National Water Sector Strategy

"A right for every citizen, a resource for the whole country"





LEBANESE REPUBLIC
MINISTRY OF ENERGY AND WATER

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Ministry of Energy and Water (Date 27/12/2010)
Lebanese Government (Resolution No. 2, Date 09/03/2012)

Baseline

Demand/Supply Forecasts

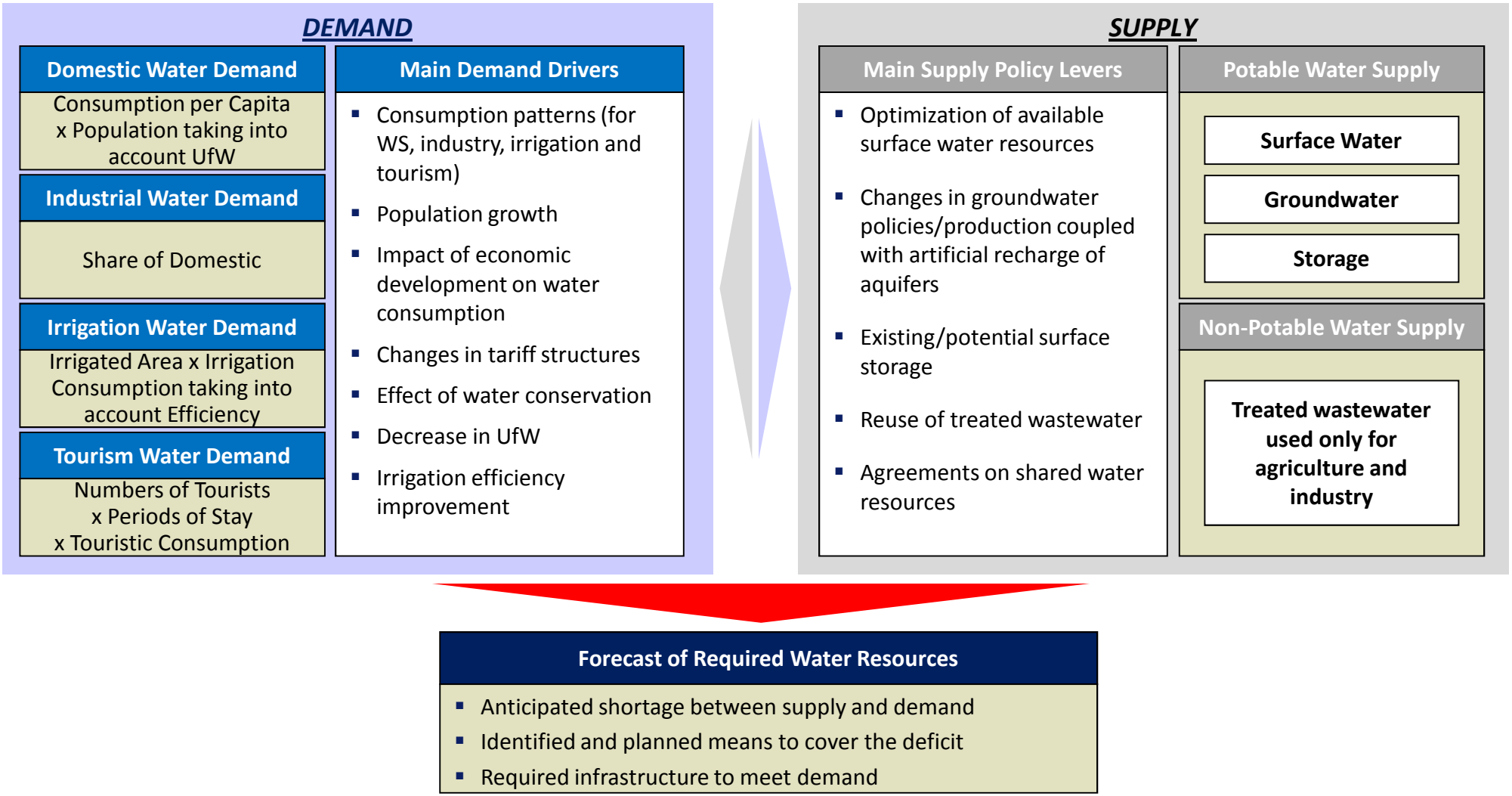
Sector Enabling Environment

Investment Plan

Strategic Roadmap

A water demand/supply model aims at forecasting required resources to cover anticipated shortages

Schematic of the Water Demand/Supply Forecasting Model



Baseline

Demand/Supply Forecasts

- **Demand**
- Supply
- Demand/Supply Balance
- Infrastructure Forecasts

Sector Enabling Environment

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Strategic Roadmap

Demand/supply forecasting methodology takes into account a number of drivers and policy levers on the demand side (1/2)

Assumptions will need to be validated/ revisited in due course during the planning phases

Drivers/Policy Levers

1.a Domestic Consumption per Capita	▪ Assumes demand per capita thresholds associated with urban development level, based on international benchmarks adapted to local conditions ▪ Domestic water includes water consumption for residential, commercial and governmental entities
1.b Industrial Consumption	▪ In the absence of recent surveys on the water consumption of the industrial sector, assumes industrial demand as a share of domestic demand
1.c Tourism Consumption	▪ Uses the latest figures of the Ministry of Tourism and the General Security, as well as international benchmarks to determine touristic water consumption ▪ Relies on Mediterranean basin benchmarks to determine daily consumption per tourist
1.d Irrigation Consumption	▪ Uses the latest figures of the Ministry of Agriculture, based on the latest census done by FAO, and World Bank studies ▪ Irrigation consumption is to be reduced, by improving irrigation efficiency of existing and planned irrigation schemes, as well as optimizing on-farm irrigation techniques
2 Population Growth	▪ Uses population figures and historical growth rates forecasts by Central Administration of Statistics to estimate projected population growth ▪ Uses numbers of Palestinian refugees based on UNRWA data

Demand/supply forecasting methodology takes into account a number of drivers and policy levers on the demand side (2/2)

Assumptions will need to be validated/ revisited in due course during the planning phases

Drivers/Policy Levers

3 **Irrigation Growth**	▪ Uses government plans for the development of the irrigation sector and achieve an integrated and sustainable rural development ▪ Irrigated areas are to be increased in line with government policies. From the current 90,000 ha of irrigated lands, targets of reaching 120,000 ha by 2020 and 150,000 ha by 2035 have been set
4 **Impact of Economic Development**	▪ Uses historical and forecasted real GDP growth to assess the impact of economic development on projected demand for water , leading to an increase of 1% per annum
5 **Tariff Change**	▪ Uses elasticity of demand to estimate the impact of water tariff changes on water consumption
6 **Water Conservation**	▪ Assumes a decrease in water consumption through anticipated water conservation initiatives and assumes its impact on domestic and non-domestic consumers. Awareness and conservation campaigns are planned through MEW's Lebanese Center for Water Management and Conservation
7 **Reduction in UfW**	▪ rates vary among the WEs from 40% to 52%. A weighted average of 48% has been adopted on country level. Targets of reducing UfW to 30% by 2020 and to 20% by 2035 have been adopted ▪ Assumes a decrease in UfW following initiatives carried out by WEs under MEW's oversight and determines its impact on distributed water

1 Water demand

Thresholds are based on international benchmarks adapted to local conditions

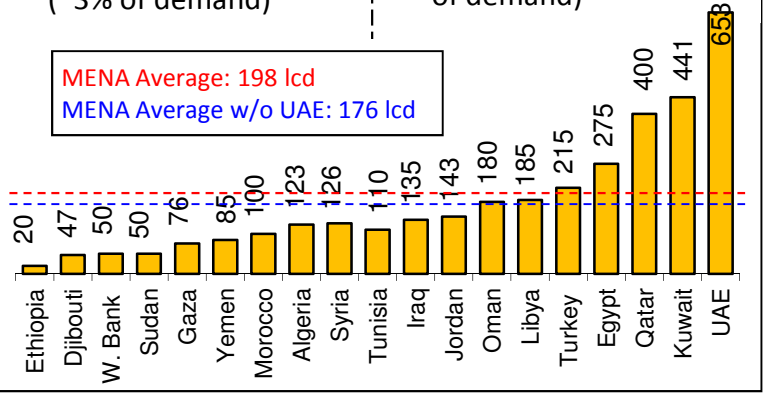
1.a Domestic

Rural Areas

- Drinking and cooking
- Personal use (bath, washing, etc)
- Laundry, dishwashing
- Cleaning
- Gardening
- Limited commercial use (~3% of demand)

Urban Areas

- Drinking and cooking
- Personal use (bath, washing, etc)
- Laundry, dishwashing (machine)
- Cleaning
- Large scale gardening
- Public Gardens
- Commercial use (5-10 % of demand)



1.b Industrial

- Mainly small scale industries: 99% of industries have less than 50 employees
- Average of 6.5 m3/day per small establishment
- Can reach up to 600 m3/day for larges establishment s
- 11% of water use goes to industry

1.c Tourism

- Consumption based on benchmarks of similar countries in the region
- Average consumption in Mediterranean countries: 440 l/tourist/day

1.d Irrigation

- Including losses in transmission and distribution networks
- 63,400 ha (70.4%) furrow irrigation
- 21,100 (23.4%) sprinkler irrigation
- 5,500 (6.2%) drip irrigation

