Chapter 8. Appendix documents

8. 1 Appendix 1：Small Hydro Seminar presentation material (Hokuden Engineering Consultants)

FY2021 City-to-city collaboration project for the realization of a zero-carbon society

Introduction on small hydroelectric power generation projects in Japan

15/02/2022

北電技術コンサルタント株式会社

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1. Company Profile

- Company name Hokuden Engineering Consultant Co., Ltd.
  (100% subsidiary of Hokuriku Electric Power)
- Head office address: 13-15 Ushijima-cho, Toyama City, Toyama Prefecture
  (North of Toyama Station: Next to the Hokuriku Electric Power Head Office Building (inside the Momokawa Building))
- Offices Head Office/Toyama, Branches/Ishikawa, Fukui, Shiga
  Tokyo, Tohoku Sales Office, Niigata Sales Office, etc.

Founded in 1974 (Founded as a civil engineering and construction division of a group company)

- Established in 2001 (Civil engineering and construction division separated)
- Project contents Construction consultants who plans and designs civil engineering and construction work
- Capital 50 million yen (FY2021 sales: 2.6 billion yen)
- President Manabu Hashimoto
- Number of employees 160 (81 civil engineering, 23 communications, 30 construction, 26 corporate)

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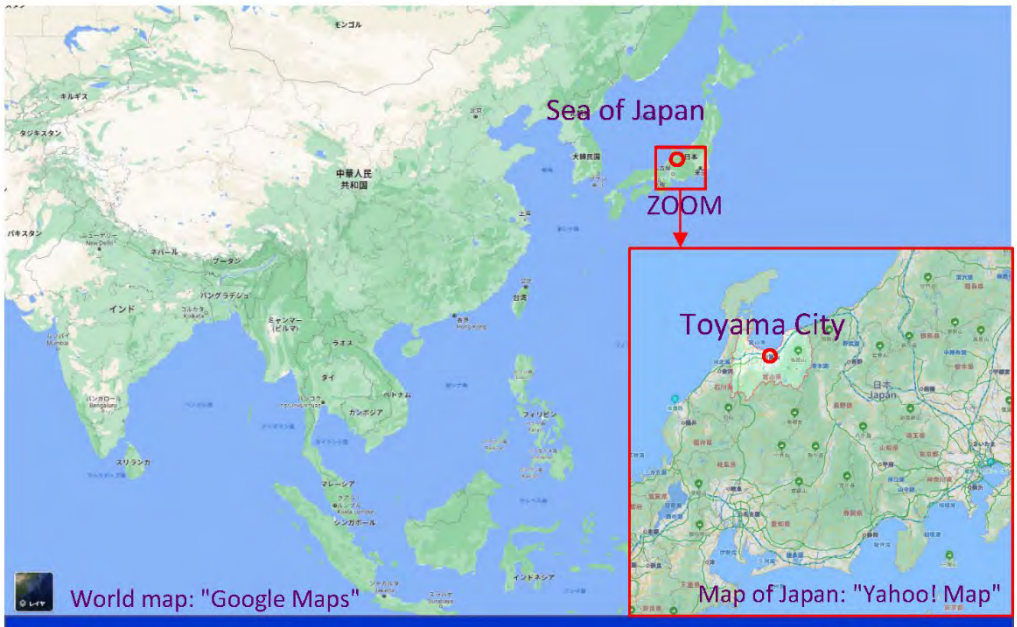
[Head office location (Toyama City)]



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2. Main track records of hydroelectric power plants [(1) New development]

Location	Power plant name	Project (ordering) proponent	Maximum output	Start of operation
Toyama Prefecture	Shin Oonagatani No. 1 Power Station	Toyama Prefectural Enterprise Bureau	7,500 kW	2001
Toyama Prefecture	Kamimomose Power Station	Toyama Prefectural Enterprise Bureau	640kW	2013
Ishikawa Prefecture	Shin Karebuchi Power Station	Ishikawa Prefectural Enterprise Bureau*	3,000 kW	2006
Ishikawa Prefecture	Miyatake Canal No. 2 Power Station	Miyatake Water Land Improvement District	580kW	2018
Fukui Prefecture	Hirono Power Station	Fukui Prefectural Enterprise Bureau*	1,400 kW	1996
Fukui Prefecture	Kuzuryu River Downstream 4 Power Station	Hokuriku Agricultural Administration Bureau	Total 807 kW	2019
Niigata Prefecture	Sasagamine Power Station	Hokuriku Agricultural Administration Bureau	997 kW	2019
Gunma Prefecture	Yamba Power Station	Gunma Prefectural Enterprise Bureau	11,700 kW	2020
Yamanashi Prefecture	Kyoutou Channel 2 Power Plant	Gunma Prefectural Enterprise Bureau	Total 135 kW	2019
Yamanashi Prefecture	Hokawa Power Station	Yamanashi Prefectural Enterprise Bureau	900kW	(under construction)

* Currently operated by Hokuriku Electric Power Co., Inc. as a project owner

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Panoramic view of Yamba Power Station (under construction)

