deployments worldwide

- **Three new sectors:** residential and commercial buildings as well as urban industry
- About **100 built-in recommendations**
- Offers full spectrum of guidelines and case studies to **deliver EE interventions**, such as PPP, leasing, municipal financing, ESCO financing
- Upon determining sector recommendations TRACE allows financial analysis through built-in **intervention models** (calculators)
- Updated data for **97 cities** worldwide

TRACE architecture



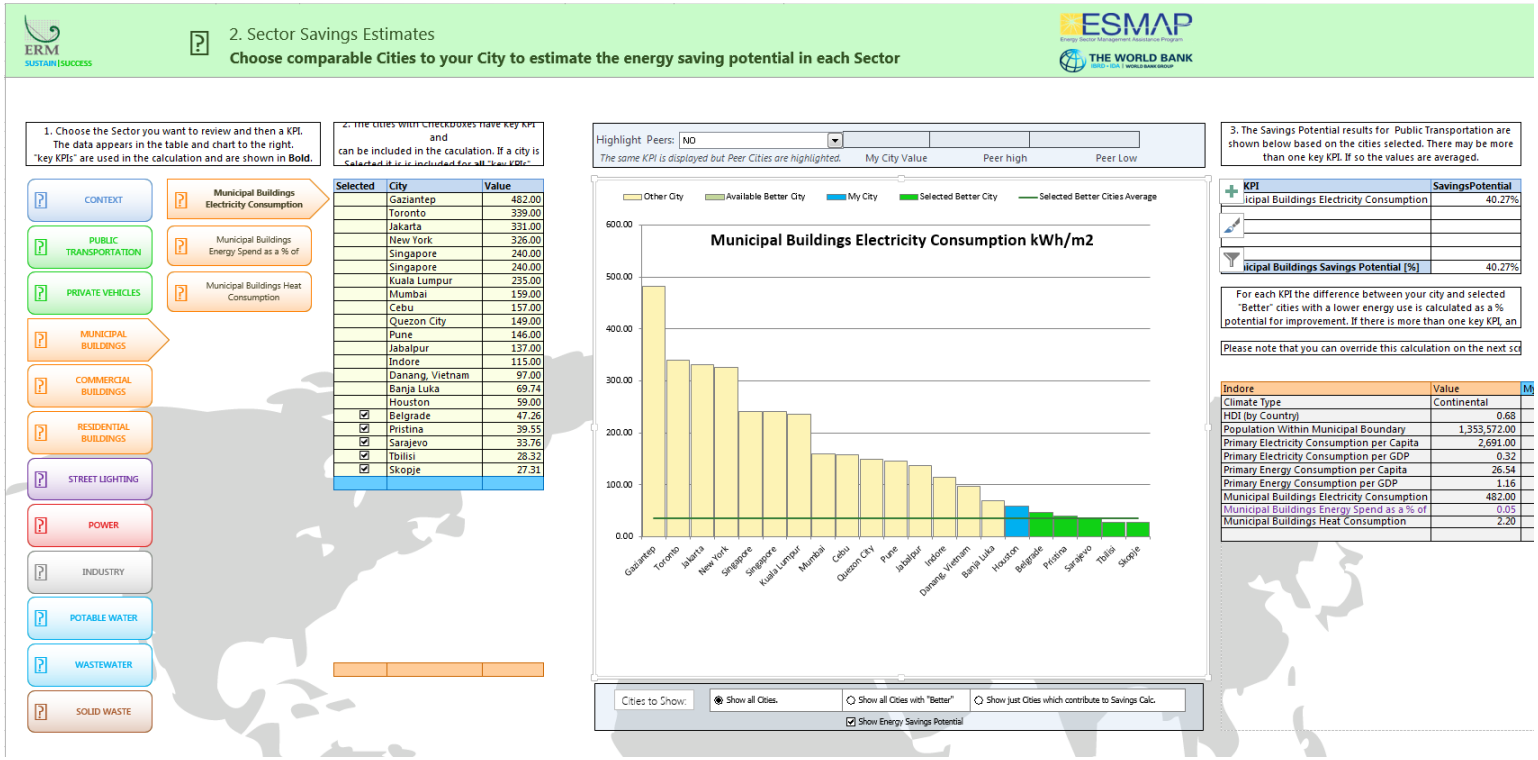
1. On-site data collection



KPI	Value	Units	Year	Source	Pro
City Name	Houston				
City Mayor	Susan George				
Assessor's Name	Pedzi				
City Full Name	Houston, TX, USA			Google Maps	
Country	USA			Google Maps	
City Lattitude	30			Google Maps	
City Longitude	-95			Google Maps	
City Lattitude and Longitude	29.7604267,-95.3698028			Google Maps	
Population Within Municipal Boundary	5,000,000		2,011		No
GDP	200,000,000	$	2,011		No
Climate Type			2,012		No
Solar Region	Tropical				
City Annual Heating Degree Days					
City Annual Cooling Degree Days	1				
HDI (by Country)	1		2,011		No
Primary Electricity Consumption	45,000,000,000	kWhe	2,011		No
Typical Electricity Costs	0	$ kWh	2,011		No
Primary Energy Consumption	5,119,979	GJ/capita	2,011		No
Primary Electricity Consumption per Capita	9,000	kWhe/capita	2,011	National Database	No