Rural Domestic Demand 160 lcd

Urban Domestic Demand 180 lcd

Industrial Demand 30% of Domestic Demand

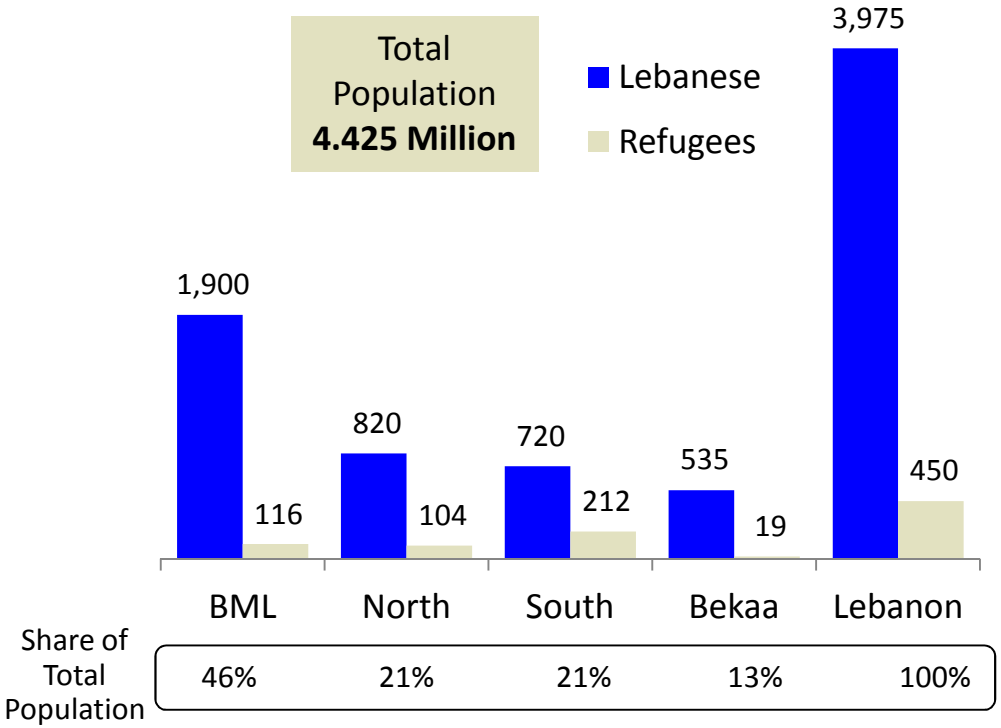
Tourism Demand 400 l/tourist/d

Agriculture Demand 9000 m3/ha/yr *In 2010*

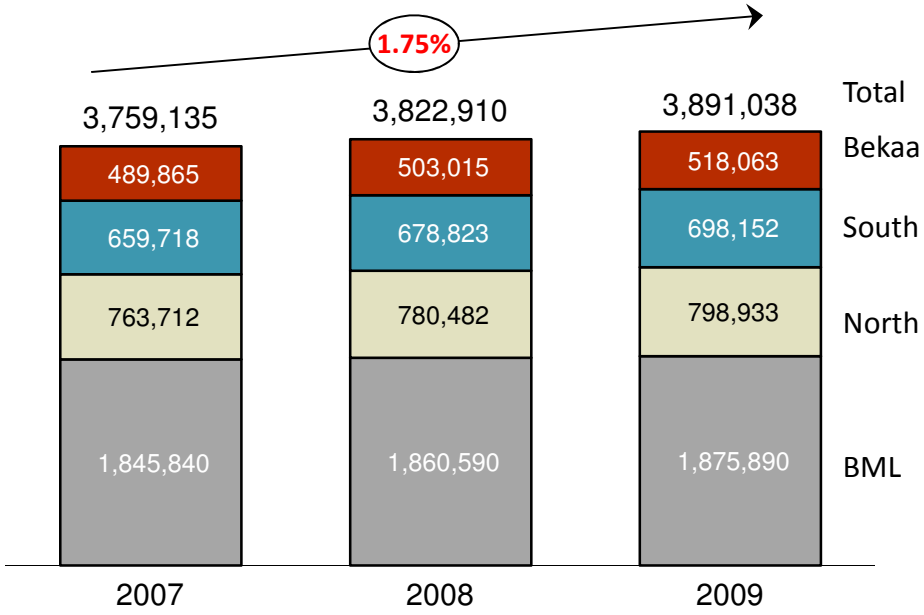
Source: MoA, FAO Aquastat, UNESCO, WB, ESCWA, MEW (1996 , 1999),

2 Population and growth

Distribution of Population by Region in, 2010 ('000)



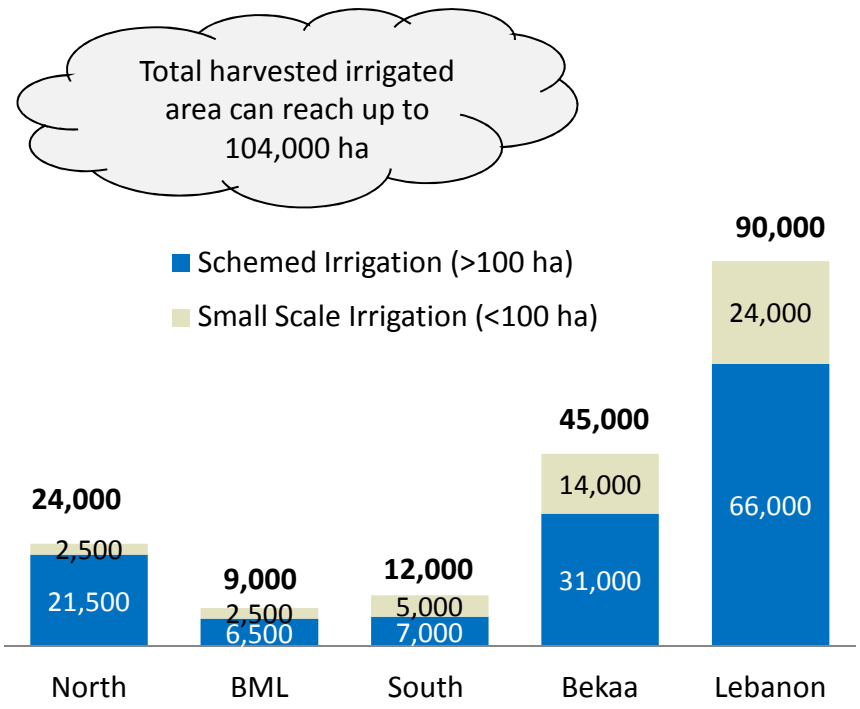
Lebanese Population Growth, 2007-2009 (%)



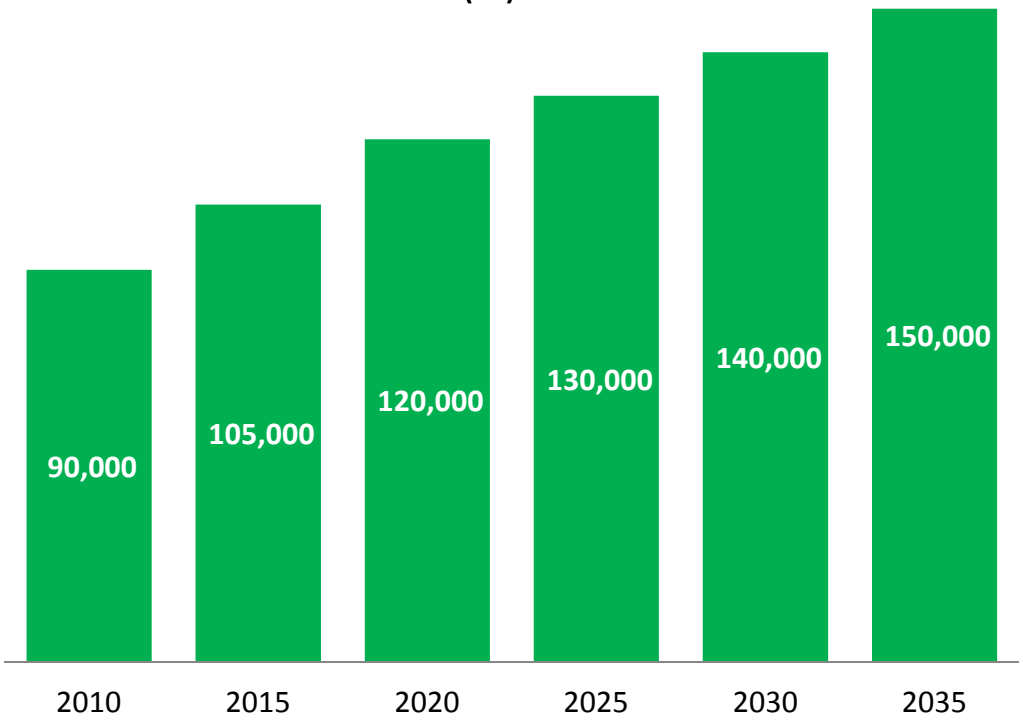
Source: CAS, UNRWA

3 Irrigated areas and growth

Irrigated Areas in WEs , 2010 (ha)

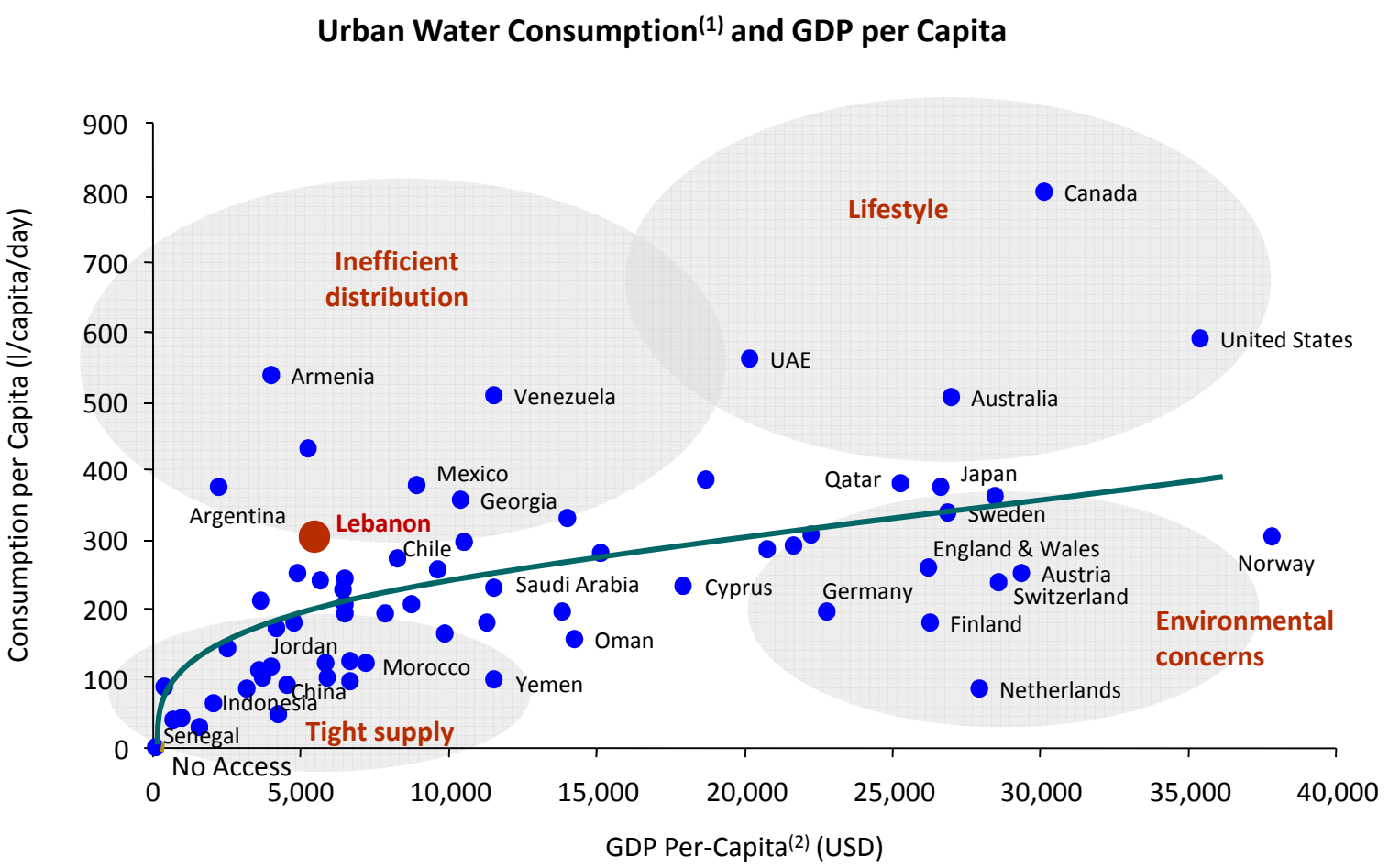


Projected Growth in Irrigated Areas in Lebanon, 2010 - 2035 (ha)