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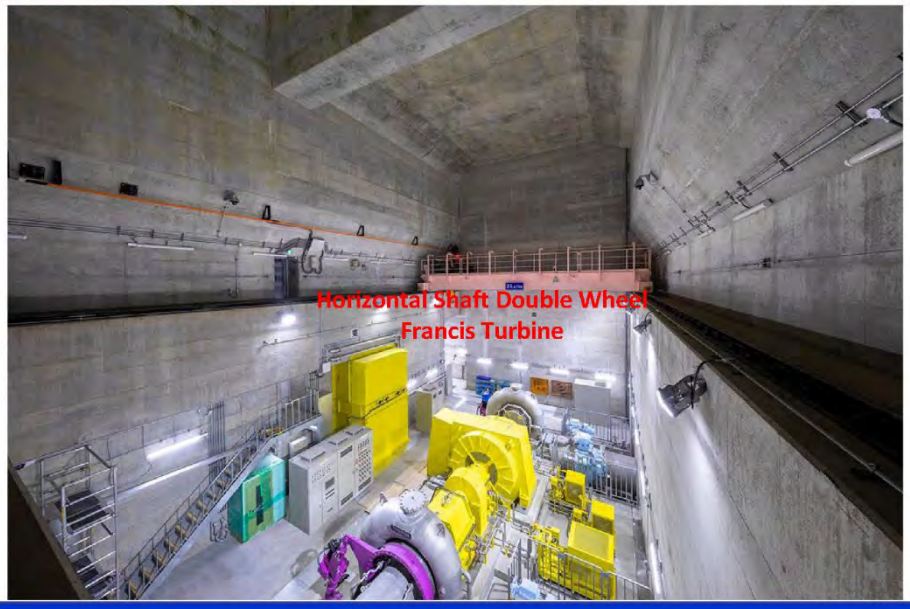
Yamba Power Station Inside the power station (after completion)



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2. Main track records of hydroelectric power plants [(2) Refurbishment]

Location	Power plant name	Project (ordering) proponent	Maximum output	Start of operation
Toyama Prefecture	Shoto Daiichi Power Station	Toyama Prefectural Enterprise Bureau	20,600kW	(under construction)
Toyama Prefecture	Wakatsuchi Power Station	Toyama Prefectural Enterprise Bureau	360kW	(under construction)
Niigata Prefecture	Takouji Power Station	Niigata Prefectural Enterprise Bureau	7,100 kW	2020
Niigata Prefecture	Takada Power Station	Niigata Prefectural Enterprise Bureau	11,500 kW	(under construction)
Yamagata Prefecture	Kurasawa Power Station	Yamagata Prefectural Enterprise Bureau	14,000 kW	(under construction)
Tochigi Prefecture	Kazami power plant	Tochigi Prefectural Enterprise Bureau	10,200 kW	(under construction)
Tochigi Prefecture	Miyama power plant	Tochigi Prefectural Enterprise Bureau	2,300 kW	(under design)
Gunma Prefecture	Shima Power Plant	Gunma Prefectural Enterprise Bureau	4,900kW	(under construction)
Gunma Prefecture	Shirasawa Power Station	Gunma Prefectural Enterprise Bureau	26,600 kW	(under design)
Nagano Prefecture	Yotagiri Power Station	Nagano Prefectural Enterprise Bureau	6,300 kW	(under construction)

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Full view of Takouji Power Station (after completion)

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Takouji Power Station Inside the power station (under construction)

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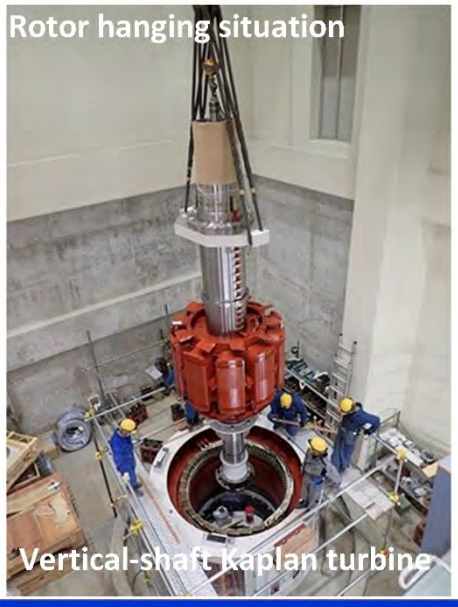
Takouji Power Station Inside the power station (under construction)



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[Introduction of Hokuden Engineering Consultant's design examples]

3. Key points when planning a new hydroelectric power plant (in the case of a company-owned hydroelectric power plant)
4. Examples of water intake methods for a reliable river water intake
5. Sand pond and water tank structure enabling reliable sand deposition
6. Selection of penstock type
7. Selection of water turbine and generator types

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3. Key points when planning a new hydroelectric power plant (in the case of a company-owned hydroelectric power plant)

[(1) Construction purpose]

◇Expansion of sales and profit

• Securing stable sales and profits

• Utilization as a communication facility that contributes to external sales expansion

◇ Succession of hydroelectric power generation technology

• Our employees practice and experience a series of processes from project launch, consultations and negotiations with related parties, planning and design, construction and supervision, maintenance and management to hand over civil engineering technology knowledge to young engineers in the hydropower generation field, which is our strength point.

