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#SDGs

# Problem Based Learning: Teaching engineers to tackle the SDGs

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Panel

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Moderated by:

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# ENERGIZING POVERTY REDUCTION IN RURAL SIERRA LEONE

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## Kelleh Gbawuru-Mansaray | Presentation outline

- Poverty reduction remains a major challenge for the Government and people of Sierra Leone.
  - Overall poverty rate is 57.0%, with 10.8% of the population living in extreme poverty.
    - Highest in the rural areas (poverty incidence of 72.4%), and lowest in urban Freetown (18.5%), thereby indicating that poverty in Sierra Leone remains a rural issue.
- The Government of Sierra Leone has established a plan for nationwide electrification to alleviate poverty.
- Despite the governmental emphasis on electrification, only about 15% of Sierra Leoneans currently have access to electricity, with the rate being only around 2% in the rural areas.

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# Overview

- Energy consumption in Sierra Leone:
  - Dominated by inefficient and polluting fuels such as kerosene for lighting and wood fuel and charcoal for cooking, which account for about 80% of the total energy use.
  - The economy has mainly depended on the consumption of imported petroleum products for electricity power generation and transportation.
- The renewable energy side of the sector remains a promising growth area for the country.
- Sierra Leone has abundant renewable energy resources
  - solar, hydropower, biomass, wind etc.
- Among these resources, hydropower has been developed and utilized on a commercial scale.
  - But only 61 MW of hydropower has been installed out of a total potential of over 1,513 MW.

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# Training Engineering Students to Tackle SDG7

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- Solar PV Installation

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# Contributions of Undergraduate Students to Tackle SDG7

- **Solar thermal refrigerator**
  - Provides sustainable Agricultural cold storage solutions for rural areas in Sierra Leone.

- **Solar water desalination system**
  - Provides clean and safe drinking water for rural dwellers. This sustainable solution is expected to offer economic benefits as well as improvements in the health and well-being of the rural people.

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# Contributions of Undergraduate Students to Tackle SDG7

- Cooking in Sierra Leone is customarily done on open fires using biomass such as firewood and charcoal.
  - excessive deforestation, $CO_2$ emissions & respiratory infections due to significant smoke inhalation.

- Interventions by USL students that can save millions of trees, does not smoke, and costs very little - solar thermal cooking:
  - **Heavy Duty Solar Cooker**
  - **Concentrating Solar Cooker**

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# Contributions of Undergraduate Students to Tackle SDG7

- **Pico Hydropower Plant**
  - Electrification of few households, a village, or a wayside business establishment

- **Solar Powered Chicken Egg Incubator**
  - Handles 100 eggs
  - Affordable to the average poor farmer dwelling in the rural areas of Sierra Leone.

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# Current Project on SDG7: Integrated Research into the Utilities and the Urban Environment (InRUE)

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- Funded by the **RAE Higher Education Partnerships in Sub-Saharan Africa (HEP-SSA)** to showcase the role of engineering in driving economic development
- 'Hub and Spoke' model
  - Hub = **USL** (lead) facilitated with bilateral secondment with local industry partners = **EGTC, UNOPS & Westwind Energy**
- Co-ordinate knowledge sharing workshops & reports with Spoke **Universities** = **Njala** and UK Partners **ICL & HP3M**
- Start date: 1st October 2019 - Completion date: 9th August 2021

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# Integrated Research into the Utilities and the Urban Environment (InRUE)

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- **Project Objectives**
  - Positioning academic research around innovative solutions that address the most significant national and regional challenges;
  - Improving regional engineering capacity in addressing SDG 7
  - Developing a two-way learning model that links industry challenges with research based solutions;
  - Disseminate learning outcomes and methodologies with other industry sectors and regional partners;
  - Developing skills in entrepreneurship and commercialisation.