Source: MoA , FAO, WB, MEW

4 Urban water consumption and relation with economic development

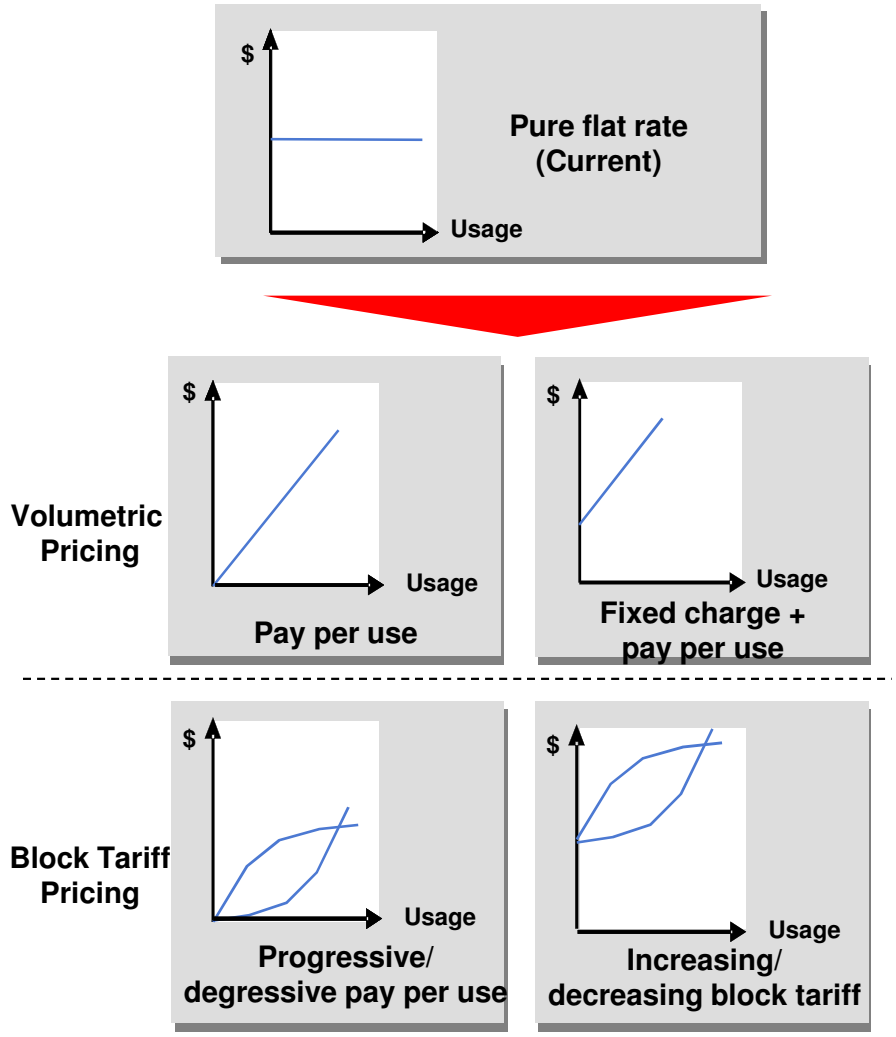


Note: (1) Includes UfW (2) Adjusted by purchasing power parity

Source: IMF, UN, MEW Analysis

5 Impact of tariff change (1/2)

Current and Proposed Tariff Systems



Source: IB-Net

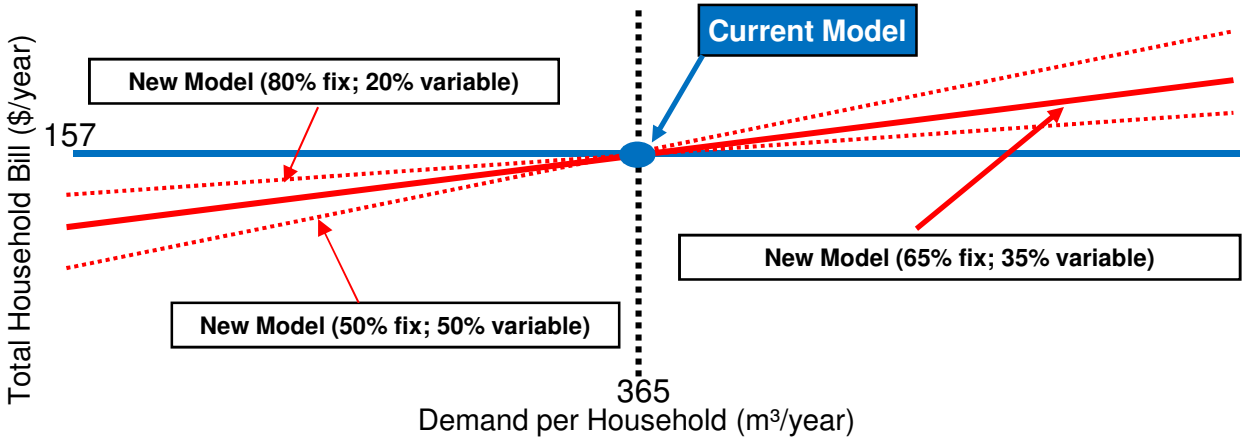
Benchmarks on Applied Tariffs in MENA region

Country	City	Structure	Block Tariff	Level of Water Tariff	Level of WW Tariff
		V, F, M	I, D, C	USD/m3	USD/m3
Turkey	Adana	V	C	1.38	0.34
	Ankara	V	C	1.31	n/a
	Izmir	V	I	1.45	1.02
	Istambul	V	I	1.96	1.29
	Konya	V	C	0.98	n/a
Syria	Damascus	V	I	0.05	0.02
Lebanon	BMLWE	F	n/a	0.43	0
Morocco	Casablanca	V	I	0.72	0.05
Oman	Muscat	n/a	n/a	0	n/a
Occupied Territories		V	I	1.23	0.32
Palestine	Ramallah	V	I	1.23	0.32
Bahrain	Manama	V	I	0.07	n/a
Qatar	Doha	V	C	1.21	n/a
KSA	Jeddah	V	C	0.05	0
	Riyad	V	I	0.03	0
UAE	Dubai	V	I	2.16	n/a

V = volumetric	I = increasing
F = fixed fee	D = decreasing
M = Mix	C = constant

5 Impact of tariff change (2/2)

	Tariffs shall be affordable	Tariffs shall cover costs	Clients able to choose consumption	Predictability for revenues
Pure flat tariff	✗	✗	✗	✓
Pure volumetric tariff	✗	✗	✓	✗
Progressive volumetric tariff	✓	✓	✓	✗
Fixed charge plus volumetric tarif	✗	✓	✓	✓
Fixed charge plus progressive volumetric tariff	✓	✓	✓	✓



Highlights

- Tariff structures will see significant modifications:
  - For water supply: the current flat tariff structure will be replaced by a volumetric tariff structure after replacement of gauges by meters
  - For irrigation: the different forms of tariffs currently applied will be replaced by volumetric tariffs
  - For wastewater: A new tariff will be introduced in proportion with the used volumes of water supply
- Tariff changes will have an impact on the different types of consumptions. This impact needs to be defined through further studies
- Once identified, the impact of these tariff changes will be reflected in demand patterns

6 Water conservation

Water Conservation Initiatives

Planned Conservation Initiatives on Domestic and Industrial Demand	Planned Conservation Initiatives on Irrigation Water
▪ Installation of conservation kits (plumbing retrofits and high-efficiency toilets and showerheads, dual flush toilets, faucet aerators, kitchen aerators) ▪ High-efficiency cloth washers ▪ Complete retrofit of large water consumers, e.g., industrial, commercial ▪ Public outreach, awareness and education programs ▪ Household and establishment audits	▪ Adoption of high efficiency on-farm irrigation techniques, e.g., drip irrigation, sprinkler irrigation, overhead irrigation where applicable ▪ Coordination with Ministry of Agriculture for the adoption towards lower consumption crops ▪ Public outreach, awareness and farmer education programs ▪ Farm audits and optimization according to local conditions

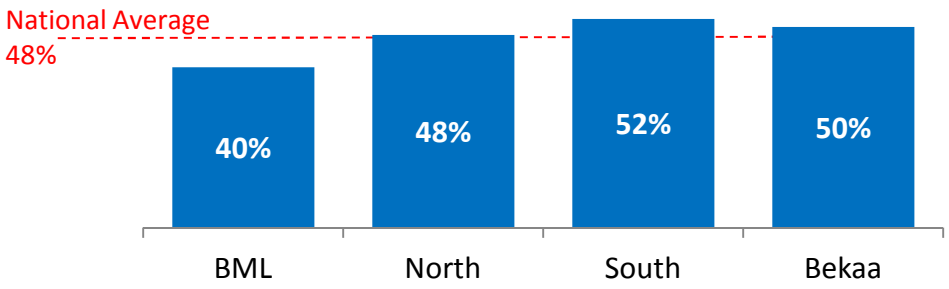
Saving per year from 2011 to 2020
3.0 lcd estimate

Awareness and conservation campaigns are planned and executed mainly through the Lebanese Center for Water Management and Conservation

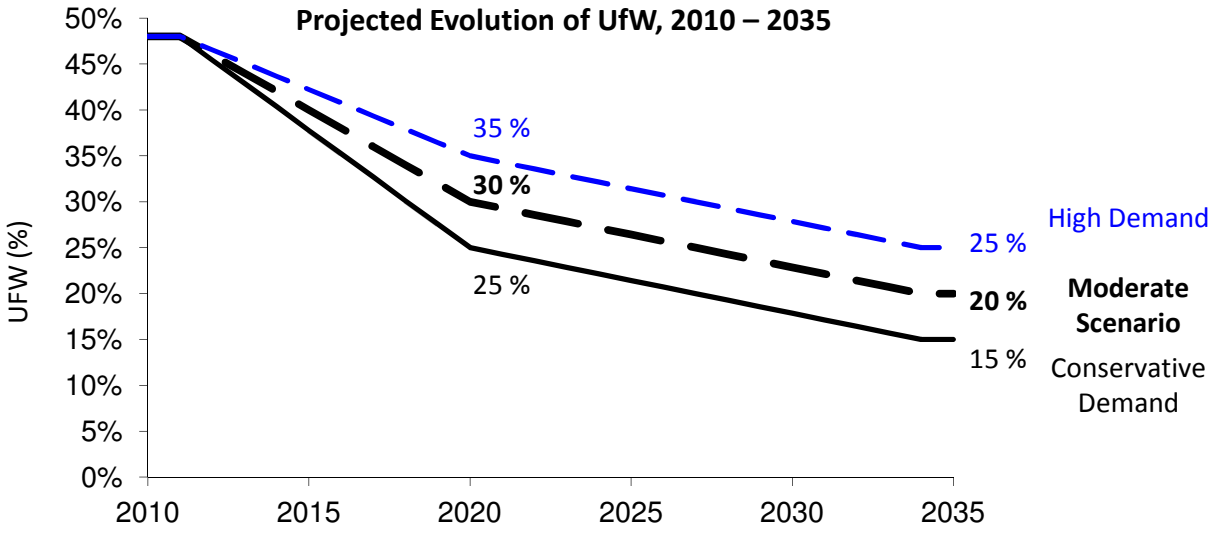
Decrease from
9,000 to 7,000 m^3/ha/yr by 2035

7 Decrease in UFW levels

Unaccounted For Water In WEs, 2010
(in % of Water Production)



Projected Evolution of UfW, 2010 – 2035



Comments and Key Assumptions

- To allow for more flexibility, three scenarios have been considered on the demand side: High Demand, Moderate Demand, Conservative Demand
- It is reasonable to assume that the UfW would reach 30% in the next 10 years and 20% in 2035 based on a scheduled decrease mainly due to fixing leakage (Moderate Scenario)
- International benchmarks and experience in MENA countries show that a level of 20% is feasible
- We assumed that significant leakage improvement projects will be carried out by WEs under MEW's oversight over the 2011–2020 period

Source: WEs, MEW analysis

To allow for more flexibility, three scenarios have been considered on the demand side: High Demand, Moderate Demand, Conservative Demand (1/2)

Drivers/Policy Levers	Scenario 1 Conservative Demand	Scenario 2 Moderate Demand	Scenario 3 High Demand
1.a Domestic Consumption per Capita	**160 lcd** - *Urban* **140 lcd** - *Rural*	**180 lcd** - *Urban* **160 lcd** - *Rural*	**200 lcd** - *Urban* **180 lcd** - *Rural*
1.b Industrial Consumption	Share of domestic **25%**	Share of domestic **30%**	Share of domestic **35%**
1.c Tourism Consumption	**350 l/tourist/d**	**400 l/tourist/d**	**450 l/tourist/d**
1.d Irrigation Consumption	Decrease from **9,000 to 7,000 m3/ha/yr by 2035**	Decrease from **9,000 to 7,000 m3/ha/yr by 2035**	Decrease from **9,000 to 8,000 m3/ha/yr by 2035**
2 Population Growth	CAGR 2010-2035 **1.5%**	CAGR 2010-2035 **1.75%**	CAGR 2010-2035 **2.0%**