• Used as a field test site for proposing new technologies

◇CSR

• Contribute to the realization of a low-carbon society through the development of renewable energy

• As a member of the Hokuriku Electric Power Group, we contribute to the "expansion of renewable energy power generation"

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[(2) Organizing river flow conditions]

The economic efficiency of a hydroelectric power plant is determined by (1) head and (2) flow rate

＜片貝別又・ノ又地点　維持流量＞

Basin surface　13.84 km²

Kept flow　winter　12/1～2/29

0.032 m³/s

(100km²当り　0.23 m³/s)

Out of winter　：3/1～11/30

0.086 m³/s

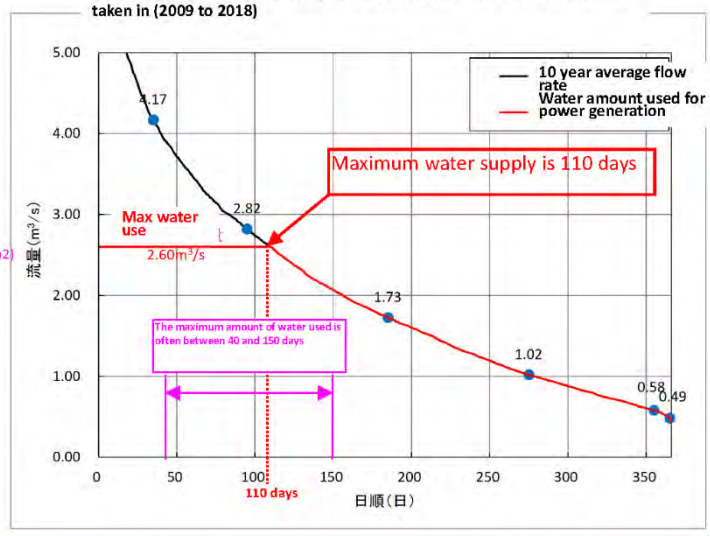
(100km²当り　0.62 m³/s)

General value in Japan (more than 0.5m3/s per 100km2)

＜ Water regime in rivers

	days		Flow rate (m³/s)	
最大流量	1		12.91	
35日流量	35		4.17	
豊水流量	110	95	2.6	2.82
平水流量		185		1.73
低水流量		275		1.02
渇水流量		355		0.58
最小流量		365		0.49
平均流量		130		2.17

Stream regime diagram Betsumatadani power plant flow rater that can be taken in (2009 to 2018)



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[(3) Consideration of power generation scale]

項目		単位	Q=3.0	採用 Q=2.6	Q=2.2	Q=1.8
発電諸元	最大使用水量	m^3/s	3.000	2.600	2.200	1.800
	取水位	m				
	放水位	m				
	総落差	m				
	損失落差	m				
	有効落差	m				
	水圧管路管径	mm				
	最大出力	kW				
	年間可能発電電力量	MWh				
	設備利用率	%				
	有効発電電力量※1	MWh				
	概算工事費（税抜き）	百万円				
経済性	kW当たり建設単価	千円/kW				
	kWh当たり建設単価	円/kWh				
	発電原価	円/kWh	27.02	26.64	27.02	28.33
	買取価格（税抜き）	円/kWh	29.00	29.00	29.00	29.00
	20年間の売電収支※2	百万円	87	101	80	24

Planned and calculated value

*1: (Effective power generation) = (Annual power generation potential) x (Capacity factor of Hokuriku area: 95.5%) x 20 years
*2: (Electricity sales balance for 20 years) = {(purchase price) - (power generation cost)} x (annual power generation capacity) x (capacity factor of Hokuriku area 95.5%) x 20 years

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[(4) Outline of Betsumatadani Power Station]

Water system/river name (ordinary river)		Second-class river Katagai river system Betsumatadani, Ichinomatadani
Power station location		Higashigura, Uozu City, Toyama Prefecture
Basin area		Betsumatadani 10.35km2 Ichinomatadani 3.51km2
Intake dyke		2 locations
Water channel	Branch channel	Extension 54m
	Penstock	Extension 428m
	Water discharge channel	Extension 63m
Power generation plan	Power generation method	Canal type (underground pipeline)
	Amount of water used	2.60m³/s
	Effective head	20.10m
	Maximum output	440kW
	Generated power	2,142 MWh/year
Private line		Extension 700m

Planned location map

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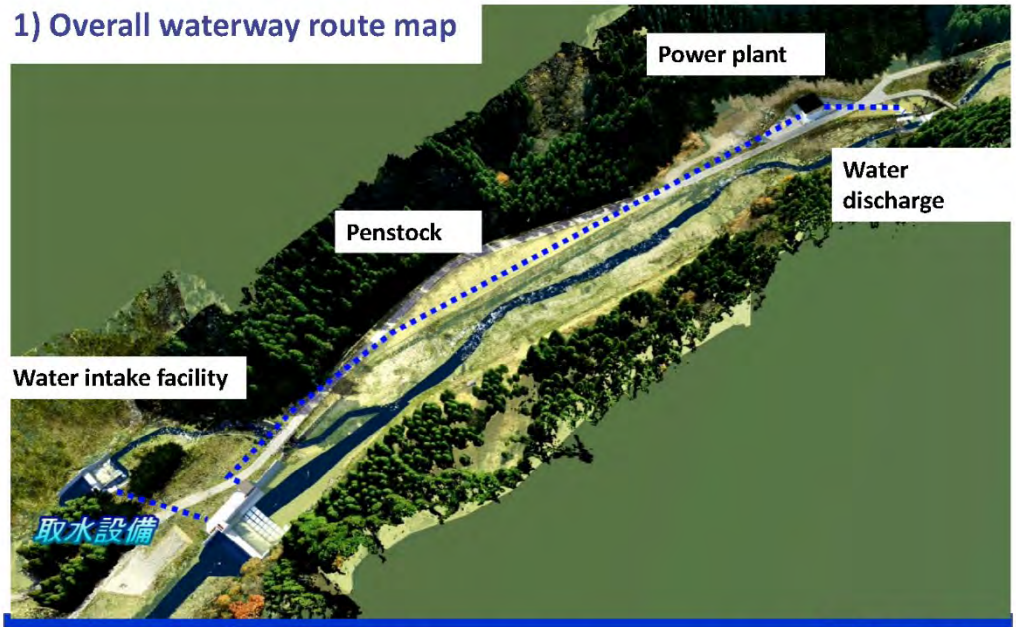
[(5) Completion image]