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# Integrated Research into the Utilities and the Urban Environment (InRUE)

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- Project Outcomes
  - **2 Cohorts** of Year 4 students taken through programme of collaborating with industry to identify solutions to significant problems
  - Graduates better prepared for the work environment - recognised as having **developed skills** and expertise **in problem based learning**
  - Graduates provided with **value added skills and experiences** + specialist knowledge of industry problems and working to tackle those associated with SDG7
  - USL as hub will formalise the **introduction and engagement of industry based problem** learning modules **within the curriculum**
  - Concept of introducing industry **specialist in delivering curriculum** in affordable and clean energy
  - Development of a framework to create a regional **Centre of Excellence** for SDG7 at USL

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# Integrated Research into the Utilities and the Urban Environment (InRUE)

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- **Engagement with Local Industry Partners**
  - **Academic staff** from FBC undertaking relevant **placements in industry**
  - **Engineering students** from the USL & Njala undertaking research projects and **work placements** with local industry partners
  - Industry partners' **staff deliver** courses, workshops **and supervise** student research projects
  - Industry partners' **staff improve their CPD** through involvement with universities

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# Sahban Alnaser | Presentation outline

- Jordan Electricity Sector: Overview
- PV Incentive Schemes: Challenges
- Transition Towards Self-Consumption PV Schemes
- Role of Residential Batteries
- Case Studies: Real Jordanian Distribution Networks
- Remarks

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# Jordan Electricity Sector: Overview

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- Peak demand of 3.5 GW (relatively small electricity system compared to 60 GW in the UK)
- However, **90%** of electricity energy needs is produced from imported fuel sources
- Jordan Government target → **50%** of electricity from local resources by 2030
  - Renewable energy law in 2012 → **10%** of electricity needs are currently supported from renewables

Do the current energy policies support the Governmental targets?

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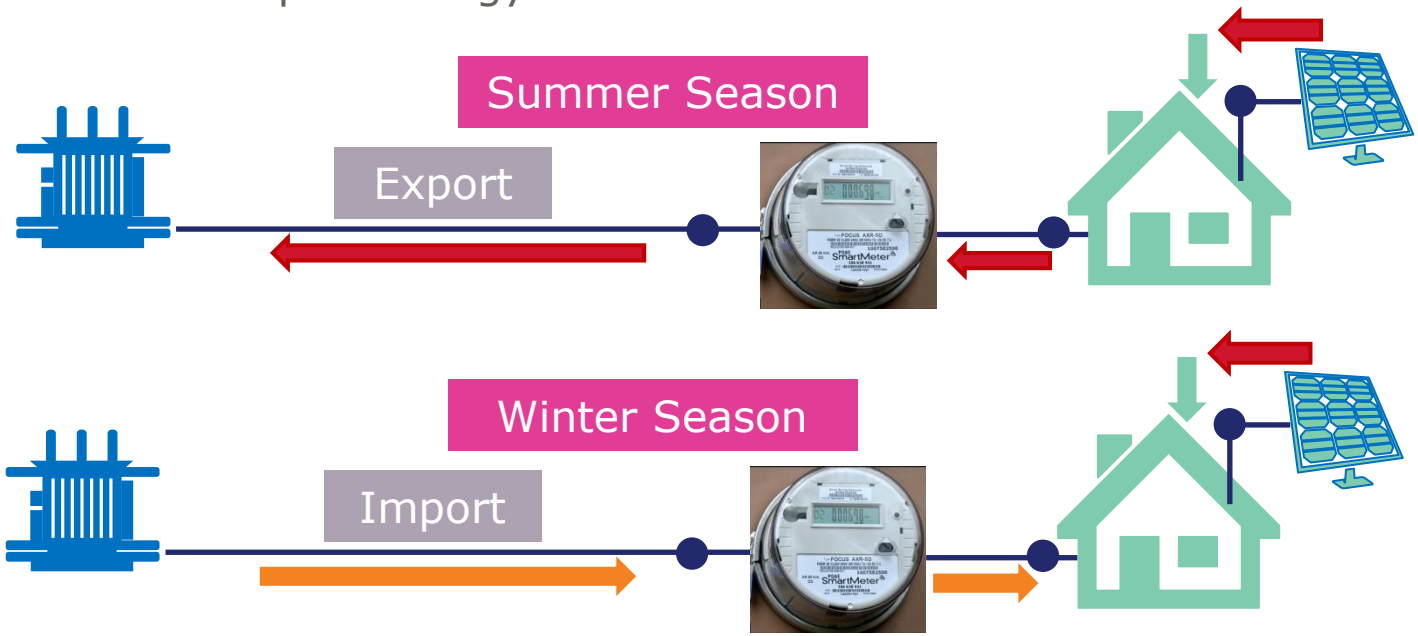
# Net Metering PV Incentive Scheme