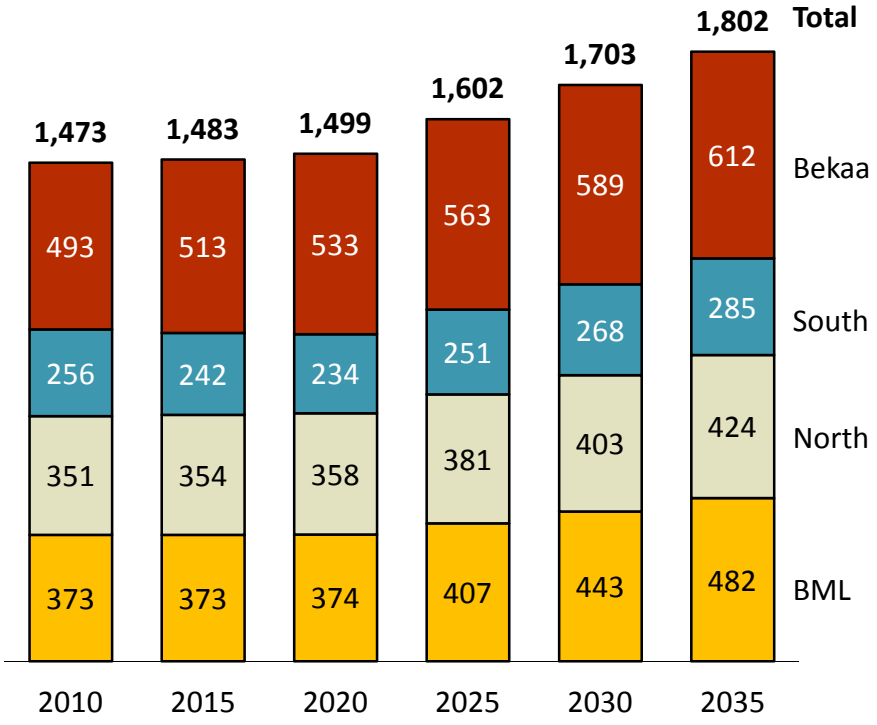
CAGR: Compound Annual Growth Rate

To allow for more flexibility, three scenarios have been considered on the demand side: High Demand, Moderate Demand, Conservative Demand (2/2)

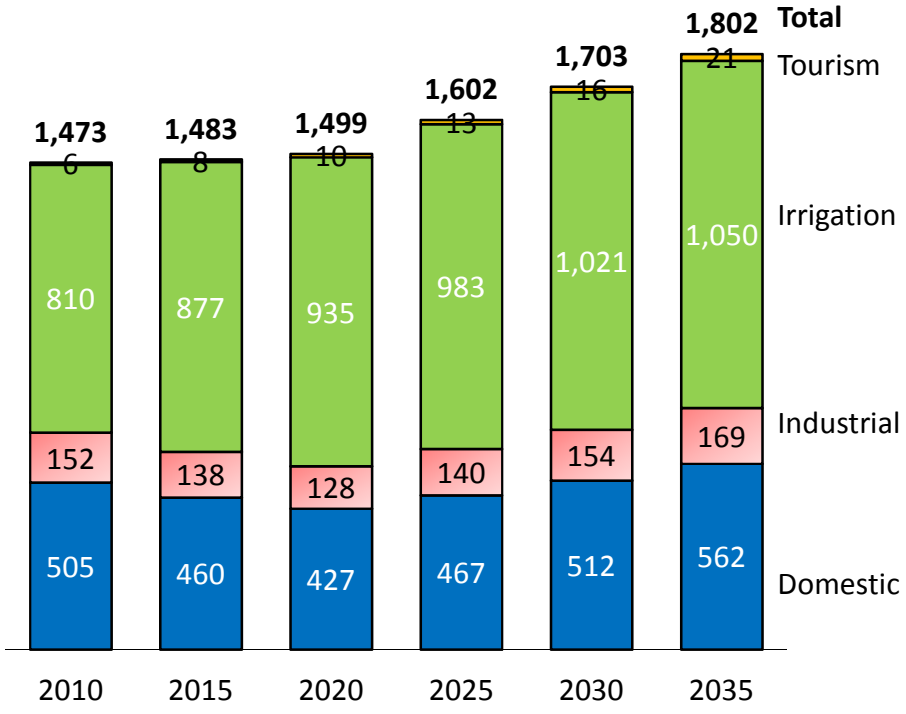
Drivers/Policy Levers	Scenario 1 Conservative Demand	Scenario 2 Moderate Demand	Scenario 3 High Demand
3 Irrigation Growth	**110,000 ha** in 2020 **130,000 ha** in 2035	**120,000 ha** in 2020 **150,000 ha** in 2035	**140,000 ha** in 2020 **180,000 ha** in 2035
4 Impact of Economic Development	Consumption Growth **0.8% per annum**	Consumption Growth **1% per annum**	Consumption Growth **1.2% per annum**
5 Tariff Change	Volumetric tariff introduction in **2012**	Volumetric tariff introduction in **2013**	Volumetric tariff introduction in **2014**
6 Water Conservation	Saving per year from 2011 to 2020 **3.5 lcd**	Saving per year from 2011 to 2020 **3.0 lcd**	Saving per year from 2011 to 2020 **2.5 lcd**
7 Reduction in UfW	Decrease from **48% to 25% by 2020 then to 15% by 2035**	Decrease from **48% to 30% by 2020 then to 20% by 2035**	Decrease from **48% to 35% by 2020 then to 25% by 2035**

Total demand under the moderate demand scenario is expected to reach 1,802 MCM/yr by 2035

Moderate Scenario for Water Demand per Region (in MCM/yr, 2010 - 2035)



Moderate Scenario for Water Demand per Usage (in MCM/yr, 2010 - 2035)

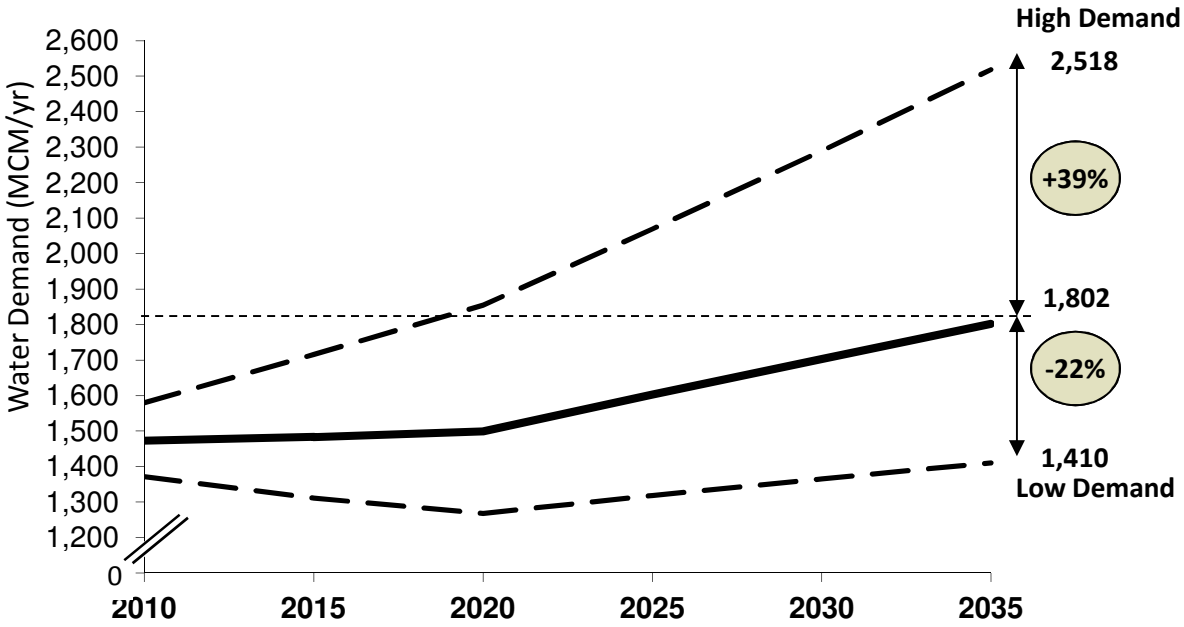


Currently the actual amount of water consumed is different form the demand due to availability and supply constraints

lcd (Urban)	180	174	167	176	185	194
Pop (M)	4.43	4.83	5.26	5.74	6.37	6.82
Irr ('000 ha)	90	105	120	130	140	150

Source: MEW, WEs,

The range between the conservative and high demand scenarios exceeds 60%



Demand Scenarios – Domestic Consumption per Capita (lcd) – Urban Area						
Low (sc. 1)	160	153	145	153	161	169
Mod (sc. 2)	180	174	167	176	185	195
High (sc. 3)	200	195	190	199	209	220

Demand Scenarios – Irrigation Consumption per Hectare (m3/ha/yr)						
Low (sc. 1)	9,000	8,600	8,200	7,800	7,400	7,000
Mod (sc. 2)	9,000	8,600	8,200	7,800	7,400	7,000
High (sc. 3)	9,000	8,800	8,600	8,400	8,200	8,000

Comments

- The range observed between the low and high demand scenarios is the result of different assumptions on the drivers in each of the scenarios
- The main drivers are consumption per capita thresholds, population growth, impact of GDP growth, industrial and irrigation consumption and growth, etc.:
  - Consumption per capita thresholds vary between 140 lcd and 200 lcd
  - Annual average population growth ranges between 1.5% and 2.0% for the low and high scenarios respectively
  - Industrial consumption varies between 25% and 35 %
  - Targets for irrigation areas in 2035 vary between 130,000 and 180,000 ha and consumption between 7000 m3/ha to 8000 m3/ha
  - Targets for UfW in 2035 vary between 15% and 25% for the low and high scenarios respectively

Baseline

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- **Supply**
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Main sources of water in Lebanon include surface water and groundwater while surface storage and non conventional sources are limited

Surface Water

- More than 2,000 springs exist all over Lebanon with varying flows around the year
- Total yield exceeds 1200 MCM in an average year, with less than 200 MCM available during the dry summer months
- Existing surface water resources (springs) are being currently exploited to a large extent by WEs. Limited optimization could be achieved by around 1% per year for the coming 10 years

Groundwater

- Around 650 governmental wells supply WEs throughout the country with potable water. Total volume used in 2009: more than 270 MCM
- More than 43,000 private wells are used for potable water and agriculture. Total volume used in 2009 is feared to be higher than 440 MCM. **Unlike other sources, private wells serve only a portion of the population**
- Although strict policies for groundwater extractions have been initiated, no major reductions in extractions are planned before 2015, planned date for the coming on board of sustainable alternatives. Between 2015 and 2024, private groundwater extractions are to be reduced gradually at a rate of 6%per year with increasing reliance on public wells.
- Ultimately, withdrawals from aquifers should not exceed natural replenishment rate, i.e. 500 MCM/yr

Surface Storage

- Surface storage is mainly concentrated in 2 dams with a total capacity of 235 MCM:
  - Qaraoun Dam: 220 MCM static and 160 MCM (up to 180 MCM) dynamic
  - Chabrouh Dam: 8 MCM static and up to 15 MCM dynamic
- Currently, only 45 MCM are used for WS and irrigation, the rest for hydropower

