

Economic and Social Commission for Western Asia

# Methodology for Monitoring Residential & LV Tertiary Energy consumption

ESCWA UNDA Closing Webinar:  
Presentation of the outcomes of the UN Development Account Project on  
“Up-scaling Energy Efficiency in the residential and services sectors in the Arab Region”

Online, via Zoom, 20 & 21 December 2021



MINISTRY OF ENERGY AND MINERAL RESOURCES  
THE HASHEMITE KINGDOM OF JORDAN



11th INTERNATIONAL FORUM ON ENERGY  
FOR SUSTAINABLE DEVELOPMENT

VIRTUAL | SEPTEMBER - NOVEMBER 2021



AGENCE NATIONALE POUR  
LA MAÎTRISE DE L'ÉNERGIE  
ANME

Un engagement durable et renouvelable



UNITED NATIONS

العشقا  
ESCWA

Shared Prosperity **Dignified Life**



**Dr. Selin YILMAZ**

(selin.yilmaz@unige.ch)

Senior Researcher and Teaching fellow

Group for Energy Efficiency

University of Geneva.

- 
- Motivation for surveys & measurement campaign
  - Added value
  - Methodology for survey & measurement campaign for building energy use
  - Experience with Tunisia & Jordan

# Motivations & Added value



UNITED NATIONS

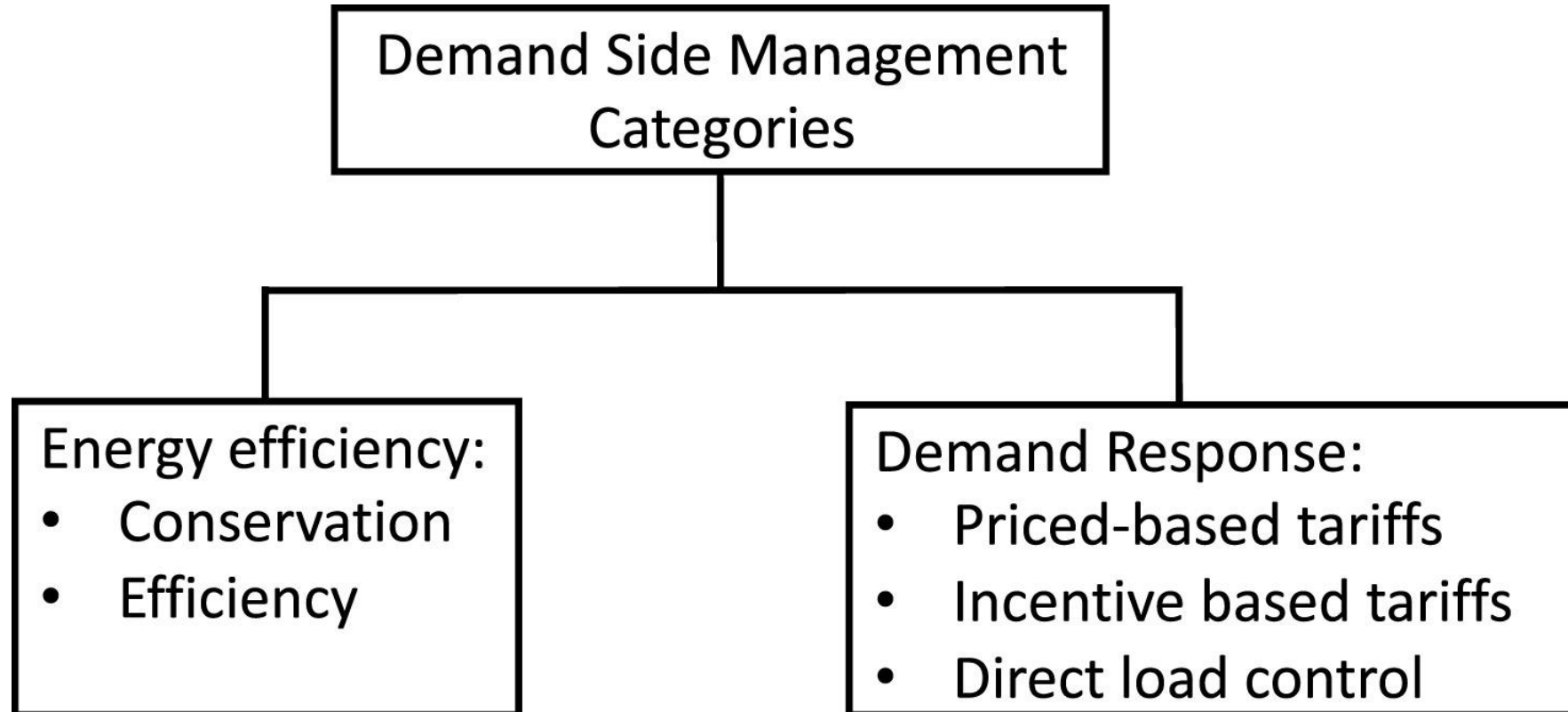
الاستقيا  
ESCWA

Shared Prosperity **Dignified Life**



Increase in policy measures on demand side in 4 sectors (residential, transport, industry & service):

- Resources are decreasing.
- Climate targets (national, international)
- Stochasticity of renewables.



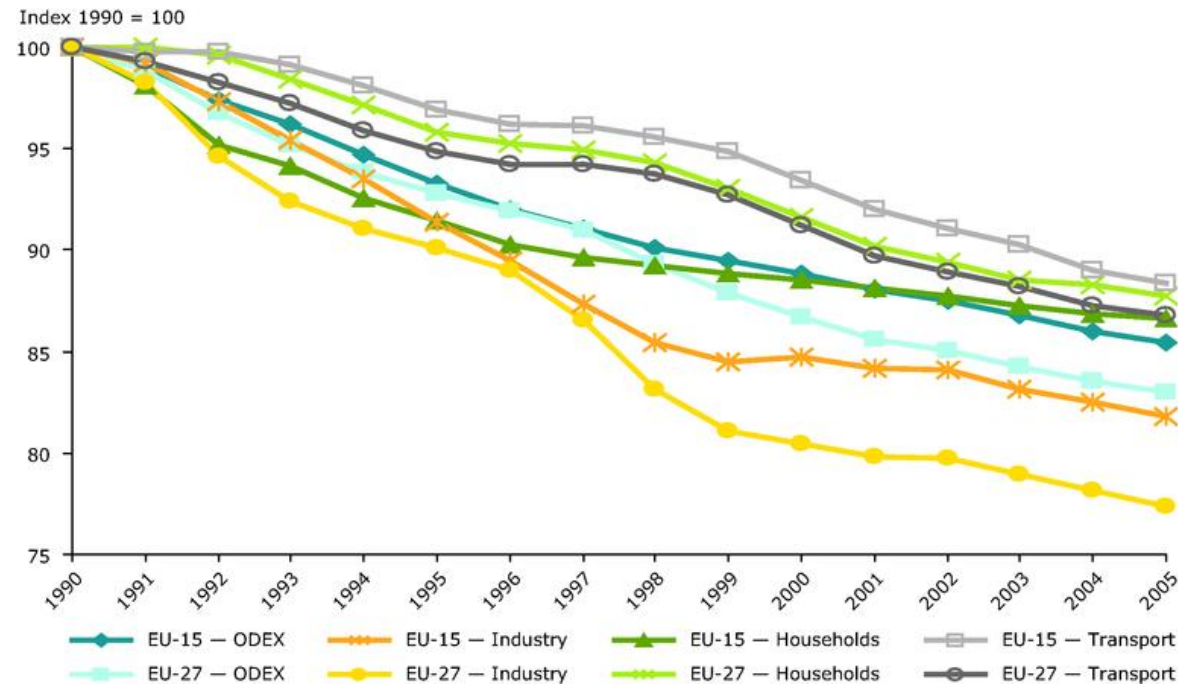
1) To understand the drivers for current and future energy consumption to develop effective policies:

- Where to intervene:
  - Houses, offices, hospitals?
- What to intervene :
  - Is it technology (efficiency of the technology) → if yes, which technology, cooling, washing machines?
  - People's energy behaviour?
- When to intervene :
  - Now?
  - Future it will be problematic (electric cars)

2) To monitor the evolution of the sectors:

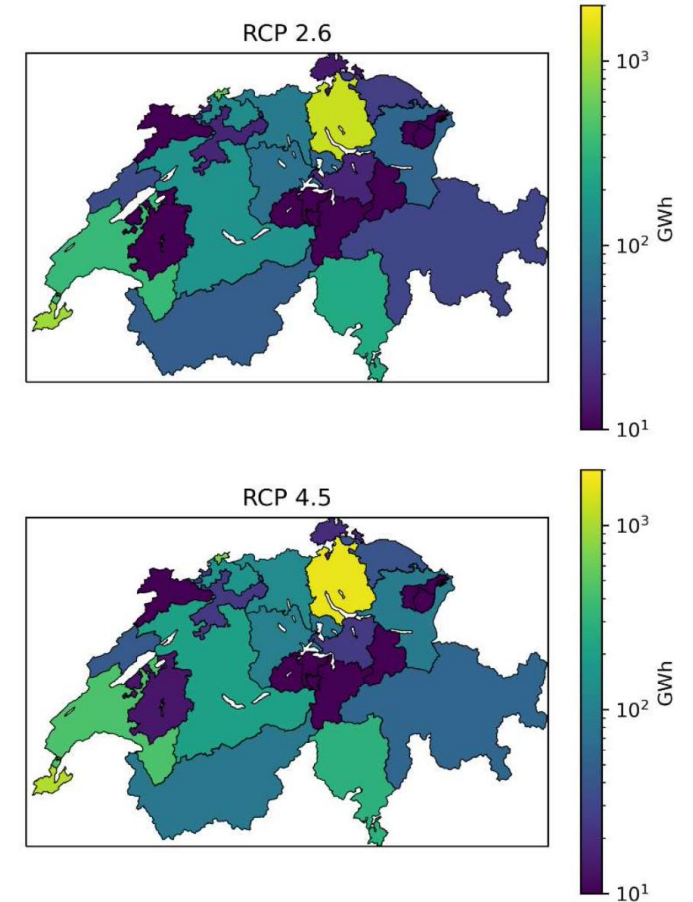
Is the policy measure working (consequences of measures)?

If not, why?, Who is adopting, what to change?



3) To characterise spatial-temporal energy demand to match demand & supply.

- Renewable supply matching
- Grid reinforcements (electrification of heating & mobility)





More in-depth data:

- 1) Building an understanding of actual consumption (complementary)
- 2) More data on temporality (day to day difference)
- 3) Impact of behaviour on energy use of appliances
- 4) Built data driven models coupled with theoretical ones

# Methodology for residential and tertiary building energy use

# Survey: Data collection strategy

---

Cover a sufficient number of variables (the longer it is, the more people will lose interest)

- i) to construct total energy consumption & load curves,
- ii) to understand energy behaviours and practices to propose energy efficiency measures
- iii) perform analyses to understand the determinants of consumption.

Obtain information as precise as possible

Ask simple questions (short, explanations on tooltips).

# Monitoring campaign: Strategy

---

- Provide reliable data on energy consumption for certain categories of products, equipment and systems
- Have reliable information on the impact of certain characteristics of the stock of devices
- Identify products and modes of use that have impact on the energy consumption
- In a short time collect data as reliable as possible.

# Building information

---

Why?

Great impact on

- energy (both electricity and heating/cooling consumption)
- energy efficiency of the house
- even behaviour of the people,
  - Construction period
  - Type of dwelling: (detached house, semi-detached house, etc., building with 3 flats, building with 4 flats, etc.) → residential or not (sometimes office exists in building apartments).
  - Number of floors
  - ZIP code
  - Energy heating supply (gas, fuel, electricity, wood)
  - Energy cooling supply (electricity, gas)
  - Energy hot water supply (gas, fuel, electricity, wood)
  - Dwelling surface (m<sup>2</sup>)
  - Dwelling heated/cooled surface (m<sup>2</sup>)
  - Retrofitting, renovation information (normally you ask for a permit to do these)

# Socio-economic data

---

Why?

Great impact on

- energy (both electricity and heating/cooling consumption)
- energy use patterns (when, how many times, and how long?)
- even behaviour of the people,

- Age combination, (<7, 7-18, 18-36, 36-56, 56-66, >66)
- Gender (female, male)
- Household composition (Single person household, Couple without children, Couple with children, Single parent with one or more children, Patchwork family, Non-family shared household, etc.)
- Employment: full-time, part time (50-80%), part-time (<50%), unemployment, retired)
- Income (monthly gross) (<1000 dinar, 1000-3000 dinar, etc.)
- Education (Primary-school, high-school, university, none).