Primary Electricity Consumption per GDP	225	kWhe/$GDP	2011		No
Average Purchased Electricity Cost	0	$/kWh			No
Primary Energy Consumption per Capita	1	GJ/capita	2011		No
Primary Energy Consumption per GDP	26	MJ/$GDP	2011	Note inconsistent in Source Data	No
Total Transportation Energy	37,848,197	GJ	2011	BHTrans and ANP	No
Total Transportation Energy Use Per Capita	7,570	MJ/capita	2011	BHTrans and ANP	No
Public Transport Energy Consumption	0	MJ/passenger km	2011	BHTrans	No
Metres of High Capacity Transit	9,166,792	metres	2011	BHTrans	No
Metres of High Capacity Transit per 1000 People	46	metres/1000 people	2012	BHTrans	No
Transportation Non-Motorized Mode Split	0	%	2011	BHTrans	No
Public Transportation Mode Split	0	%	2011	BHTrans	No
Private Transport Energy Consumption	3	MJ/passenger km	2011	ANP	No
Municipal Buildings Electricity Consumption	59	kWhe/m2	2012	SMAGEA (adminstrative secretariat)	No
Municipal Buildings Energy Spend as a % of Municipal B	0	%			No
Municipal Buildings Heat Consumption		kWh/m2			No

2. Benchmarking

Selection of 10-12 peer cities with a similar climate and level of development gives an idea of the relative potential for energy efficiency



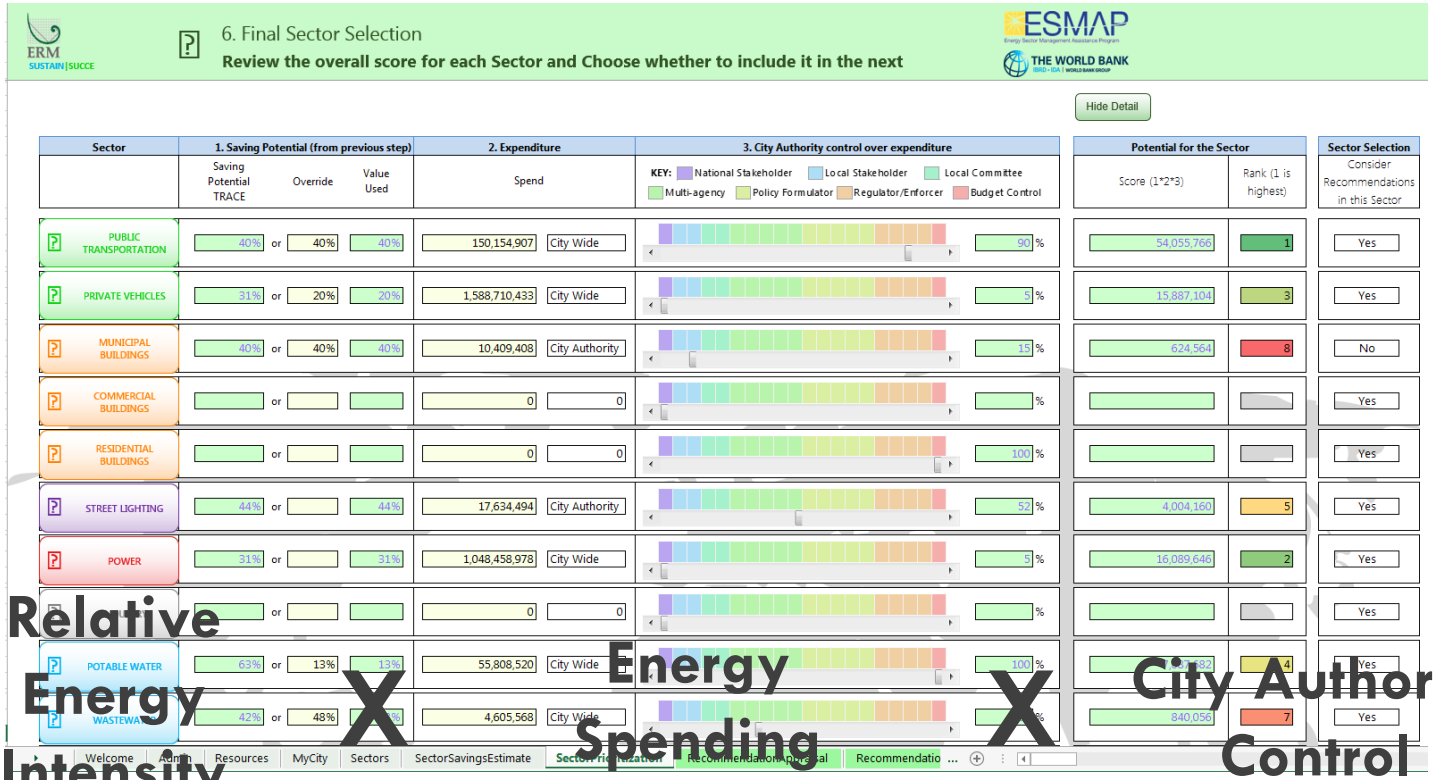
Beware of wrong conclusions as local peculiarities might skew results (e.g. down-hill flow of potable water might significantly reduce electricity consumption for pumps)