- Net-metering is a high PV incentive scheme
  - Potential to achieve **zero** electricity bill
  - Annual electricity bills is calculated based on the: **Annual** import energy – **Annual** export energy

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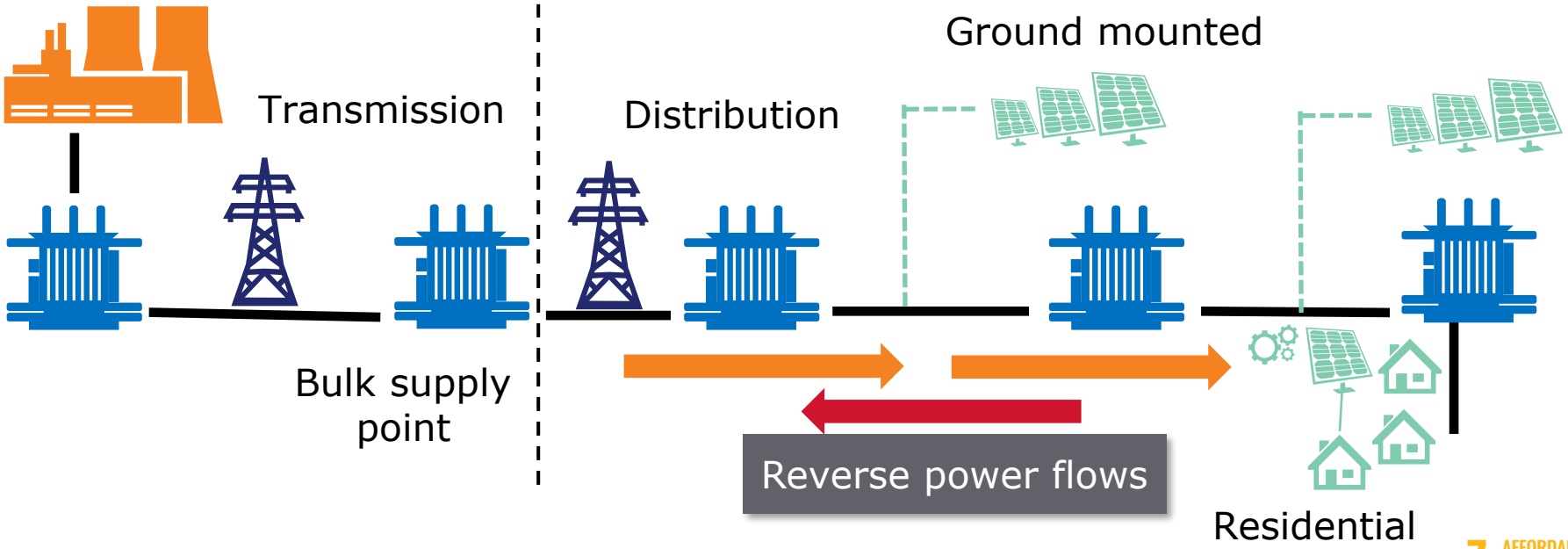
# PV Impacts on Distribution Networks




Reverse power flows → network issues (voltage rise and overloading of network assets)

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# Jordanian 33 kV Real - Distribution Networks