# Appliance information

---

Why?

Great impact on

- energy consumption (both electricity and heating/cooling consumption) depending on the fuel
  - Load profiles of the consumption
- 
- Ownership: yes or no (microwave, oven, dishwasher, coffee machine, washing machine, etc.)
  - Number of specific appliances (fridge, freezer, TV, desktop computer, laptops, tablets, mobile phones, light bulbs)
  - Age of the appliances
  - Energy efficiency label (does this exist in Jordan?)
  - Appliance characteristics:
    - ⇒ Volume of fridges, freezers
    - ⇒ Brand and type (siemens, fridge)
    - ⇒ LED, halogen for lighting
    - ⇒ Capacity for washing machines, tumble dryer
    - ⇒ Disk number for dishwasher

# Energy use behaviour

---

Why? (Develop effective policies)

Great impact on

- Energy consumption
- Load profiles of the consumption

Five very key energy behaviour indicator:

1. Switch-on time: this is the time at which the occupant begins to use the equipment
2. The frequency of use: this is the number of equipment switching on events over a specified period
3. The duration of use: this is the duration of use of the equipment during each event
4. Choice of power mode: this is the power mode selected for the operation of the equipment during each event
5. Behaviour of the equipment in relation to standby mode: When the equipment is not in use, does the occupant leave it in standby mode or turn it off completely

This behaviour should be collected across different day types and seasons.



# Energy use behaviour (examples)

**Table 23 Television usage behaviour (the frequency of usage)**

How many times a week do you use:				
Television 1				
	Total	Weekday (M, T, W, T, S)	Friday	Saturday and holidays
Summer	3	0/5	1	0
Winter	1	1	0	1
Ramadan	2	0	0	2
Rest of the year	4	0	2	2
Television 2				
	Total	Weekday (M, T, W, T, S)	Friday	Saturday and holidays
Summer	3	0/5	1	0
Winter	1	1	0	1
Ramadan	2	0	0	2
Rest of the year	4	0	2	2

# Energy use behaviour (examples)

**Table 24 Television 1 usage behaviour (period: switch on time and switch off time)**

On average, during which time slots do you use your Television 1																		
Day of the week (Monday, Tuesday, Wednesday, Thursday, Sunday)																		
Season	1h	2h	3h	4h	5h	6h	7h	8h	9h	10h	.	.	.	20h	21h	22h	23h	24h
Summer																		
Winter																		
Ramadan																		
Rest of the year																		
Friday																		
Season	1h	2h	3h	4h	5h	6h	7h	8h	9h	10h	.	.	.	20h	21h	22h	23h	24h
Summer																		
Winter																		
Ramadan																		
Rest of the year																		
Saturday and holidays																		
Season	1h	2h	3h	4h	5h	6h	7h	8h	9h	10h	.	.	.	20h	21h	22h	23h	24h
Summer																		
Winter																		
Ramadan																		
Rest of the year																		

# Energy use behaviour (examples)

What temperature do you usually wash your clothes at?

- 30°C
- 60°C
- 90°C

What temperature do you usually dry your clothes at?

- 30°C
- 60°C

Indicate the frequency of loading rates of your washing machine compared to its rated capacity?

- approximately 50% of the nominal capacity
  - Never
  - Sometimes
  - Often

# Experience with Tunisia & Jordan

---

## Tunisia:

Société Tunisienne de l'Electricité et du Gaz (STEG)

Approximately 30 years of experience of energy use survey (7 surveys with clients)

