Energy and climate modelling tools in the Western Balkans – experience from ECRAN and RIPAP

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Workshop: Modelling options for NECPs in the Energy Community

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National systems

National system needs for projections

Countries need to prepare for regular submission of projections and PaMs

This requires continuous maintenance of system for modelling used for preparing projections, including updating input data, reviewing policies and measures, updating scenarios, etc.

Implementation details will differ by country,

Common elements of national systems:

1. **Insitutional arrangements**:

- Main responsibilities for technical analysis and making proposals
- Additional institutions involved
- Involvement of other stakeholders

2. Climate mitigation requires economy-wide aciton, therefore significant need for **policy coordination**:

- National system components (inventory, projections, policies and measures)
- Analytical and policy coordination (national policies build on analysis)
- Climate and other: energy, transport, agriculture, etc.

National system needs for projections

3. **Significant capacity needs**
- Technical knowledge: modelling, data collection,
- Sufficient number of staff
- Staff turnover issues addressed

4. **Procedures**
- Data sharing
- Information flows, consultation procedures
- Approval procedures

5. Significant **data needs**:
- Inventory and energy statistics
- Information on activity levels from different sources such as industrial outputs and transport performance, including current and planned (e.g. transport and insustrial strategies)
- Technology related information
- Other sector-specific information
- Data management systems

6. **QC/QA, evaluation** of existing system and improvement

To Do – Setting up national systems for projections

Institutional arrangements and procedures
- Institutional responsibilities
- Administrative capacity
- Procedures for data collection and sharing

Legal elements
- Climate law
- MMR/Energy Union Governance
- Other (institutional responsibilities, statistics laws, etc.)

Policy coordination
- Coordination between institutions
- Procedures for stakeholder involvement
- Regional cooperation

Funding
- Continuity

Technical elements
- Modelling tool
- Modelling team
- Permanence
- Constant improvement and updating

Data needs and gaps

Data needs for projections

- Energy Balance
- Detailed energy production and consumption data
- GDP, population, other macro level drivers of energy demand
- Sector specific activity levels (industrial sector GVA, industrial production natural units, transport pkm and tkm, heated floor area in buildings, etc.)
- Technology attributes (e.g. power plant efficiency, building envelope insulation properties, etc.)
- Cost and price data
- Other economic data (demand elasticities, SAMs, etc.)
- Emission factors

Data gaps in the Western Balkans

RIPAP project gap analysis:

- Legislative basis for of roles and responsibilities of data providers and data suppliers lacking
- Ad hoc procedures for sharing data among government institutions (MoU and informal requests)
- Focus on energy balance, more detailed sub-sectoral data or data disaggregated by energy end use missing
- Limited capacity in statistical offices and other institutions dealing with data collection
- Data validation an issue
- Inventories using tier 1 calculation methods,
- Data gaps on activity (e.g. pkm, vkm and tkm in the transport sector), technological data (e.g. building typology or vehicle stock), costs, elasticities

Models and technical capacity

Projections to date – Albania (1)

Project	Model	Sectors	Gases	Timeframe	Institution
NC3 UNDP and USAID	LEAP, GACMO, MARKAL	Energy	CO2, CH4, N2O	2030	National experts
EU Reference / PRIMES	PRIMES	Energy	CO2 (energy and process)	2050	E3MLab/ICCS
SLED	EEMM, LEAP	Electricity, residential buildings	CO2 (energy)	2030	REC, REKK, IKEM
LOCSEE	LEAP	Road transport	CO2 (energy), CH4, N2O	2030	NOA, Joanneum Research
PROMITHEAS4	LEAP	Energy	CO2 (energy)	2050	University of Tirana, National and Kapodistrian University of Athens

Projections to date – Albania (2)

Project	Model	Sectors	Gases	Timeframe	Institution
SEE 2050 carbon calculator	SEE 2050 Calculator	Energy	CO2	2050	SEEChangeNet
SEERMAP	EEMM, EGMM, Green-X, EKC network model	Electricity	CO2	2050	REKK
INDC	LEAP	Energy	CO2, CH4, N2O	2030	ECRAN project experts
National Energy Strategy 2030	LEAP	Energy	n.a.	2030	National Agency of Natural Resources
Transport strategy	TRANSCAP model	Transport	none	n.a.	Institute of Transport