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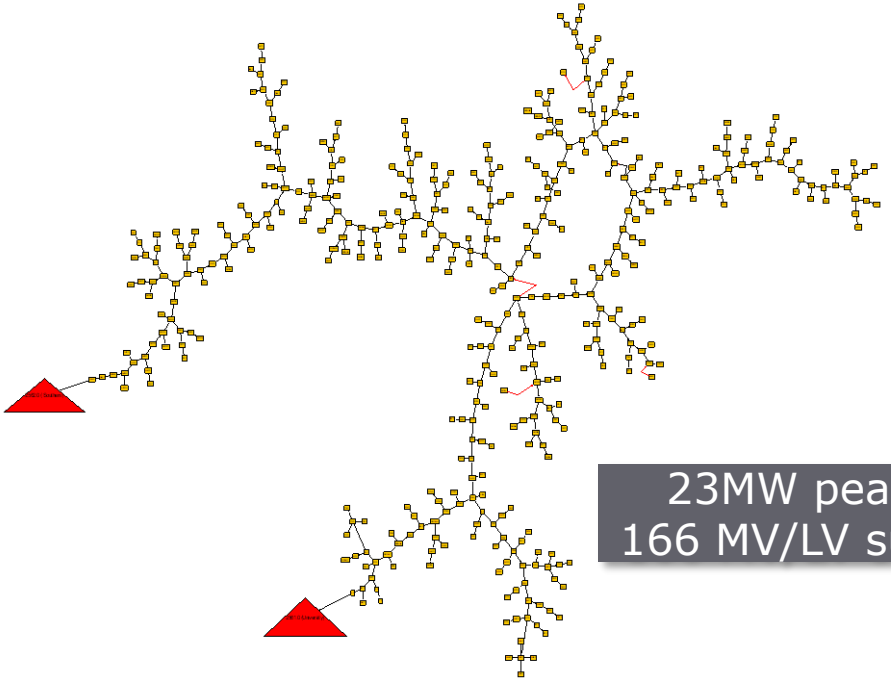
- Rural network topology
- Long distribution networks (ma
  length ~ 55km feeder)
- 4400+ residential customers
- 7 MW PV systems already connected to the MV networks - Residential PV is challenging
- Integrated Models of MV/LV distribution networks



23MW peak
166 MV/LV subs

Networks are traditionally demand driven

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# Jordanian Real Distribution Network: Net - Metering Results

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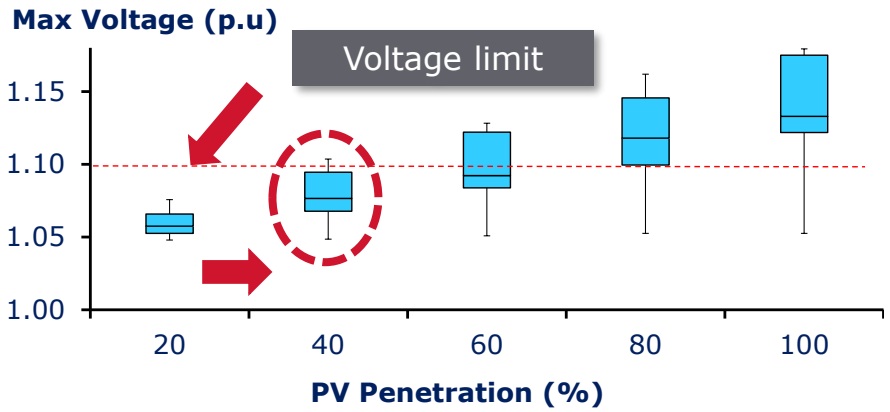
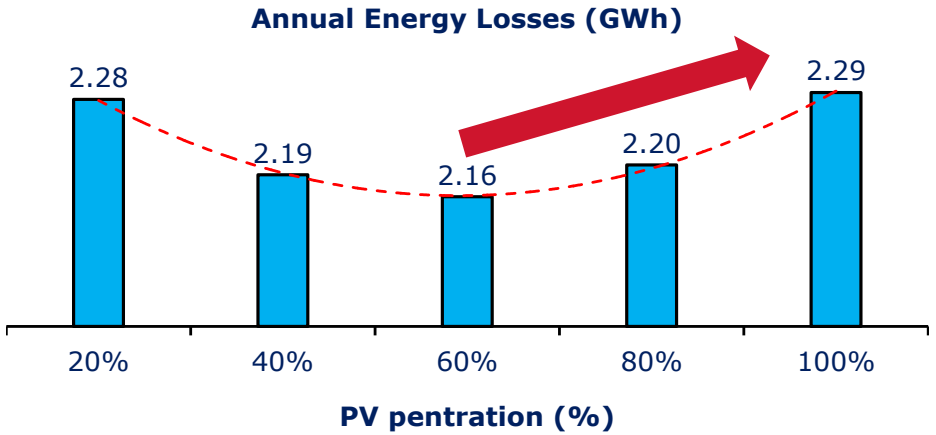
- Net- Metering scheme
  - PV is sized to meet annual energy consumption
  - PV impacts are assessed versus different PV penetrations