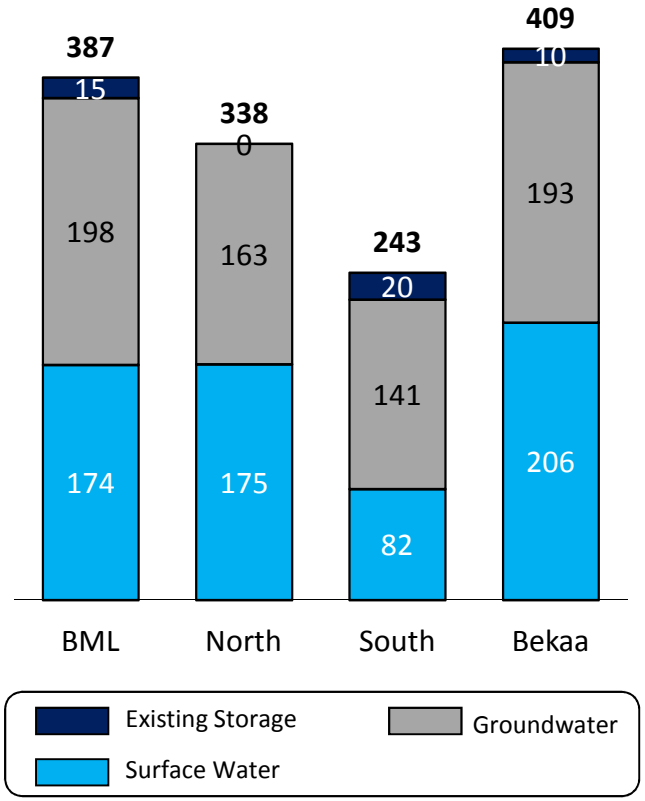
Non Conventional Water

- The average rate of wastewater treatment reached 4% in 2009 – Virtually no reuse is being currently practiced
- Limited desalination is done by private sector (4.5MCM) and EDL (5.5 MCM)
- Additional flows are expected from non conventional sources, but have not been modeled for lack of clarity on available data

Source: MEW, WEs, Ministry of Agriculture

3 scenarios for water resources are studied to balance between the use of groundwater vs. surface storage

Supply per Region, 2010 (MCM/yr)

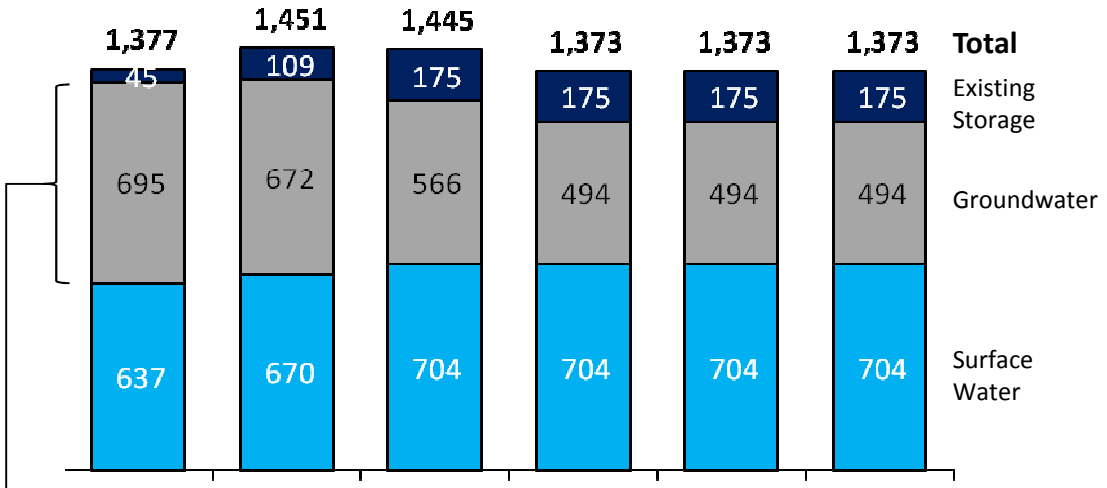


Total Supply: 1,377 MCM/yr
Surface Water: 46%
Groundwater: 51%
Used Storage: 3%

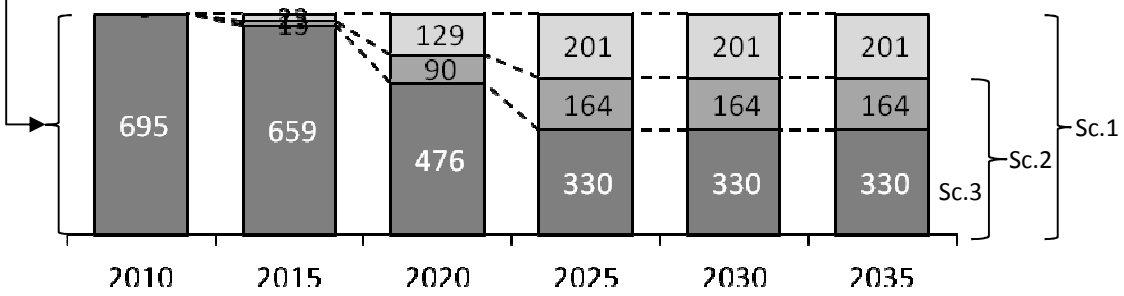
	Scenarios for water resource s
High Groundwater Supply Policy (Sc. 1)	▪ Optimize and fully utilize available renewable surface water capacities ▪ Utilize the full groundwater capacities currently used by MEW/WEs and by the private sector ▪ Provide surface storage to fill the shortage
Moderate Groundwater Supply Policy (Sc. 2)	▪ Optimize and fully utilize available renewable surface water capacities ▪ Utilize a moderate proportion of groundwater capacities currently used by MEW/WEs and by the private sector (up to 90% of the average renewable groundwater resources) ▪ Rely more on surface storage to fill the shortage
Low Groundwater Supply Policy (Sc. 3)	▪ Optimize and fully utilize available renewable surface water capacities ▪ Utilize a low proportion of groundwater capacities currently used by MEW/WEs and by the private sector (up to 60% of the average renewable groundwater resources) ▪ Rely extensively on surface storage

As surface water is limited, the tradeoff between groundwater and surface storage shall be carefully managed to ensure additional needed resources

Split between Surface Water, Groundwater and Surface Storage (in MCM/yr, 2010-2035)



Groundwater Scenarios (in MCM/yr, 2010-2035)



Key Highlights

- Currently exploited storage capacity, 45 MCM:
  - Chabrouh: 15 MCM in BML
  - Qaraoun: fro m the 220 MCM total static capacity (160 MCM dynamic capacity), only 30 MCM are currently exploited: 10 MCM for the irrigation of South Bekaa Phase I (2000 ha) and 20 MCM for Qasmieh - Ras Al Ain irrigation scheme in the South. The rest of the capacity is currently used for hydropower. 110 MCM will be used in the future (2014-2018) for irrigation of South Bekaa Ph II (additional 20 MCM) and, through canal 800, for irrigation (90 MCM) and water supply (20 MCM) in the South
- Groundwater extractions to be reduced to no more than 500 MCM by 2025
- Surface water resources to be optimized to reach around 700 MCM by 2020

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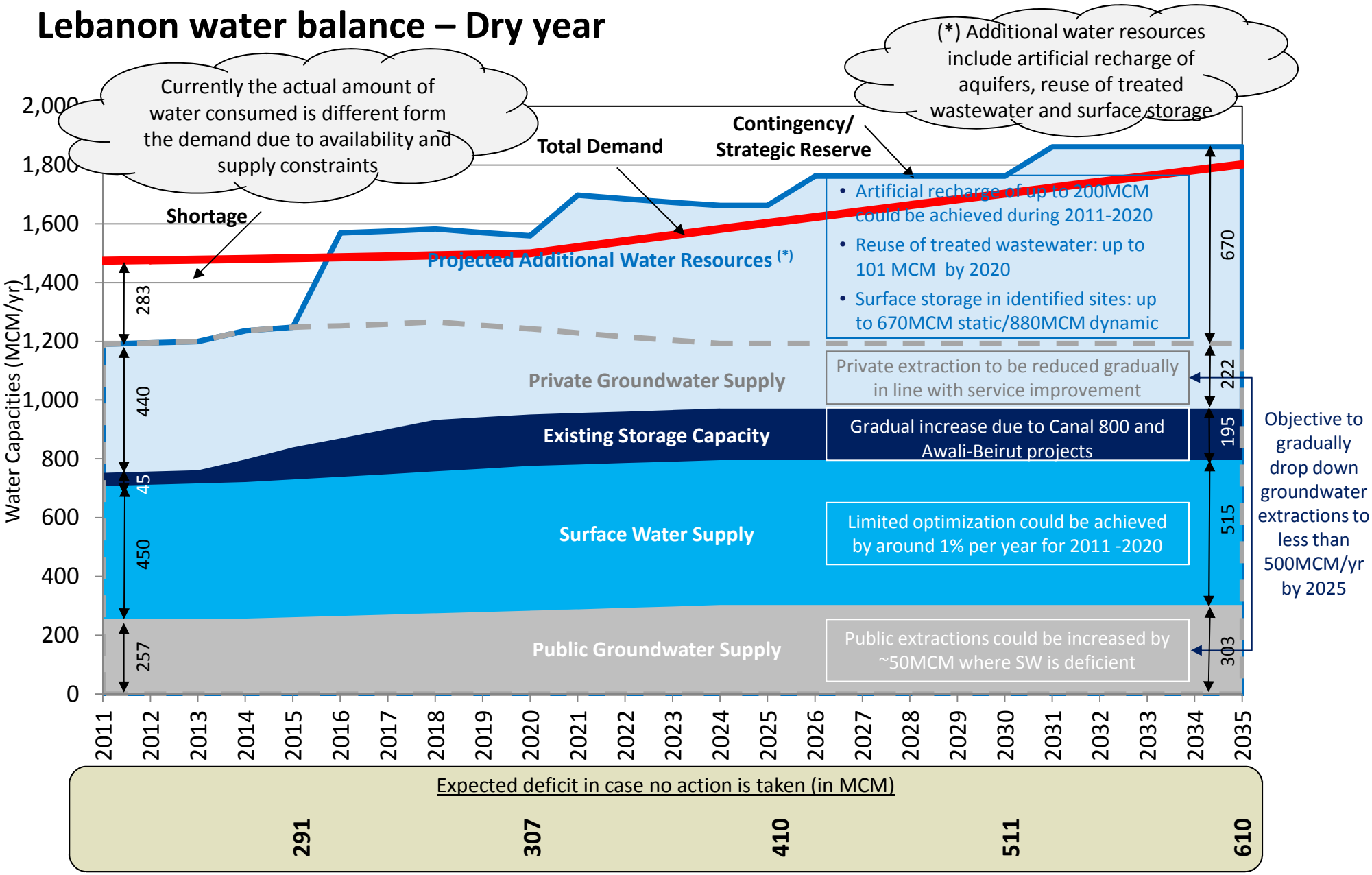
Several considerations and assumptions on supply/demand outputs are considered based on hydrology and duration