Energy models used in the Western Balkans

Country	LEAP	TIMES/ MARKAL	MAED, WASP	PRIMES	Other
Albania	x				
Bosnia and Herzegovina	x				
former Yugoslav Republic of Macedonia	x	x	x		x
Kosovo*					
Montenegro	x				x
Serbia	x	x		x	

- Includes models used for preparation of official strategies and reports only

(source: RIPAP project)

Creating capacity (1)

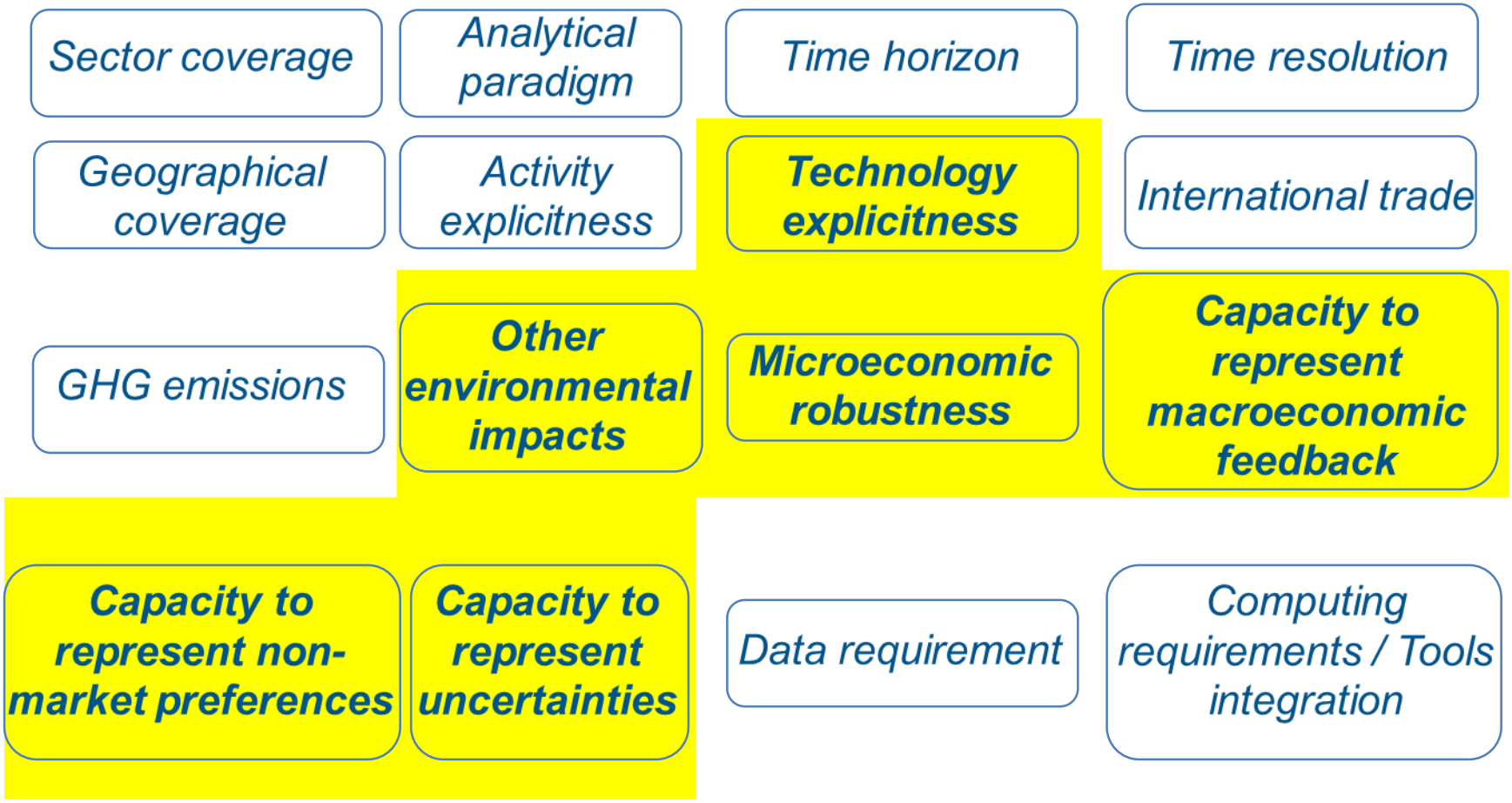
Main issues identified in the Western Balkans:

- Reliance on foreign expertise on a project basis
- Where technical capacity exists outside national public administration, funding of experts a challenge
- Issue is also related to low staff numbers (often single person with more extensive modelling experience)
- High staff turnover

Challenge to identify realistic options – balance different criteria:

- Achievable technical capacity
- Available funding
- Data availability
- Modelling requirements, sophistication

Capability to provide integrated climate and energy projections



Source: Rocco De Miglio, E4SMA

Capability to provide integrated climate and energy projections

Tool	Purpose	Emissions	Cost optimization	Activity Explicitness	Technology Explicitness	Microeconomic Robustness	Macroeconomic Feedback
BALMOREL	Electricity and CHP only	N	Y	L	H	H	N
MAED	Energy demand modeling	N	N	L	H	L	N
MESSAGE	Energy supply modeling	N	Y	H	M	M	N
WASP	Electric capacity planning	N	Y	L	M	L	N
LEAP	Energy/Non Energy planning	Y	Y	H	H	M	Y (w/ API)
ENPEP/BALANCE	Energy system simulation	N	N	H	M	H	N
TIMES/MARKAL	Energy sector planning	Y	Y	H	M	H	Yes w/ MARKAL-MACRO
OSeMOSYS	Energy supply modeling	Y	Y	H	M	M	N

Source: Charlie Heaps, SEI (2018)

Technical/analytical capacity

Technical expertise indicated for modelling of projections (RIPAP project)