3. Sector prioritization

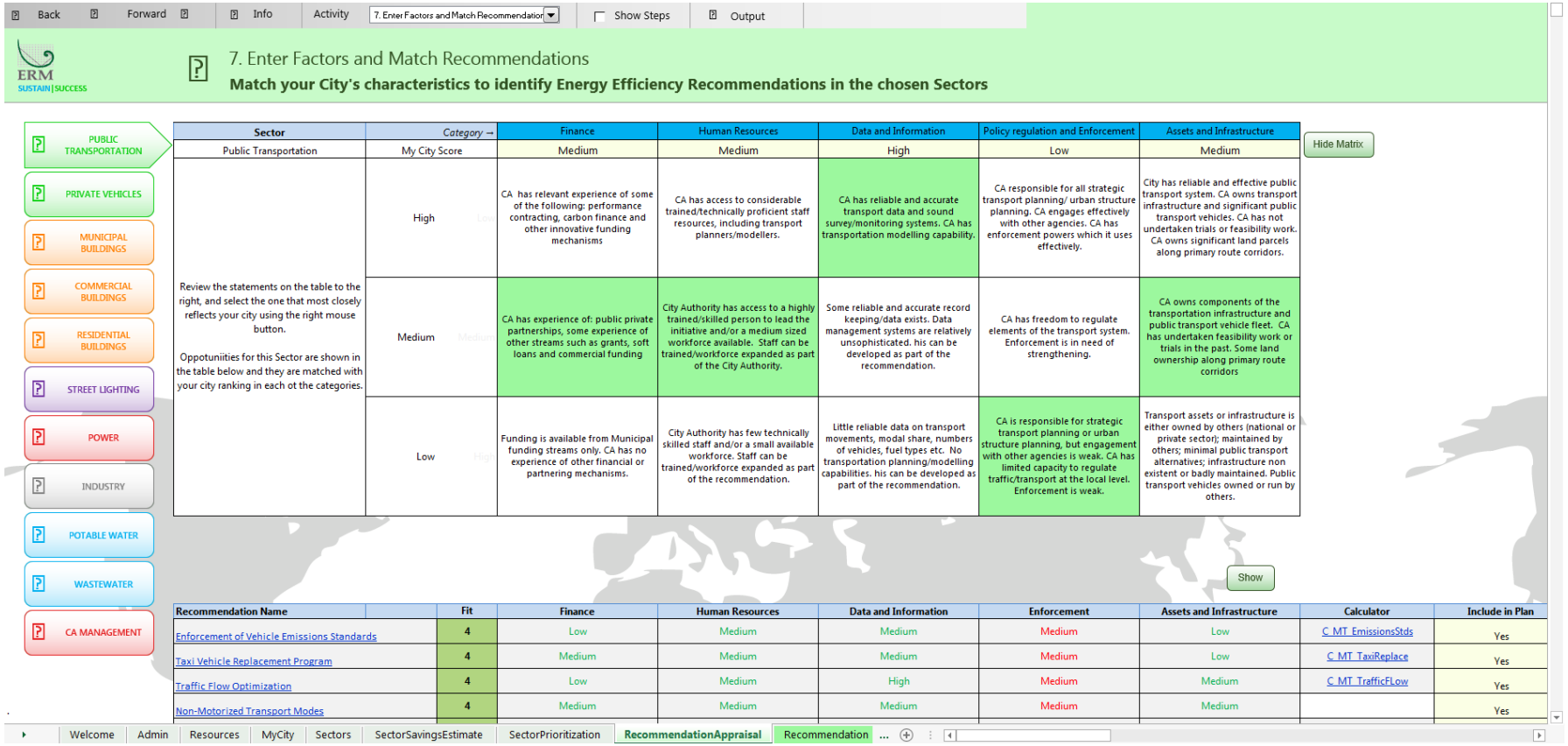
Purpose

- Sheds light on sector control and potential EE benefits for City Authority
- Weights energy efficiency potentials and savings
- Identifies energy spending hotspots and potential energy efficiency savings