## Jordan:

Several stakeholders

No experience of building energy use survey

Methodologies for building energy use survey

Survey implementation

Training sessions

# Key points: Implementation

---

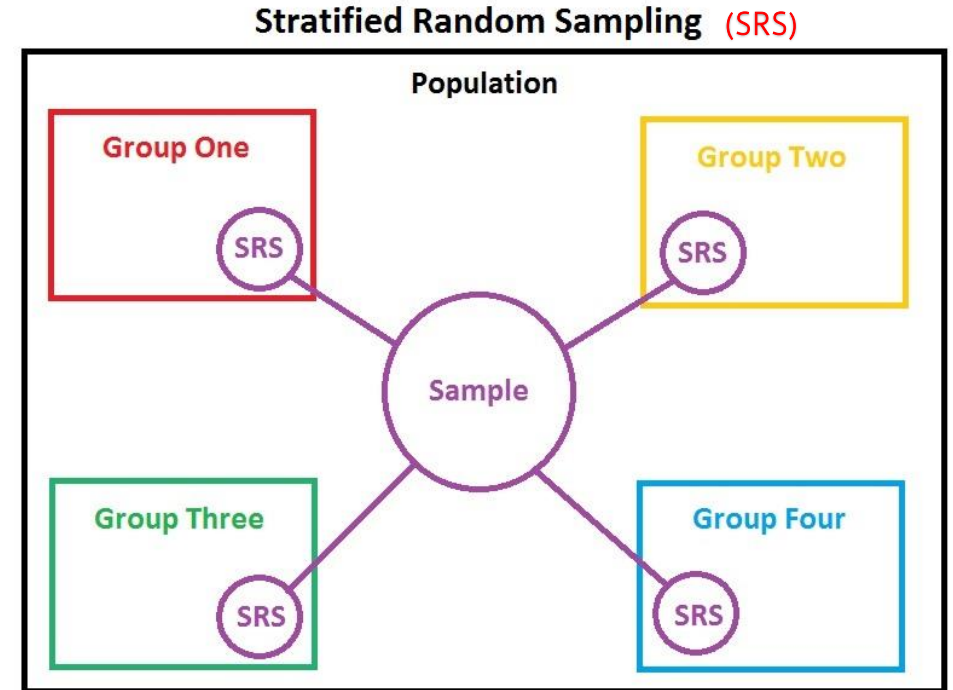
## Surveys:

Representativity (something before and after)

- Stratification
- Students, ambassadors (phone, going home).

## Measurement campaigns:

- Representativity is difficult. Do your best!
- Sub-sample from survey
- Electricians, trained people (phone, going home).



# Key points: Implementation

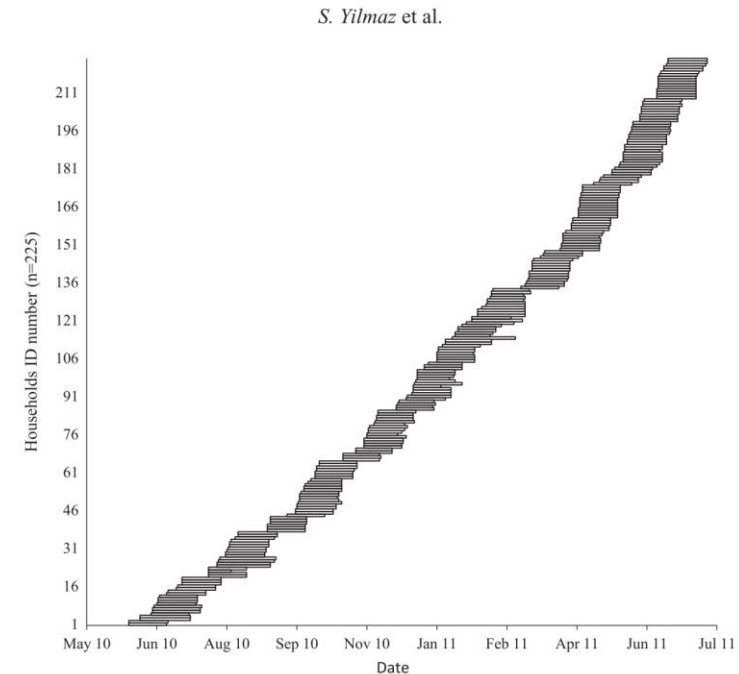
---

## Survey launch:

- Several stages of implementing surveys
- Survey tools to use: Qualtrics, Lime Survey

## Measurement campaign:

- Equipments to measure
- Time resolution and period of measurements



# Conclusion

---

Robust surveys and measurement campaigns are key in

- knowing the appliances, devices exist in the building sector
- understanding the society' energy use, their patterns, practices and habits

are therefore key in

- developing effective energy efficiency programmes
- modelling and forecasting the current and future scenarios



Shared Prosperity Dignified Life



# Thank you

**Dr. Selin YILMAZ** ([selin.yilmaz@unige.ch](mailto:selin.yilmaz@unige.ch))  
Senior Researcher and Teaching fellow

Group for Energy Efficiency  
University of Geneva