1) Overall waterway route map



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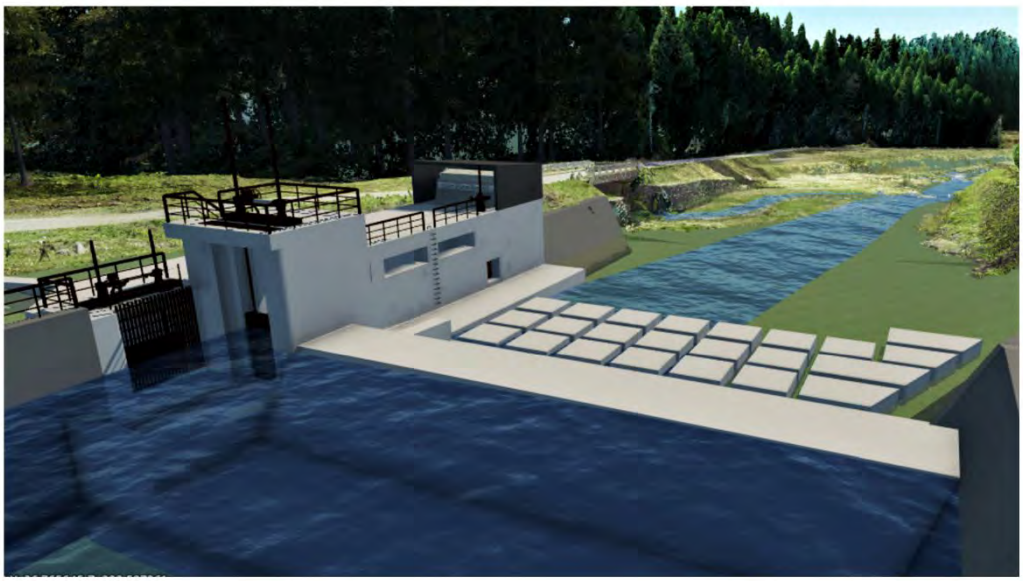
2) Bird's-eye view of Betsumatadani water intake facility



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2) Bird's-eye view of powerhouse and discharge channel

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4. Examples of water intake methods aimed at reliable river water intake

[(1) Side water intake method]

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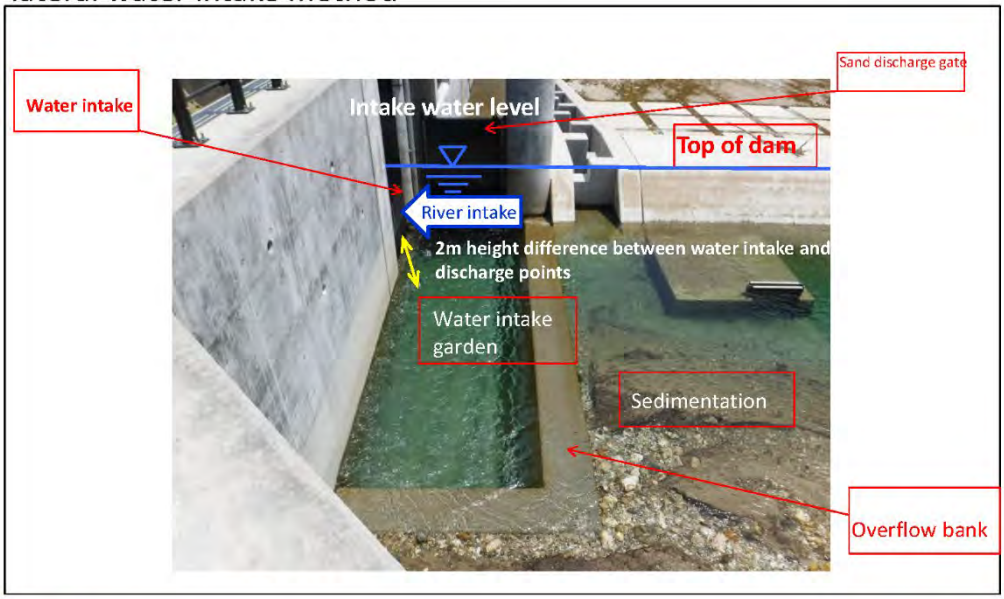
・Example of countermeasures against sediment flow using the lateral water intake method



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[(2) Bottom (Tyrolean) water intake method]

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[Comparison of water intake methods]

Types	(1) Lateral water intake method	(2) Bottom (Tyrolean) water intake method
Construction cost (Ratio)	1.0 (△)	0.9 (○)
River intake (Reliability)	◎Because it is a lateral water intake, it enables a reliable water intake without overflow even in the event of a flood. ・In Japan, the inflow velocity of water intake is within 1.0m/s.	×If sediment accumulates at the water intake (photo), water cannot be taken reliably. ・In Japan, it is generally considered possible to take in about 0.1m3/s of water per 1m of water intake width.
Maintenance (maintainability)	◎Even during floods, it is difficult to intake as a large quantity of earth, sand, driftwood, etc. flow in. ◎Enables to safely remove dust from above the water intake.	×A large amount of sediment is likely to flow in during floods. × Impossible to take in the water when driftwood or rocks get caught in the screen.
Evaluation	From the above, when aiming for reliable water intake, the "lateral intake system" is common in Japan. For the reasons mentioned above, the "bottom (Tyrolean) water intake system" is difficult to reliably take in water, so it is often used for mountain stream water intake for the purpose of supplementary water intake.	