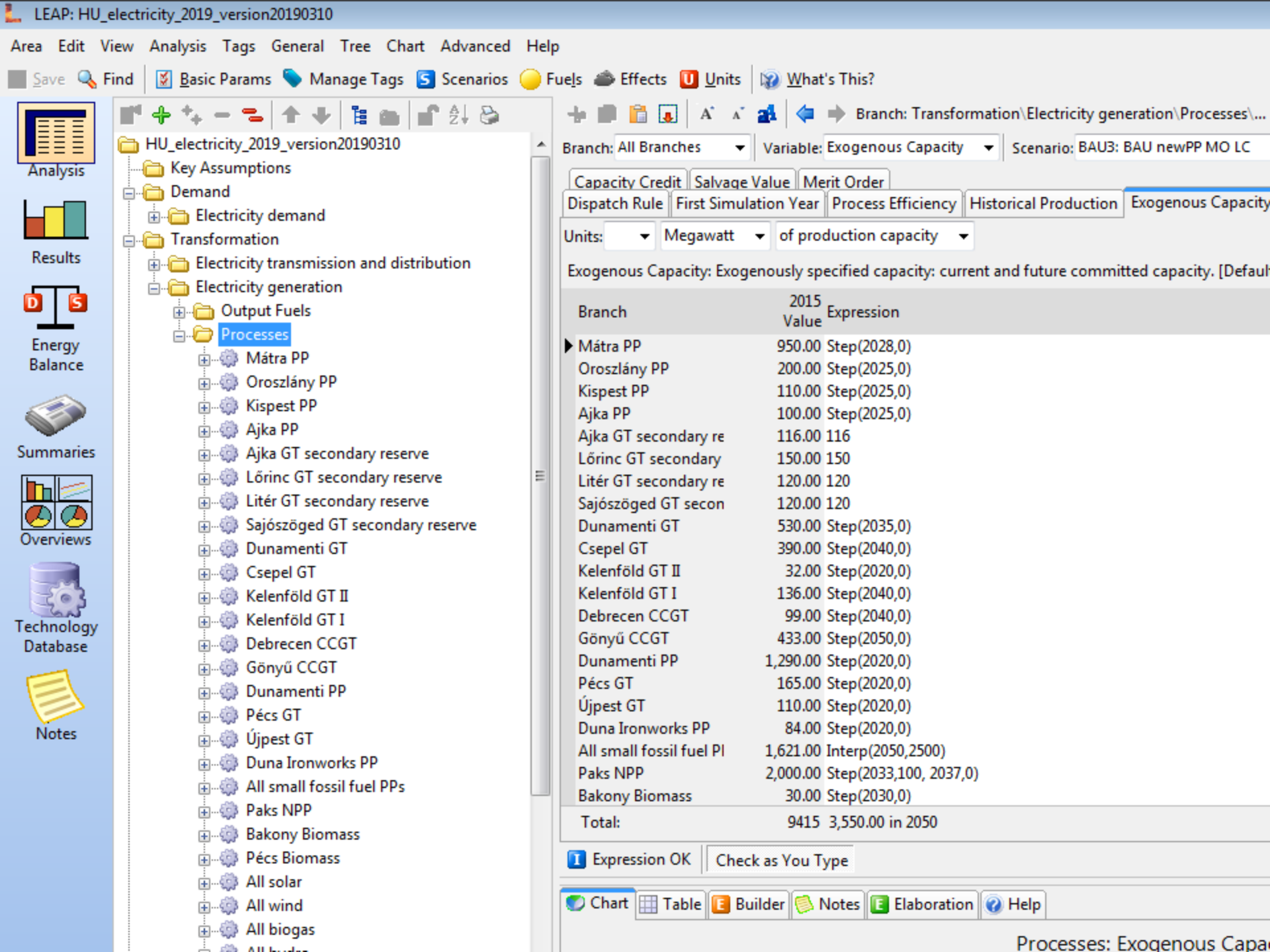
Foreign expertise	National expertise outside public administration	National expertise in public administration
AL **BH** **ME** **KO*** **RS**	**MK** (Macedonian Academy of Arts and Sciences) **RS** (University of Belgrade, private sector) **BH** (University of Banja Luka) **AL** (University of Tirana, individual consultant) **ME** (individual consultant)	(**RS** – Ministry of Mining and Energy, private sector) **AL** (National Agency of Natural Resources)

Creating capacity (2)

~~1. Pay external consultant~~

2. Opt for simpler model solutions

- User friendly software - LEAP
- Model structures pre-programmed
  - TIMES Starter, available free of charge to licence holders
  - EU TIMES, to be made available early 2019, covers Western Balkans countries


LEAP: HU_electricity_2019_version20190310
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Save Find Basic Params Manage Tags Scenarios Fuels Effects Units What's This?
Analysis
Results
Energy Balance
Summaries
Overviews
Technology Database
Notes
HU_electricity_2019_version20190310
Key Assumptions
Demand
Electricity demand
Transformation
Electricity transmission and distribution
Electricity generation
Output Fuels
Processes
Mátra PP
Oroszlány PP
Kispest PP
Ajka PP
Ajka GT secondary reserve
Lőrinc GT secondary reserve
Litér GT secondary reserve
Sajószöged GT secondary reserve
Dunamenti GT
Csepel GT
Kelenföld GT II
Kelenföld GT I
Debrecen CCGT