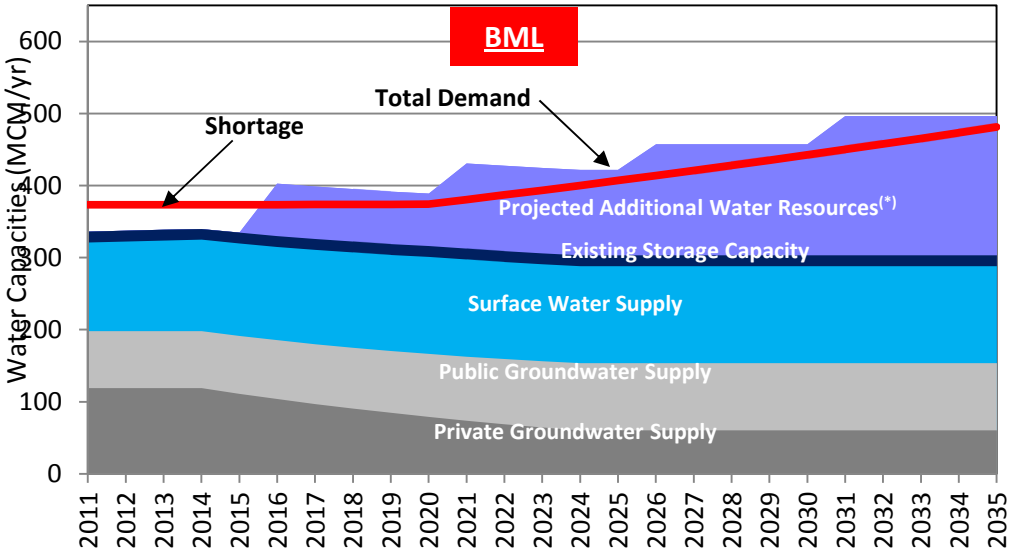
	Average Year	Dry Year
	▪ Total precipitation: 8.6 BCM/yr ▪ Total renewable water resources: 4.1 BCM/yr ▪ Groundwater resources naturally replenished up to 500 MCM/yr	▪ 10 yrs recurrence interval ▪ Precipitation and surface flows < 70% of average year ▪ Available groundwater resources: 80% of average year
Full year	▪ Surface water: 100% of available exploitable throughout the year after optimization ▪ Groundwater: 90 % of annual renewable capacity ▪ Used storage: 100% of full capacity (45 MCM in 2010)	▪ Available surface water: 70% of average year ▪ Available groundwater: 100% of average year ▪ Used storage: 100% of full capacity (45 MCM in 2010)
Summer Months (July – October)	▪ Total demand: ~60% of full year demand (irrigation demand ~70% of full year demand) ▪ Available surface water: 25% of full year ▪ Extracted private groundwater: 70% of full year ▪ Extracted public groundwater: 60% of full year ▪ Used storage: 65% of full capacity	▪ Available surface water: 25% of full dry year ▪ Extracted private groundwater: 70% of full dry year ▪ Extracted public groundwater: 60% of full dry year ▪ Used storage: 65% of full capacity

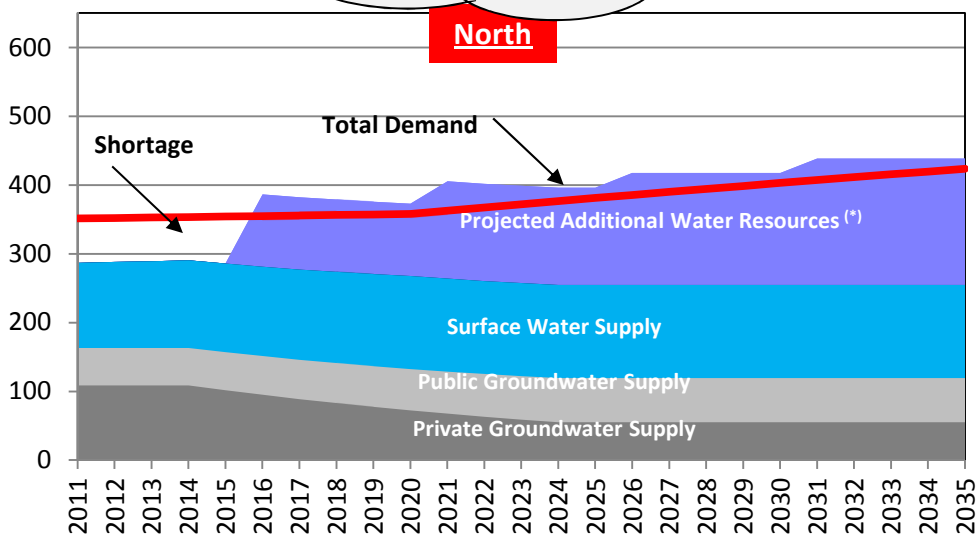
Lebanon water balance – Dry year

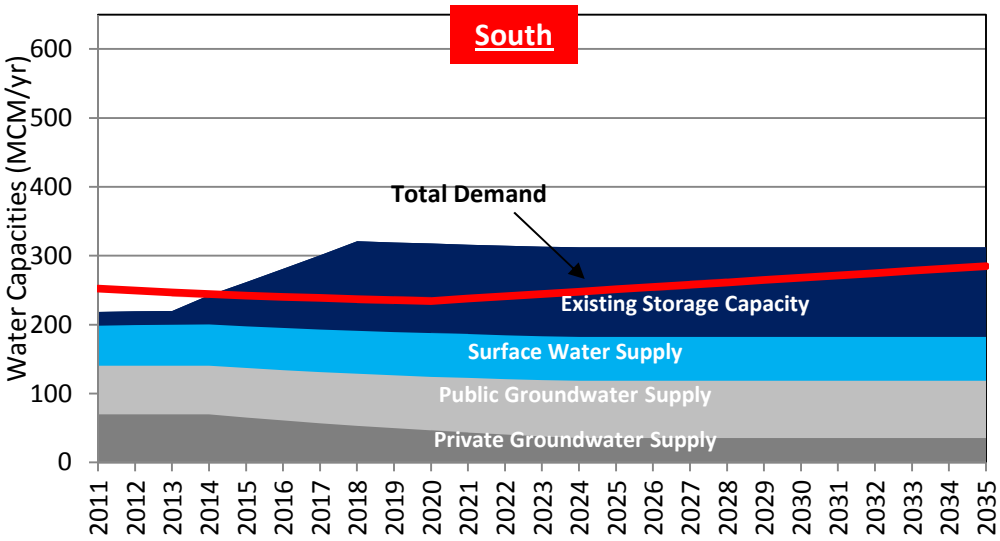


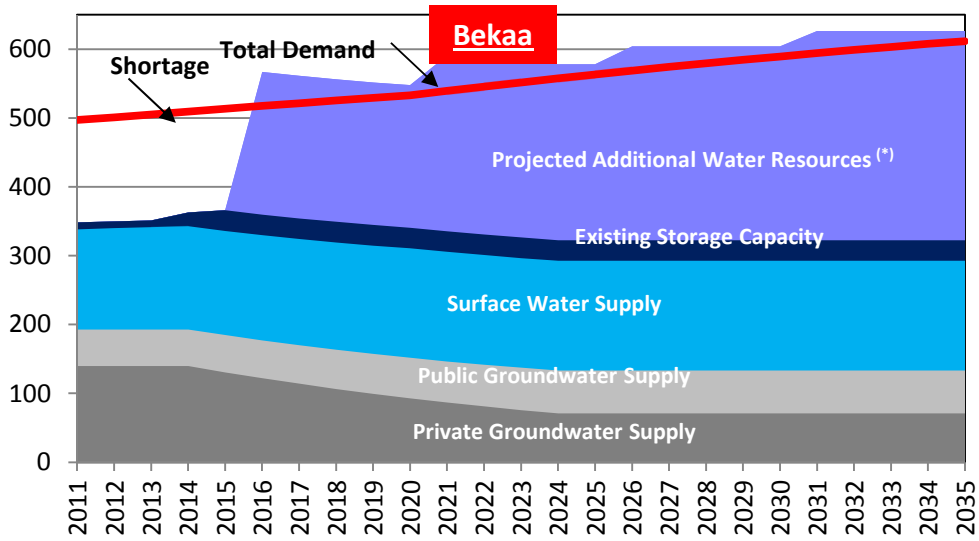
WEs – Dry Year (with projected storage)

(*) Additional water resources include artificial recharge of aquifers, reuse of treated wastewater and surface storage









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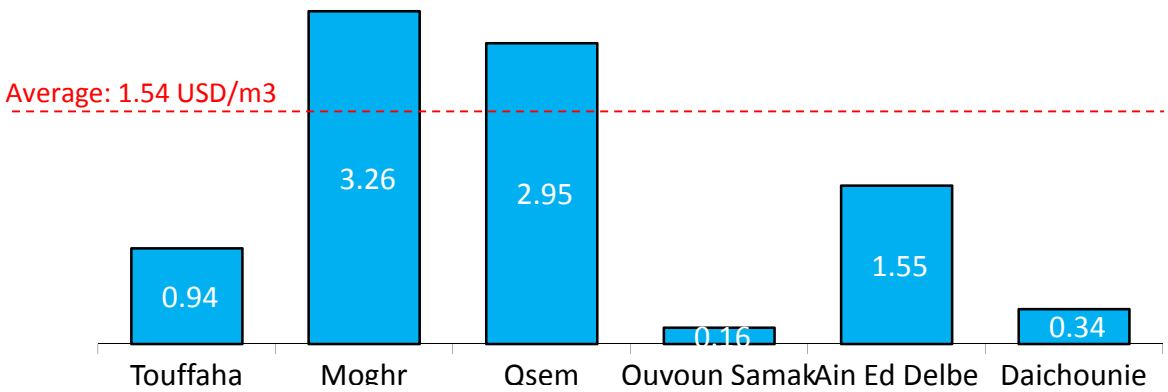
Investment Plan

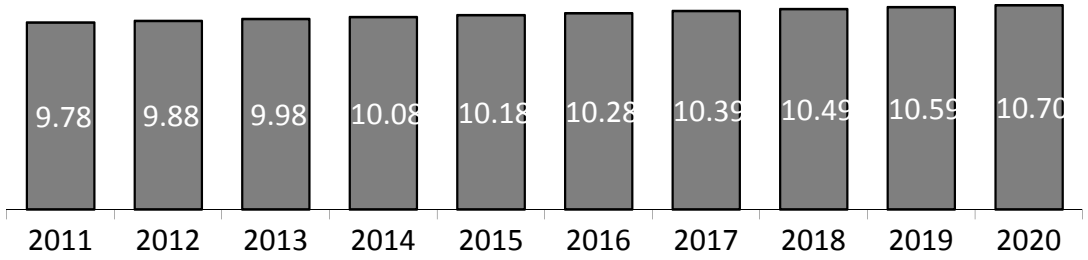
Strategic Roadmap

Outflow of existing surface water resources (springs) will be optimized by around 1% per annum for the period 2011 -2020

Unit Cost of Optimization of Surface Water Resources – Previous Experience (in USD/m3)



Cost of Optimization of Surface Water Resources (in MUSD, 2011-2020)

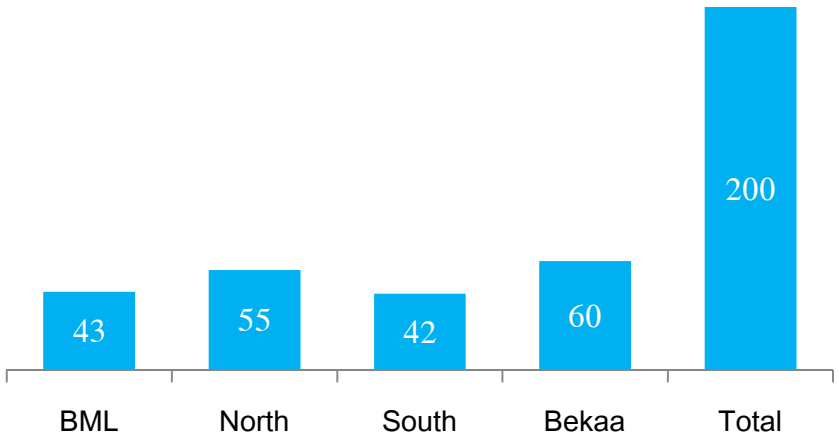


Highlights

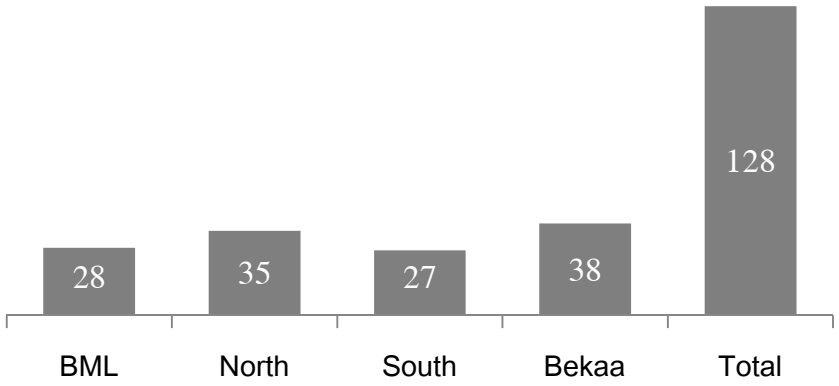
- Existing surface water resources (springs) are being currently exploited to a large extent by WEs
- Previous experience at MEW proved the efficiency of superficial improvement of the catchment of surface water springs
- An increase of 10-15% of the initial flow during the low season was achieved
- Limited optimization could be achieved by around 1% per year for the period 2011 -2020
- **Additional 65 MCM/yr are expected by 2020**