Calculation



4. Selection and fine-tuning of recommendations

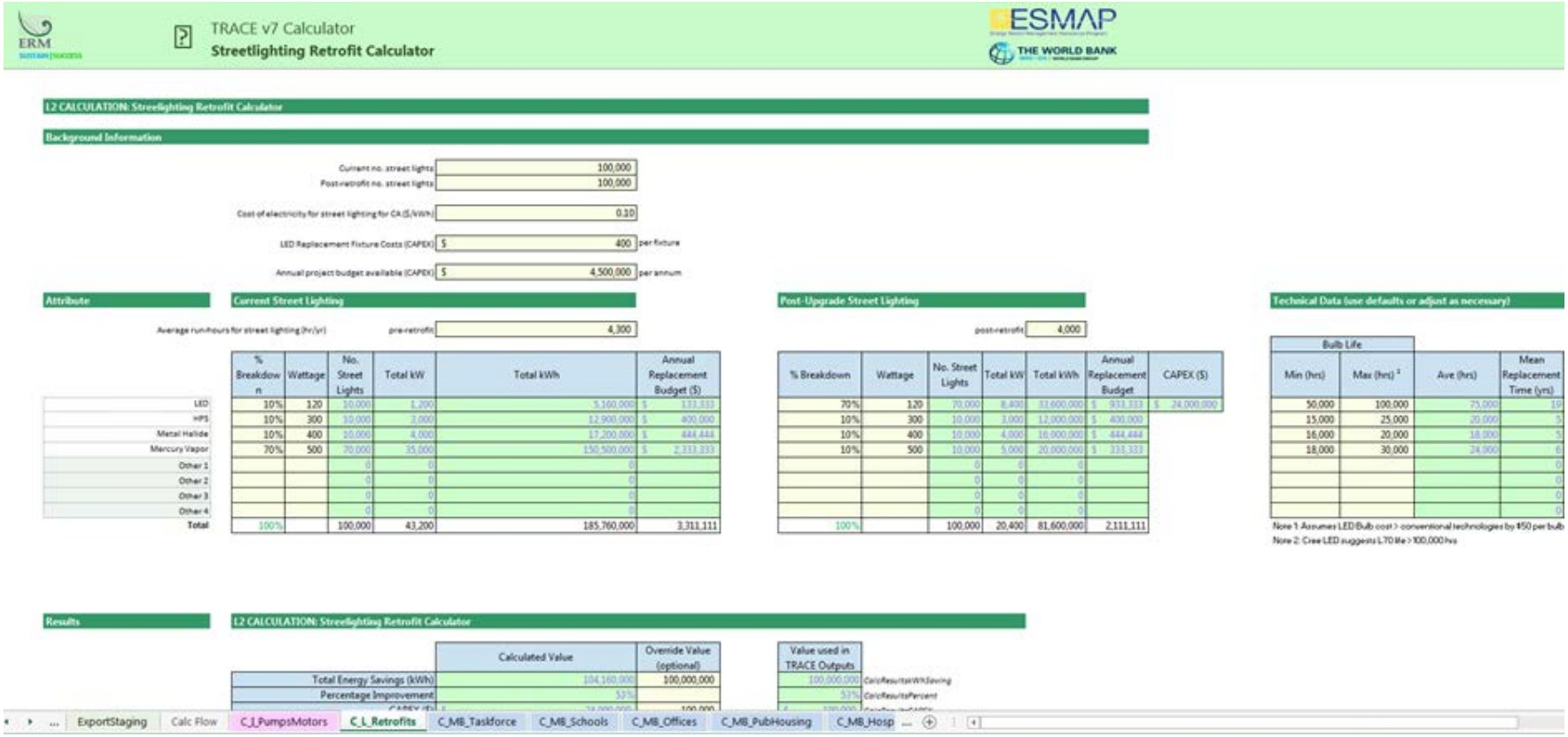


Sector	Category →	Finance	Human Resources	Data and Information	Policy regulation and Enforcement	Assets and Infrastructure
Public Transportation	My City Score	Medium	Medium	High	Low	Medium
Review the statements on the table to the right, and select the one that most closely reflects your city using the right mouse button. Oppotuniities for this Sector are shown in the table below and they are matched with your city ranking in each ot the categories.	High	CA has relevant experience of some of the following: performance contracting, carbon finance and other innovative funding mechanisms	CA has access to considerable trained/technically proficient staff resources, including transport planners/modellers.	CA has reliable and accurate transport data and sound survey/monitoring systems. CA has transportation modelling capability.	CA responsible for all strategic transport planning/ urban structure planning. CA engages effectively with other agencies. CA has enforcement powers which it uses effectively.	City has reliable and effective public transport system. CA owns transport infrastructure and significant public transport vehicles. CA has not undertaken trials or feasibility work. CA owns significant land parcels along primary route corridors.
	Medium	CA has experience of: public private partnerships, some experience of other streams such as grants, soft loans and commercial funding	City Authority has access to a highly trained/skilled person to lead the initiative and/or a medium sized workforce available. Staff can be trained/workforce expanded as part of the City Authority.	Some reliable and accurate record keeping/data exists. Data management systems are relatively unsophisticated. his can be developed as part of the recommendation.	CA has freedom to regulate elements of the transport system. Enforcement is in need of strengthening.	CA owns components of the transportation infrastructure and public transport vehicle fleet. CA has undertaken feasibility work or trials in the past. Some land ownership along primary route corridors