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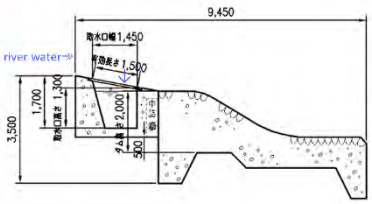
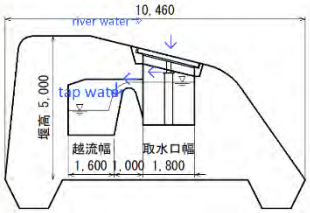
[Reference] Improvement example of bottom water intake (Tyrolean) method]

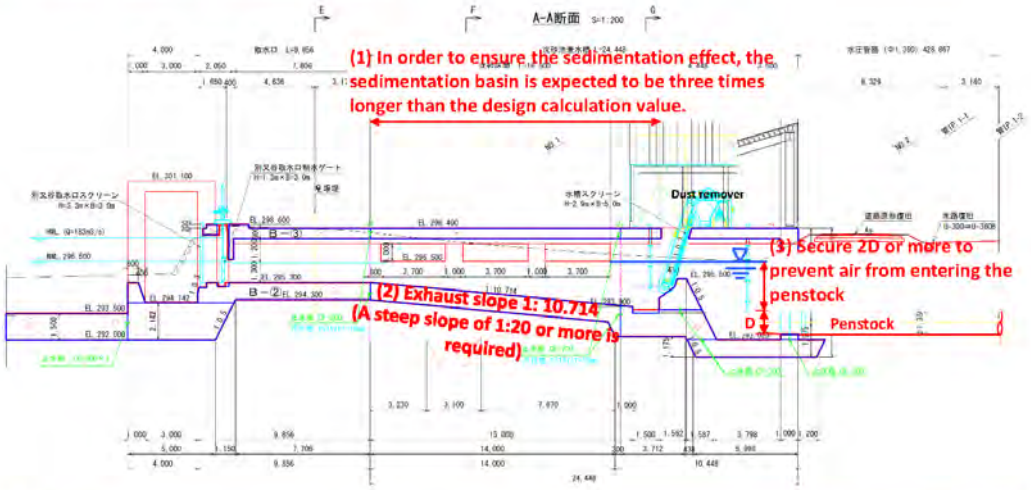
Item	① Tyrolean water intake method [standard type]	(2) Tyrolean water intake method [improved overflow type]
Overview Diagram		
Water intake method	It is a general Tyrolean water intake method, and it is a method of taking in the total amount of water that has fallen from the horizontal screen.	After falling from the horizontal screen, it is a method of taking in only tap water.

[Reference] Improvement example of bottom water intake (Tyrolean) method]

Item	(1) Tyrolean water intake method [standard type]		(2) Tyrolean water intake method [improved overflow type]	
Prevention of sediment inflow	Since the river water is directly taken in, there is a high possibility that the sediment that has flowed in from the water intake will flow down to the downstream waterway.	×	Since only clean water is taken in, the possibility that sediment that has flowed in from the water intake will flow down into the downstream waterway is low.	○
Maintenance (maintainability)	It is necessary to periodically open the sediment discharge gates installed in the intake weir and the sedimentation basin/water tank to discharge sediment.	×	Compared to the left, sand removal work is less frequent.	○
Construction cost (Ratio)	0.7	○	1.0	×
Evaluation	If there is concern about the inflow of sediment due to river water intake during floods, the "improved overflow type" structure is advantageous as a countermeasure to prevent sediment from entering the sand basin, headrace, and water tank downstream.			

5. Sand pond and water tank structure enabling reliable sand deposition

[(1) Longitudinal cross-sectional view of the sedimentation basin and water tank of the company's hydraulic power]



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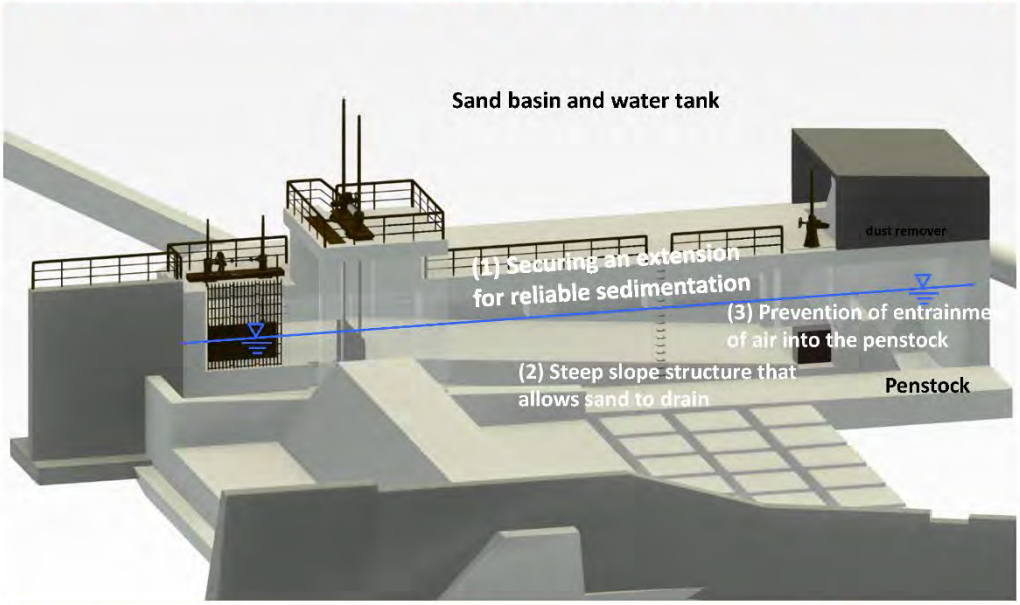
[Reference: Completion image (CIM) of settling basin and water tank]