200 MCM of artificial groundwater recharge are targeted at a first stage (2011-2020)

Potential for Artificial Groundwater Recharge (MCM/yr)



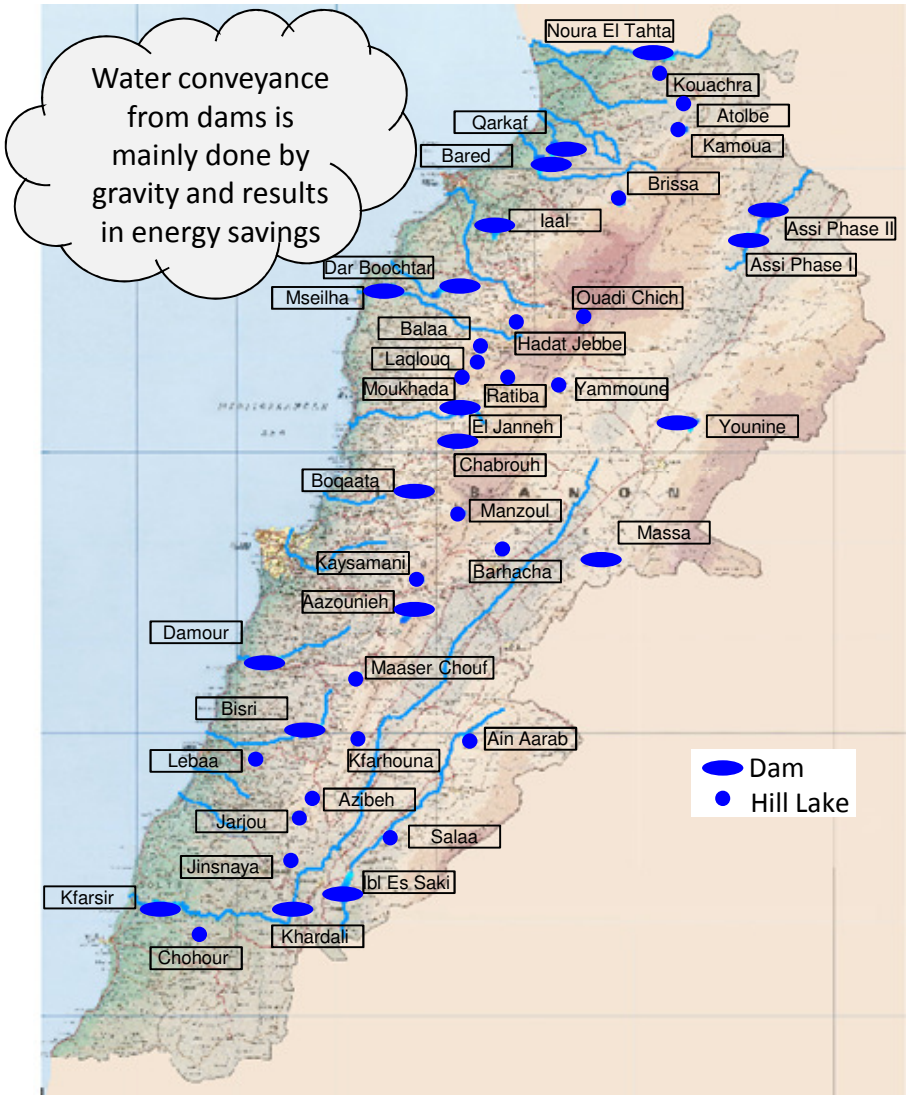
CAPEX Forecast for Artificial Groundwater Recharge (MUSD, 2011-2035)

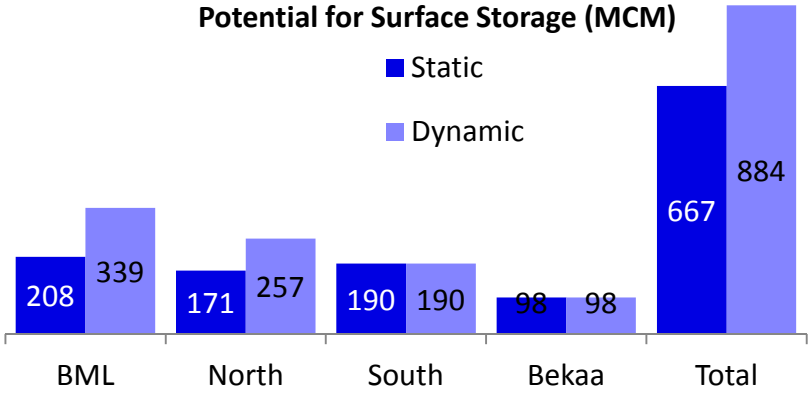


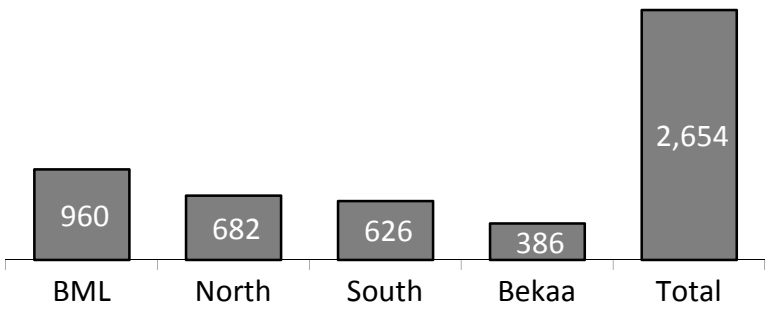
Artificial Groundwater Recharge - Rationale

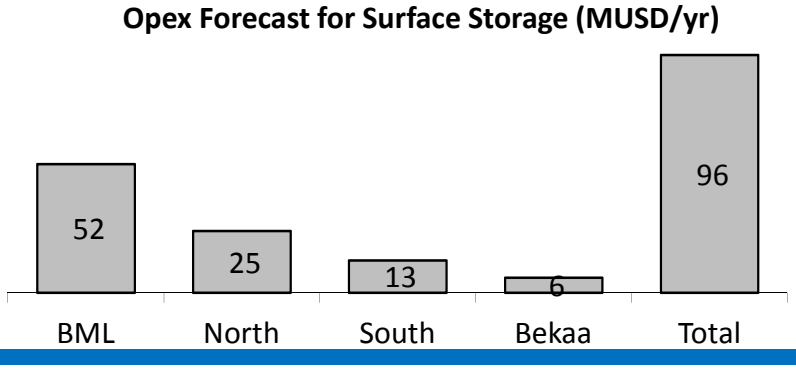
- Groundwater aquifers in Lebanon are highly exploited, mainly in Beirut, Tripoli, South Lebanon and the Bekaa.
- Around 500 MCM/yr are being naturally replenished. Current extractions amount to around 700 MCM/yr leading to a deficit of around 200 MCM/yr. As a result, the water table is depleting with saline water intrusion in coastal areas
- Karstic aquifers are well spread all over Lebanon and contain considerable volumes of water
- Groundwater is a localized resource with no surface evaporation and does not involve large transmission systems
- Artificial recharge is technically feasible in a large portion of the country
- Pilot projects can be started near Beirut, Tripoli and Baalbek. The situation in South Lebanon requires deeper consideration
- Preliminary studies show that each well could have a potential flow of 50-100 l/s during a period of at least 3 months

Up to 670 MCM of static storage (~880 MCM dynamic) can be achieved in identified sites