	Low	Funding is available from Municipal funding streams only. CA has no experience of other financial or partnering mechanisms.	City Authority has few technically skilled staff and/or a small available workforce. Staff can be trained/workforce expanded as part of the recommendation.	Little reliable data on transport movements, modal share, numbers of vehicles, fuel types etc. No transportation planning/modelling capabilities. his can be developed as part of the recommendation.	CA is responsible for strategic transport planning or urban structure planning, but engagement with other agencies is weak. CA has limited capacity to regulate traffic/transport at the local level. Enforcement is weak.	Transport assets or infrastructure is either owned by others (national or private sector); maintained by others; minimal public transport alternatives; infrastructure non existent or badly maintained. Public transport vehicles owned or run by others.

Recommendation Name	Fit	Finance	Human Resources	Data and Information	Enforcement	Assets and Infrastructure	Calculator	Include in Plan
Enforcement of Vehicle Emissions Standards	4	Low	Medium	Medium	Medium	Low	C_MT_EmissionsStds	Yes
Taxi Vehicle Replacement Program	4	Medium	Medium	Medium	Medium	Low	C_MT_TaxiReplace	Yes
Traffic Flow Optimization	4	Low	Medium	High	Medium	Medium	C_MT_TrafficFLow	Yes
Non-Motorized Transport Modes	4	Medium	Medium	Medium	Medium	Medium		Yes

5. Intervention model

ESTIMATING THE COSTS AND BENEFITS OF EE INTERVENTIONS



TRACE v7 Calculator
Streetlighting Retrofit Calculator

L2 CALCULATION: Streetlighting Retrofit Calculator

Background Information

Current no. street lights	100,000	
Post-retrofit no. street lights	100,000	
Cost of electricity for street lighting for CA ($/kWh)	0.10	
LED Replacement Fixture Costs (CAPEX)	$ 400	per fixture
Annual project budget available (CAPEX)	$ 4,500,000	per annum

Attribute | Current Street Lighting | Post-Upgrade Street Lighting | Technical Data (use defaults or adjust as necessary)

Average run-hours for street lighting (hr/yr): pre-retrofit 4,300; post-retrofit 4,000