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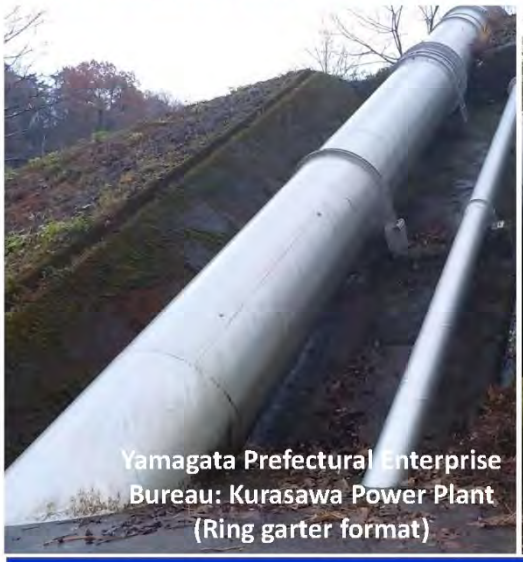
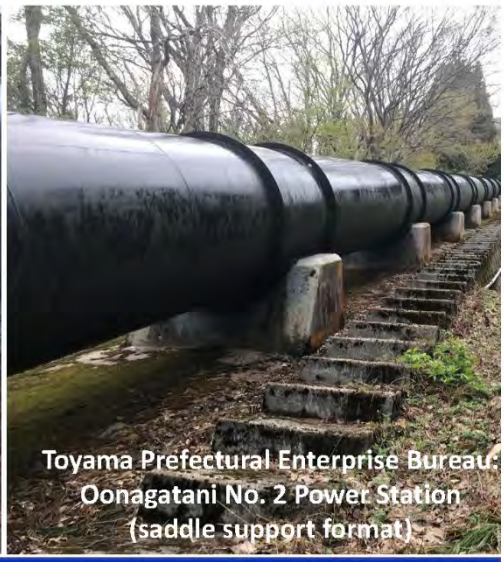
6. Selection of penstock type

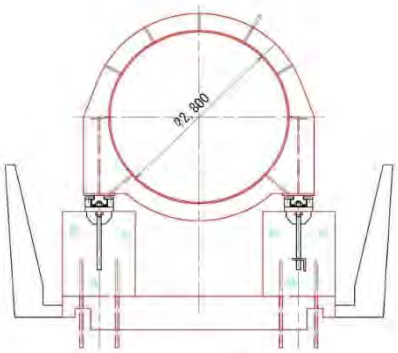
[(1) Support type of penstock]

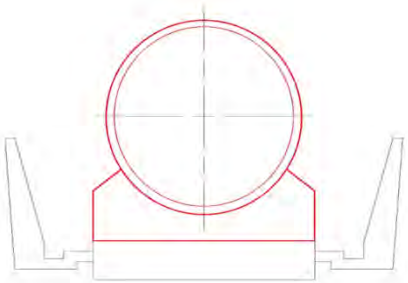


Yamagata Prefectural Enterprise Bureau: Kurasawa Power Plant (Ring garter format)



Toyama Prefectural Enterprise Bureau: Oonagatani No. 2 Power Station (saddle support format)





Ring garter format

Since it is possible to lengthen the interval of the pipeline support (about 18 m), the number of supports can be reduced, which is more economical.
There are many examples of adoption in recent years.

Saddle support form

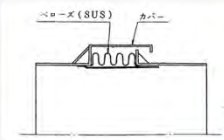
Since it is supported by concrete, it is simple, but since the interval of the pipeline support is shorter (approximately 6.0m), the number of pieces increases and it is less uneconomical.
There are few examples of adoption in recent years.

[(2) Types of penstock joints and expansion joints]

[Joint type]

Joint type	Overview
Butt joint	Joint used for imported pipes in the Meiji and Taisho eras and is a method of joining by heating the joining part from the outside and applying pressure or impact. It is not used nowadays anymore.
Flange joint	Structure in which a ring-shaped flat plate is attached to the pipe and tightened with bolts. Mainly used for penstock control water valves and turbine inlet valves.
Rivet joint	Method of making holes in a plurality of plates, inserting heated rivets, and crimping the rivet heads to tighten them. Highly reliable construction is possible if skilled workers do it. Much used until the 1960s, tend to be less used and the number of engineers has decreased. **Generally applied**
Welded joint	Joins two or more members together by applying heat or a filler material. There are many types of welding methods, but most of them are fuses by electric arc heat. Advantages over other joints: simple structure, less work time, high joint efficiency, good watertightness, ability to handle thick plates. Disadvantages: changes in properties of the base material due to welding heat, generation of cracks and defects, etc.