Gönyű CCGT
Dunamenti PP
Pécs GT
Újpest GT
Duna Ironworks PP
All small fossil fuel PPs
Paks NPP
Bakony Biomass
Pécs Biomass
All solar
All wind
All biogas
Branch: Transformation\Electricity generation\Processes\...
Branch: All Branches
Variable: Exogenous Capacity
Scenario: BAU3: BAU newPP MO LC
Capacity Credit
Salvage Value
Merit Order
Dispatch Rule
First Simulation Year
Process Efficiency
Historical Production
Exogenous Capacity
Units:
Megawatt
of production capacity
Exogenous Capacity: Exogenously specified capacity: current and future committed capacity. [Defaul
Branch
2015 Value
Expression
Mátra PP 950.00 Step(2028,0)
Oroszlány PP 200.00 Step(2025,0)
Kispest PP 110.00 Step(2025,0)
Ajka PP 100.00 Step(2025,0)
Ajka GT secondary re 116.00 116
Lőrinc GT secondary 150.00 150
Litér GT secondary re 120.00 120
Sajószöged GT secon 120.00 120
Dunamenti GT 530.00 Step(2035,0)
Csepel GT 390.00 Step(2040,0)
Kelenföld GT II 32.00 Step(2020,0)
Kelenföld GT I 136.00 Step(2040,0)
Debrecen CCGT 99.00 Step(2040,0)
Gönyű CCGT 433.00 Step(2050,0)
Dunamenti PP 1,290.00 Step(2020,0)
Pécs GT 165.00 Step(2020,0)
Újpest GT 110.00 Step(2020,0)
Duna Ironworks PP 84.00 Step(2020,0)
All small fossil fuel Pl 1,621.00 Interp(2050,2500)
Paks NPP 2,000.00 Step(2033,100, 2037,0)
Bakony Biomass 30.00 Step(2030,0)
Total: 9415 3,550.00 in 2050
Expression OK
Check as You Type
Chart
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Help
Processes: Exogenous Capac