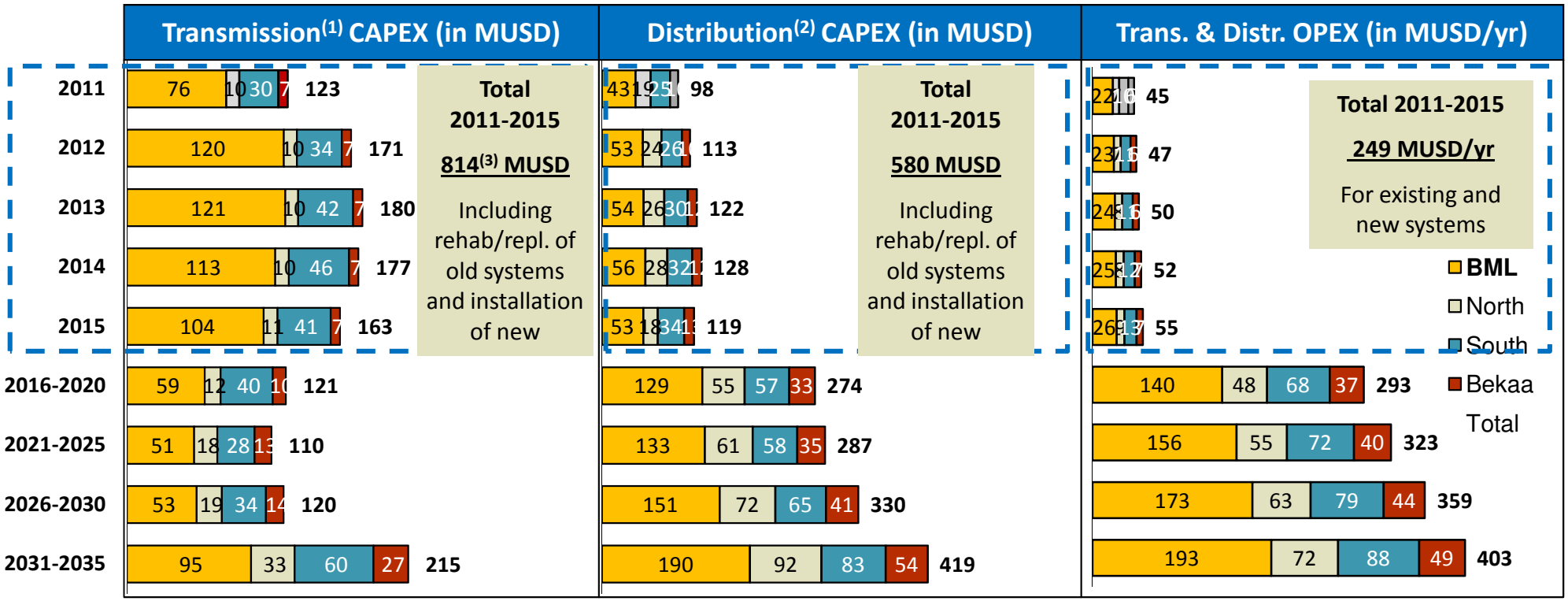


Surface storage potential per WE

Designation of Dam	Static-Dynamic Cap. (MCM)			CAPEX (MUSD)	OPEX (MUSD/yr)
	Total	WS	Irrig.		
Boqaata	6-12	6-12	0.0	69.0	2.3
El Manzoul	0.35	0.35	0.0	15.0	0.2
Bisri	120	120	0.0	265.0	26.4
Kaysamani	1.0	1.0	0.0	25.0	0.3
Aazounieh	4.1-5.0	4.1-5.0	0.0	65.0	1.1
Maaser Chouf	2.2	2.2	0.0	53.0	0.5
Damour	42-106	34-94	8-12	150.0	7.3
El Janneh	30-90	25-75	5-15	300.0	13.2
Moukhada	2.0	2.0	0.0	9.0	0.6
Ratiba	0.3	0.15	0.15	9.0	0.1
Total BML	**208-339**	**195-312**	**13-27**	**960.0**	**52.0**
Bared	37-90	37-90	0.0	144.0	14
Qarkaf	20-25	0.0	20.0-25	81.0	0.5
Kouachra	0.35	0.0	0.35	3.0	0.0
Noura El Tahta	35-50	0.0	35-50	69.0	0.9
Kamoua	1.2	0.0	1.2	25.0	0.1
Atolbe	0.70	0.70	0.0	18.0	0.3
Mseilha	6-12	5-10	1-2	55.0	2.0
Balaa	1.2-2.2	1.2-2.2	0.0	26.0	0.4
Iaal	12-18	9.5-14	2.5-4	69.0	3.2
Brissa	0.8	0.0	0.8	20.0	0.1
Dar Boochtar	55.0	20.0	35.0	150.0	3.0
Ouadi Chich	1.0	0.9	0.1	13.0	0.3
Hadat ElJebbe	0.4	0.4	0.0	9.0	0.1
Total North	**171-257**	**75-138**	**96-119**	**682.0**	**25.0**

Designation of Dam	Static-Dynamic Cap. (MCM)			CAPEX (MUSD)	OPEX (MUSD/yr)
	Total	WS	Irrig.		
Kfarhouna	1.2	0.0	1.2	17.0	0.1
Lebaa	0.8	0.0	0.8	15.0	0.1
Azibeh	0.6	0.0	0.6	13.0	0.1
Jarjou	0.5	0.5	0.0	19.0	0.3
Chohour	0.56	0.56	0.0	22.0	0.3
Jinsnaya	0.95	0.95	0.0	15.0	0.2
Ibl Es Saki	50	15.0	35.0	200.0	3.9
Khardali	120	20.0	100.0	280.0	6.4
Kfarsir	15	3.0	12.0	45.0	1.8
Total South	**189.6**	**40.0**	**149.6**	**626.0**	**13.1**
Yammouneh	1.5	0.0	1.5	Under construction	0.1
Younine	5.8	5.8	0.0	66.0	1.5
Assi Phase I	63	0.0	63.0	50.0	1.3
Assi Phase II	15	0.0	15.0	141.0	0.8
Barhacha	0.55	0.55	0.0	37.0	0.6
Ain Aarab	2.0	2.0	0.0	21.0	0.5
Salaa	2.5	2.5	0.0	36.0	0.6
Massa	8.0	1.5	6.5	35.0	0.8
Total Bekaa	**98.4**	**12.4**	**86.0**	**386.0**	**6.0**

Infrastructure forecasting – Water supply transmission & distribution

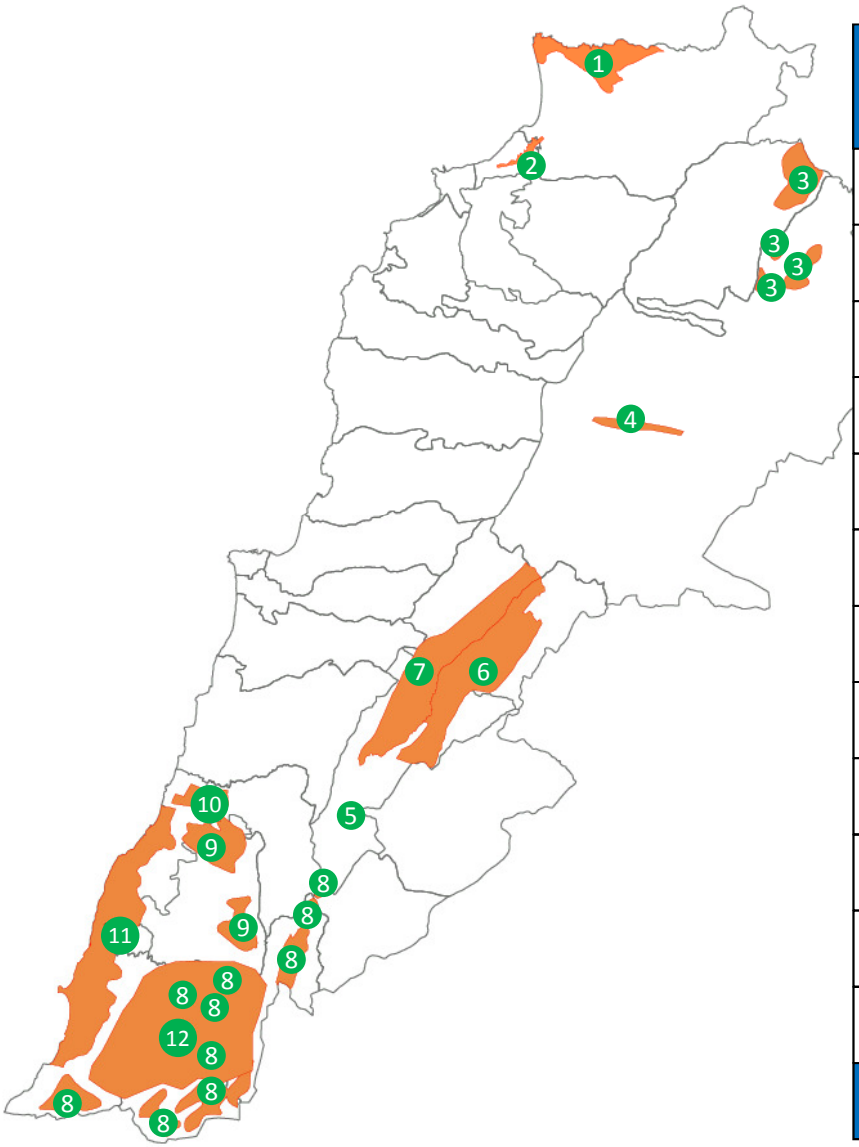


Highlights

- CAPEX in first five years are relatively high because of efforts to replace existing over-age assets. More than 50% of existing transmission and distribution assets have reached the end of their useful life
- High Transmission CAPEX for BML and South in 2011-2015 relates to the execution of Awali-Beirut and Canal 800 (WS share only)
- Storage targets to achieve 0,5 and 1 day retention time for BML and other WE's respectively
- Metering targets until 2015 in BML 95%, in North/South 85% and Bekaa 75%. Total meter installation over 1 Million in 2011-2020

Note: (1) Includes bulk meters and storage tanks, (2) includes customer meters, (3) includes CAPEX for Awali-Beirut and Canal 800 conveyors (WS share)

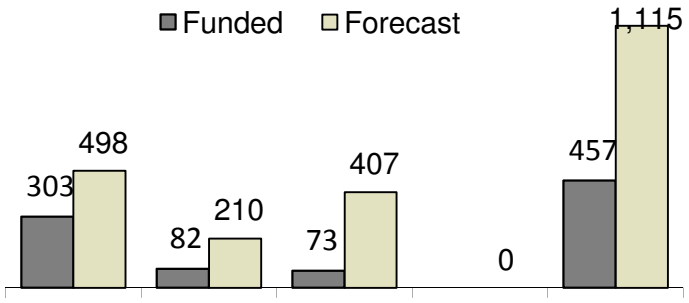
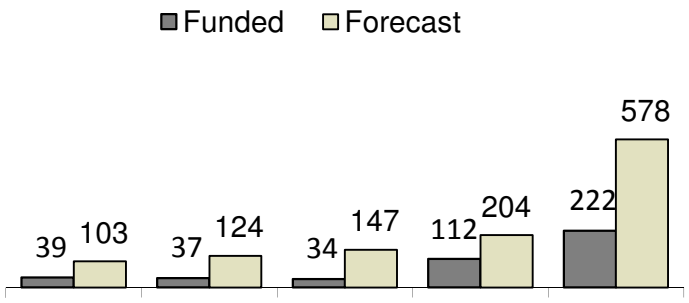
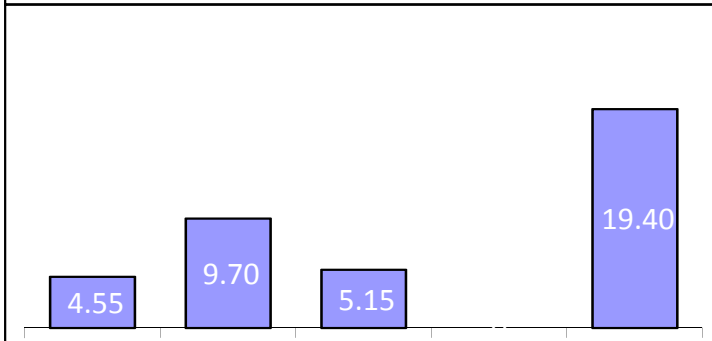
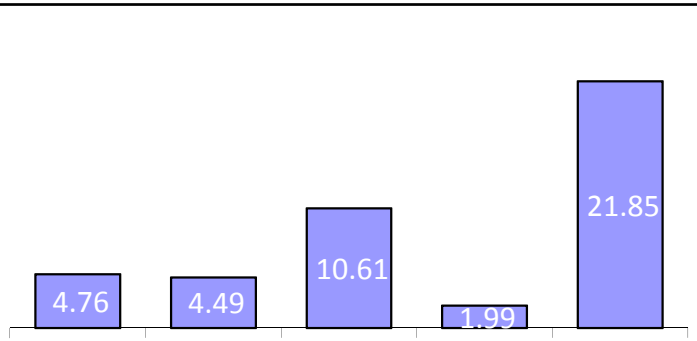
Infrastructure forecasting – Irrigation



Designation	Area (ha)	Commissioning		CAPEX (MUSD)	OPEX (MUSD/yr)
		Before 2020	After 2020		
1 Noura Et Tahta Scheme	5,000	✓		58	1.2
2 El Bared Scheme	750	✓		6	0.2
3 Assi River Basin	5,400	✓		170	2.8
4 Younine Scheme	1,550	✓		28	0.6
5 Southern Qaraoun Irrigation Project	500		✓	8	0.25
6 South Bekaa (Phase 2), Left Bank	6,700	✓		60	1.25
7 South Bekaa, Right Bank & North	12,800		✓	35	0.7
8 South Lebanon-Conveyor 800	14,700	✓	✓	255+255	5.2
9 Conveyor Anane-Nabatieh	3,500		✓	145	2.6
10 Saida-Jezzine Project	1,200		✓	8	0.25
11 Qasmieh-Ras El Ain (Phase 2)	2,100		✓	22	0.5
12 Khardale	9,000		✓	220	3.8
Total	**63,200**	**31,600**	**31,600**	**1,040**	**18.35**

Source: MEW

Infrastructure forecasting – Wastewater

	Coastal Systems	Inland Systems	Comments
CAPEX (in MUSD)			▪ Networks for coastal treatment plants and inland plants are already funded by CDR
OPEX (in MUSD)			

Assumptions

- Schemes that are currently partly funded will be funded and completed and will become operational by 2015
- Schemes that are currently unfunded will be implemented between 2013—2020
- It is estimated that remaining areas not covered by the identified schemes would require around 500 million US$ and will be implemented between 2013-2020