Attribute	% Breakdown	Wattage	No. Street Lights	Total kW	Total kWh	Annual Replacement Budget ($)
LED	10%	120	10,000	1,200	5,160,000	$ 133,333
HPS	10%	300	10,000	3,000	12,900,000	$ 400,000
Metal Halide	10%	400	10,000	4,000	17,200,000	$ 444,444
Mercury Vapor	70%	500	70,000	35,000	150,500,000	$ 2,333,333
Other 1			0	0	0	
Other 2			0	0	0	
Other 3			0	0	0	
Other 4			0	0	0	
Total	100%		100,000	43,200	185,760,000	3,311,111

% Breakdown	Wattage	No. Street Lights	Total kW	Total kWh	Annual Replacement Budget	CAPEX ($)
70%	120	70,000	8,400	33,600,000	$ 933,333	$ 24,000,000
10%	300	10,000	3,000	12,000,000	$ 400,000	
10%	400	10,000	4,000	16,000,000	$ 444,444	
10%	500	10,000	5,000	20,000,000	$ 333,333	
		0	0	0		
		0	0	0		
		0	0	0		
		0	0	0		
100%		100,000	20,400	81,600,000	2,111,111	

Bulb Life			
Min (hrs)	Max (hrs) [2]	Ave (hrs)	Mean Replacement Time (yrs)
50,000	100,000	75,000	16
15,000	25,000	20,000	5
16,000	20,000	18,000	5
18,000	30,000	24,000	6
			0
			0
			0
			0

Note 1: Assumes LED Bulb cost > conventional technologies by $50 per bulb
Note 2: Cree LED suggests L70 life > 100,000 hrs

Results | L2 CALCULATION: Streetlighting Retrofit Calculator

	Calculated Value	Override Value (optional)	Value used in TRACE Outputs
Total Energy Savings (kWh)	104,160,000	100,000,000	100,000,000 CalcResultskWhSaving
Percentage Improvement	53%		53% CalcResultsPercent

ExportStaging | Calc Flow | C_I_PumpsMotors | C_L_Retrofits | C_MB_Taskforce | C_MB_Schools | C_MB_Offices | C_MB_PubHousing | C_MB_Hosp ...

APPROACH IN THE BUILDING SECTOR

EXPERIENCE FROM UKRAINE, INDIA, BRAZIL AND KYRGYZ REPUBLIC

Entry points for urban energy diagnostics

- Enhanced understanding of energy use challenges and potentials to inform future policy and urban planning processes or support the development of an urban sustainability agenda
- Identifying and prioritizing sectors with high energy efficiency potentials and quick returns to showcase viability of urban energy efficiency and improve service delivery to city dwellers
- Providing a set of implementable and tailored recommendations that can be used to develop an investment pipeline or inform the municipal investment plan
- Mainstreaming energy efficiency and sustainability into the institutional structure of the city, e.g. by a city-wide procurement policy

Experience from India and Ukraine

- Engagements in the three cities of Bhubaneswar, Cuttack and Puri in Odisha, India taught us that a tool needs to anticipate future urbanization growth and associated challenges such as increasing cooling demands and construction of residential buildings
- TRACE deployments in the cities Kiev, Ternopil and Kamianetsk-Podilskyi in Ukraine revealed enormous energy efficiency potentials in the public and residential building sector and highlighted need for sound national-level legislation (ESCO and HOA laws)

Experience from Brazil and Kyrgyz Republic

- In Kyrgyz Republic TRACE was used to inform municipal energy savings plans and select public buildings for piloting retrofits to significantly reduce electricity consumption, TRACE opened-up dialogue opportunities and revealed that capacity building was necessary for building sector stakeholders
- For Belo Horizonte in Brazil TRACE provided the city administration with an understanding of consumption patterns and helped them to subsequently introduce electricity consumption monitoring for public buildings and a Sustainable Building Certification Program for residential and commercial buildings

Lessons learnt from TRACE deployments

- Experience shows that ability of city administrations to facilitate changes (through policies or investments) varies across countries and even cities
- Because urban energy challenges can be very diverse even within the same country a broad range of measures (investment, non-investment) should be considered
- Usually the need for intervention is not limited to city-level but also requires central government to get involved (e.g. energy subsidies, budget codes, etc.)
- While TRACE provides analysis and intervention guidance another great feature is that it offers an opportunity for dialogue with a city and cross-departmental exchange
- Urbanization rates need to be taken into account

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Thank You.

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