Net-metering enables only 20% of residential customers with PV

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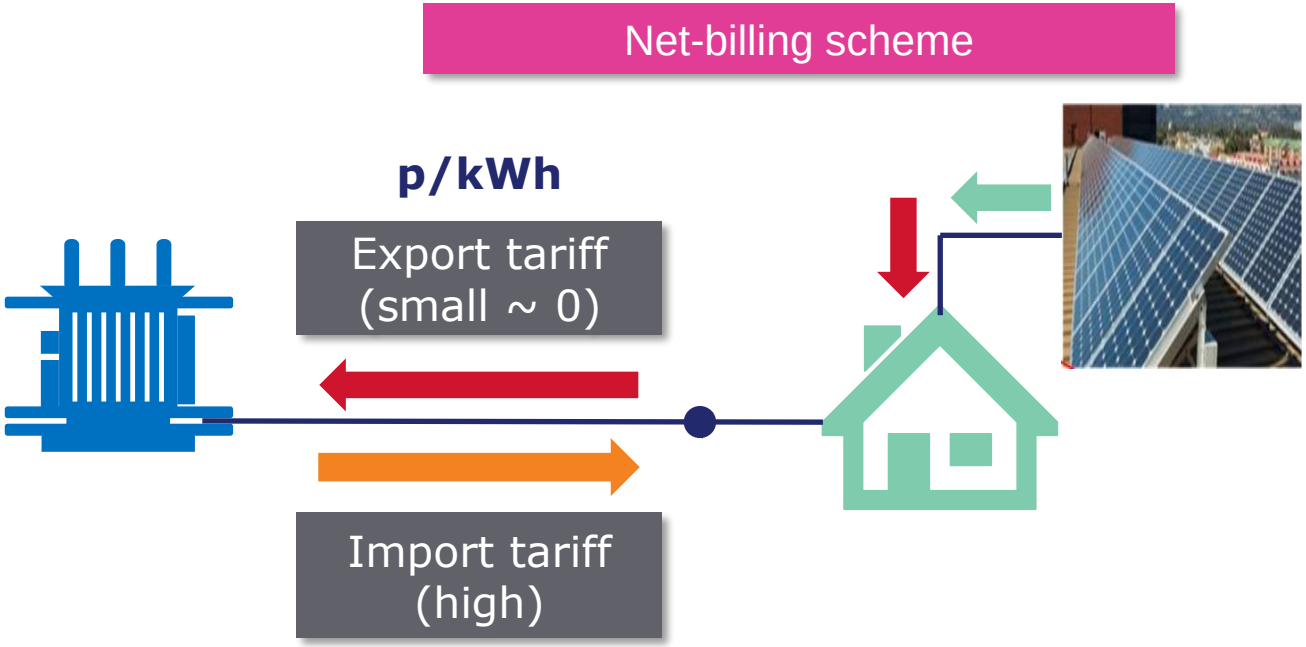
# Transition Towards Self-Consumption PV Scheme

- Alternative regulatory scheme is needed to reduce PV export and increase local energy self-sufficiency

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# Self-Consumption PV Scheme @ 30 % Energy Sufficiency (Net-Billing)

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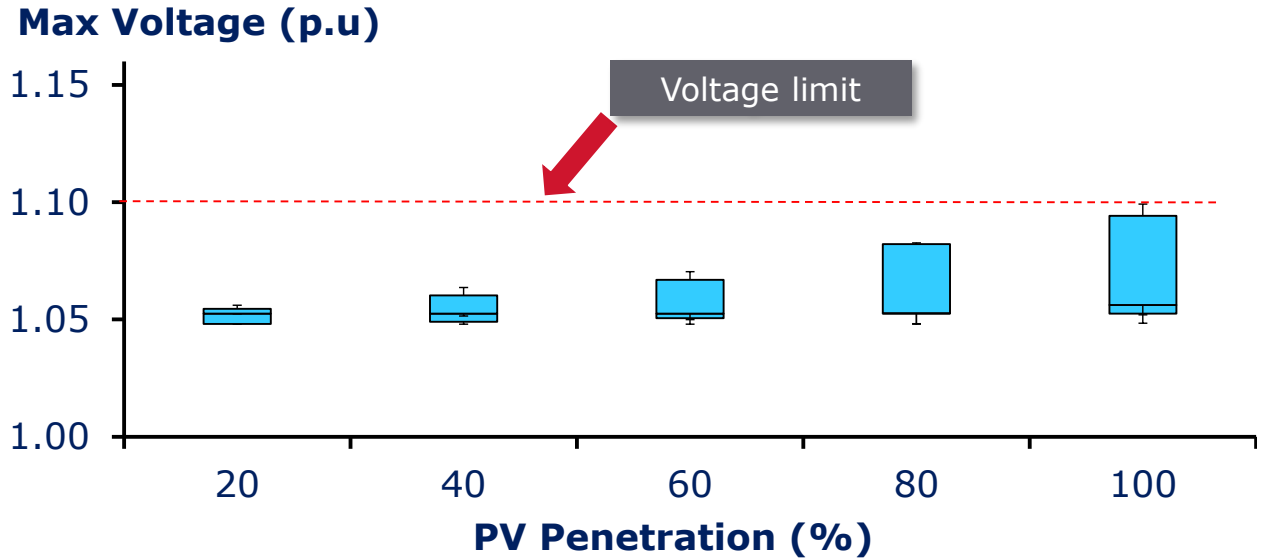
- PV system is sized for each customer to achieve 30% of energy consumption from PV