[Expansion joint type]

	Overview	Remarks
		Generally applied
Sleeve format		Supports expansion and contraction in the tube axial direction **Tube axis: temperature shrinkage**
Sleeve coupling type		Supports expansion and contraction in the tube axial direction and movement in the right angle direction **Tube axis: temperature shrinkage** **Right angle: ground deformation**
Bellows type		Supports expansion and contraction in the tube axial direction and movement in the right angle direction **Tube axis: temperature shrinkage** **Right angle: ground deformation**

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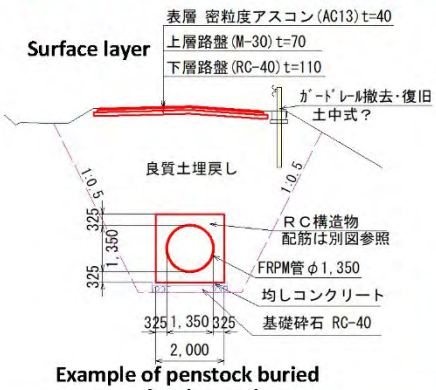
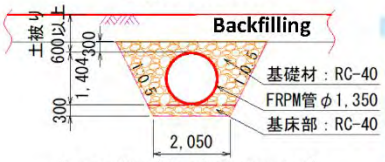
[(3) Construction example of underground pipeline]



Example of penstock buried under the road



Example of buried penstock under rice paddy fields


Outside welding of pipeline


Inside welding of pipeline


Backfilling

Reference: Sekisui Chemical Catalog

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[Reference: Selecting pipe types for underground pipelines (maximum diameter of 3.0m)]

	RCP (FRPM pipe)		Hume tube	
Standard	JIS A5350 JSWAS K-2		JIS A5372 JSWAS A-1	
① Aqueous	Roughness factor = 0.010 Anti Hume pipe: flow rate 30% UP	○	Roughness factor = 0.013	△
② Economy	Material is a little expensive, but the direct construction cost is low because the concrete foundation is not required and can be downsized.	○	Pipe material is inexpensive, straight construction quality is expensive due to concrete foundation	△
③ Seismic resistance	Adapts well to ground changes due to joint elasticity and body flexibility. No need for expensive flexible joints.	○	It has little stretchability and cannot absorb the amount of displacement due to uneven subsidence. Flexible joints are expensive	X
④ Workability	Because of its light weight, it can be transported, unloaded, and tied with a small heavy machine. Φ1000: 154kg/m	○	Due to the large pipe mass, large heavy machinery is required for transportation, unloading, and installation. Φ1000: 761kg/m	X
⑤ Applicable overburden	Shallow ground: pavement thickness +30 cm (or 50 cm thicker) ~ high overburden: 8.7 m for 1 type, 5.7 m for 2 types	○	Sheet pile extraction: 0.5-2m for 1st class, 0.5-4m for 2nd class (7m possible for slope gradient)	○
⑥ Stock management	Durability confirmed for 50 years or more according to ISO10467 acid resistance standard (JSWAS K-2 specification)	○	Due to its poor resistance to hydrogen sulfide and corrosion, it may be subject to renovation.	△
Comprehensive evaluation	It is inexpensive due to direct construction costs and has excellent earthquake resistance and workability.	○	Straight construction quality is expensive with concrete foundation. Slightly inferior in terms of earthquake resistance, workability, and storm management.	△

Reference: Sekisui Chemical Catalog

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[Reference: Selecting pipe types for underground pipelines (maximum diameter of 3.0m)]

	BOX culvert		Howell tube (PE pipe with ribs)	
Standard	JIS A5372 JSWAS A-12		JIS K6780 JSWAS K-15 (up to Φ1000)	
① Aqueous	Roughness factor = 0.013	△	Roughness factor = 0.010 Anti Hume pipe: flow rate 30% UP	△
② Economy	As with Hume pipes, direct construction costs are expensive with concrete foundations	△	Tubing is slightly more expensive than RCP. No need for concrete foundation, but slightly more expensive than pipe materials	○
③ Seismic resistance	Joint stretchability is small, and displacement due to uneven subsidence cannot be absorbed. Flexible BOX culverts are expensive.	X	Adapts well to ground changes due to joint elasticity and pipe flexibility. However, public earthquake resistance certification is up to Φ1000	○
④ Workability	Mass is large, and heavy machinery is required for transportation, unloading, and installation. Φ1000: 1580kg/m	X	Because of its light weight, it can be transported, unloaded, and installed using a small heavy machine. Φ1000 : 65 kg/m	○
⑤ Applicable overburden	0.2~3.0m Although there are many shallow installations, there are considerations such as avoiding stress concentration.	○	Overburden of 14.5m with management of compaction degree of 95% or more, 19m with management with particularly good grain size	○
⑥ Stock management	Since it is made of concrete, it has the same performance as the Hume pipe on the left.	△	Durability data unknown	
Comprehensive evaluation	The direct construction cost of the Hume pipe is a little expensive, it is advantageous for shallow burial, and construction requires large heavy machinery.	△	Excellent earthquake resistance and workability, but the direct construction cost is slightly expensive	△