File | Home | Insert | Page Layout | Formulas | Data | Review | View

Cut | Copy | Format Painter | Paste | Clipboard | Arial | 8 | Font | Wrap Text | Merge & Center | Alignment | General | Number | Conditional Formatting | Format as Table | Parent row | Normal

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- row-1 has MATCH for VLOOKUP
- VT attributes in row-7
- VT parameter descriptions for each attribute included in comment box
- Units in row-8
- Data in row-10
- "*" as 1st character to eliminated row/column from that point right/down

	A	B	C	D	E	F	G	H	I	J
1	**Region**	STARTER					AFA			
7		* Tech Description	* Unit Act/Cap	* Lookup Tech	* Lookup Sheet	* set Vintage for ProcDcl	AFA		TechName	Comm-IN
8									* Units	
9	* Residential Heating								* Residential Heating	
10		Residential Heating: Electricity Air Heat Pump-Existing 00	PJ / PJa	RSHEHPR	EPA		0.16		RHBELC-HA-X0	RSDELC
11		Residential Heating: Electricity Ground Heat Pump-Existing 00	PJ / PJa	RSHGHPR	EPA		0.16		RHBELC-HG-X0	RSDELC
12		Residential Heating: Electricity Radiant-Existing 00	PJ / PJa	RSHERDR	EPA		0.16		RHBELC-R-X0	RSDELC
13		Residential Heating: Natural Gas Furnace-Existing 00	PJ / PJa	RSHNFRR	EPA		0.16		RHBGASNAT-F-X0	RSDGASNA
14		Residential Heating: Natural Gas Heat Pump-Existing 00	PJ / PJa	RSHNHPR	EPA		0.16		RHBGASNAT-H-X0	RSDGASNA
15		Residential Heating: Natural Gas Radiant-Existing 00	PJ / PJa	RSHNRDR	EPA		0.16		RHBGASNAT-R-X0	RSDGASNA
16		Residential Heating: Diesel Furnace-Existing 00	PJ / PJa	RSHDFRR	EPA		0.16		RHBOILDSL-F-X0	RSDOILDSL
17		Residential Heating: Diesel Radiant-Existing 00	PJ / PJa	RSHDRDR	EPA		0.16		RHBOILDSL-R-X0	RSDOILDSL
18		Residential Heating: Kerosene Furnace-Existing 00	PJ / PJa	RSHKFRR	EPA		0.16		RHBOILKER-F-X0	RSDOILKER
19		Residential Heating: LPG Furnace-Existing 00	PJ / PJa	RSHLFRR	EPA		0.16		RHBOILLPG-F-X0	RSDOILLPG
20		Residential Heating: Heat Furnace-Existing 00	PJ / PJa	RHBLTH-F-X0	Temp		0.16		RHBLTH-F-X0	RSDLTH
21		Residential Heating: Lignite Stove-Existing 00	PJ / PJa	RHBCOALIG-S-X0	Temp		0.16		RHBCOALIG-S-X0	RSDCOALIG
22		Residential Heating: Primary Solid Biofuels Stove-Existing 00	PJ / PJa	RSHWDHR	EPA		0.16		RHBBIOPSF-S-X0	RSDBIOPSF
23	* Residential Cooling								* Residential Cooling	
24		Residential Cooling: Electricity Air Heat Pump-Existing 00	PJ / PJa	RSCEHPR	EPA		0.15		RCBELC-HA-X0	RSDELC
25		Residential Cooling: Electricity Ground Heat Pump-Existing 00	PJ / PJa	RSCGHPR	EPA		0.15		RCBELC-HG-X0	RSDELC
26		Residential Cooling: Electricity Central-Existing 00	PJ / PJa	RSCRACR	EPA		0.15		RCBELC-C-X0	RSDELC
27		Residential Cooling: Electricity Room-Existing 00	PJ / PJa	RSCCACR	EPA		0.15		RCBELC-R-X0	RSDELC
28		Residential Cooling: Natural Gas Air Heat Pump-Existing 00	PJ / PJa	RSCNHPR	EPA		0.15		RCBGASNAT-HA-X0	RSDGASNA
29	* Residential Water Heating								* Residential Water Heating	
30		Residential Water Heating: Electricity -Tank-Existing 00	PJ / PJa	RWHEWHR	EPA		0.1		RWHELC-T-X0	RSDELC
31		Residential Water Heating: Natural Gas -Tank-Existing 00	PJ / PJa	RWHNWHR	EPA		0.1		RWHGASNAT-T-X0	RSDGASNA

```
Equations newcap(t)           new capital
          newprod(t)          new production
          fnewelec(t)         new electric energy in first period
          newelec(t)          new electric energy
          fnewnon(t)          new non-electric energy in first period
          newnon(t)           new non-electric energy
          totalcap(t)         total capital stock
          ftotalprod(t)       total production in first period
          totalprod(t)        total production
          costnrg(t)          cost of energy
          cc(t)               capacity constraint
          tc(t)               terminal condition
          util                discounted log of consumption;


newcap(t+1)..       kn(t+1) =e= i(t)*ipm(t);

newprod(t+1)..      yn(t+1) =e= (aconst*(kn(t+1)**(rho*kpvs)) *
                                 (ln(t+1)**(rho*(1 - kpvs))) +
                                bconst*(en(t+1)**(rho*elvs)) *
                                (nn(t+1)**(rho*(1 - elvs)))) ** (1/rho);


fnewelec(tfirst)..  en(tfirst) =e= e(tfirst) - e0*(spda**nyper);

newelec(t+1)..      en(t+1) =e= e(t+1) - e(t)*(spda**nyper);


fnewnon(tfirst)..   nn(tfirst) =e= n(tfirst) - n0*(spda**nyper);

newnon(t+1)..       nn(t+1) =e= n(t+1) - n(t)*(spda**nyper);


totalcap(t+1)..     k(t+1) =e= k(t)*(spda**nyper) + kn(t+1);
```

User friendliness

Tool	Online Support Community	Expertise/ Data Required	Users/Countries
BALMOREL	N	H	Handful of users
MAED	N	M	Hundreds of users
MESSAGE	N	H	88 countries
WASP	N	H	107 countries
LEAP	Y	M	37,000/ 190 countries
ENPEP/BALANCE	N	H	80 countries
TIMES/MARKAL	Y	H	Hundreds of users
OSeMOSYS	Y	H	Handful of users

Source: Charlie Heaps, SEI (2018)

Creating capacity (3)

1. ~~Pay external consultant~~
2. Opt for simpler model solutions

- User friendly software - LEAP
- Modelling structures pre-programmed - TIMES Starter and EU TIMES (?)

3. Build capacity

- Use EU, UNDP funding and bilateral support for capacity building
- LEAP – ECRAN training and support received in past, user forum
- TIMES – support for licence holders, VEDA forum
- IAEA toolset (e.g. MAED, MESSAGE, WASP) – support programmes for training and TA

Thank you for your attention!

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