Net billing enables **100% PV penetration** within the distribution networks constraints

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# 50 % Energy Sufficiency – Role of Residential Batteries

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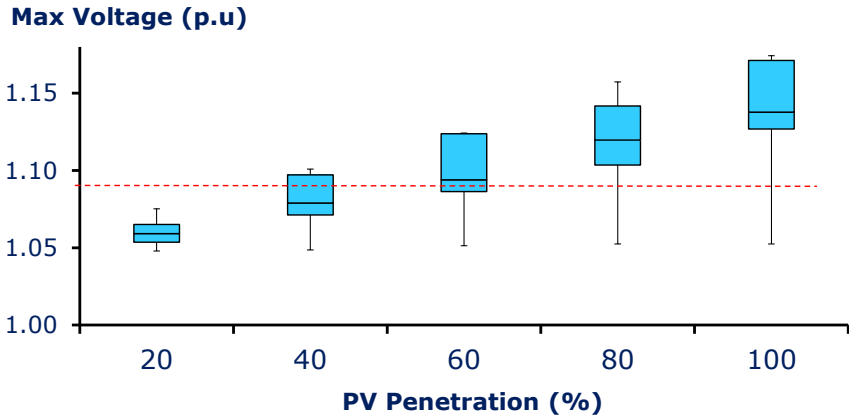
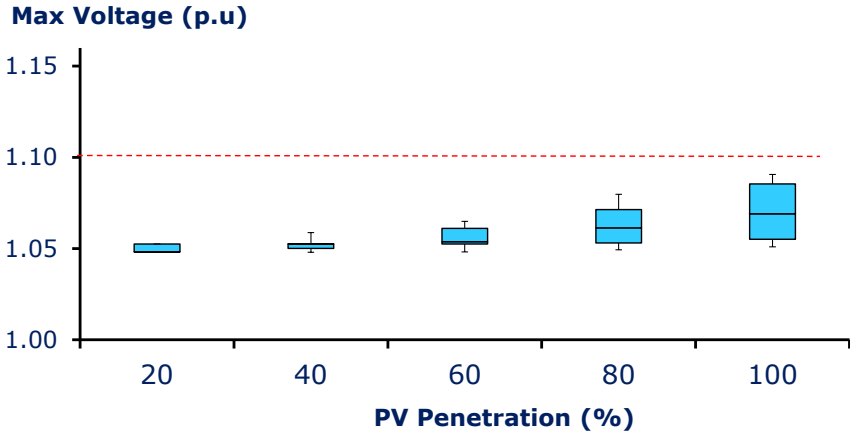
- Lithium-Ion battery prices fell **80%** from 2010-2017
- **With managing** of batteries and PV, it is possible to achieve **50%** energy sufficiency within network constraints




Control for the benefit of user only

Control for the benefit of both user and network

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# Remarks

- Jordan Governmental target aims to achieve 50% of electricity energy needs from local resources by 2030
- Current net-metering PV scheme enables only 20% of customers with PV due to distribution network constraints
- Transition towards self-consumption scheme enables larger PV penetration and improve self-sufficiency
- Batteries could be a crucial PV enabler technologies, However Governmental subsidy scheme is needed to support their capital cost and allow the management of batteries to solve network issues