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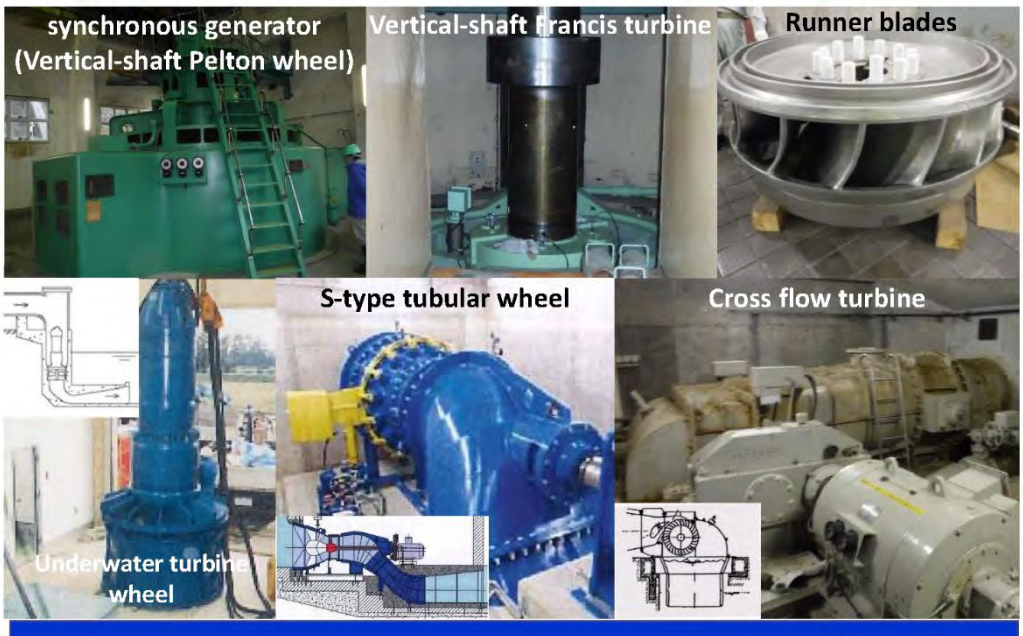
7. Type selection method for water turbines and generators



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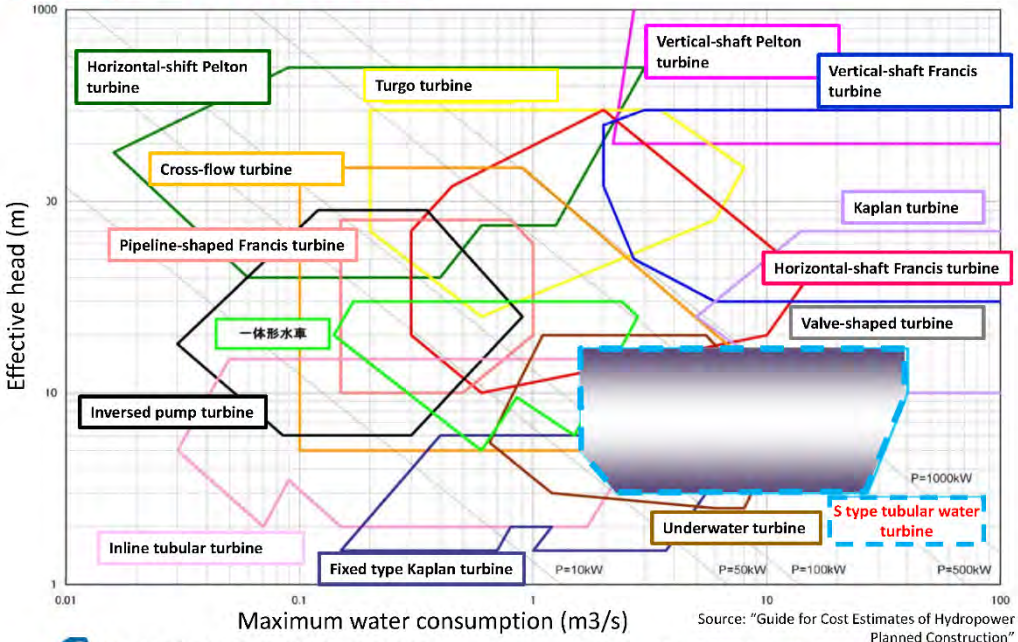
[(1) Type of water wheel]



Source: "Guide for Cost Estimates of Hydropower Planned Construction" (August 2013 Agency for Natural Resources and Energy)

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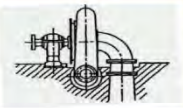
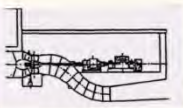
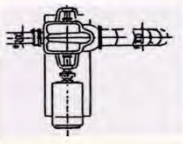
・Reaction water turbine: water turbine with a structure that applies the water pressure of running water with a pressure head to the runner.

Types		Overview	Structural outline	Scope of application	Part load characteristics	Variable head characteristics	Remarks
Reactive recoil water turbine	Francis turbine		Flowing water flows in from the periphery of the runner, changes direction in the axial direction inside the runner, and flows out.	Output: about 50 to 4,000 kW Drop: about 10 to 300m Flow rate: 0.3 to 10m3/s	Efficiency tends to decrease when the load is lighter.	Efficiency decline is small against head changes.	A model with a power capacity of about 1 kW has also been manufactured for use in micro water turbines.
	S type tubular turbine		Cylindrical propeller turbines (those in which water flows through the runner in the axial direction), with a structure that bends the water channel in order to install the generator outside the water channel.	Output: about 50 to 5,000 kW Drop: about 3 to 18m Flow rate: 1.5 to 40m3/s	10 to 100% operation for those with movable runner vanes. 80 to 100% operation for fixed water volume.	Efficiency decline is small against head changes.	Suitable for low head and high flow rate.
	Reversed pump turbine		Used by reversing the standard vertical shaft (horizontal shaft) pump. It is necessary to cut the runner fixing screw in reverse to the standard pump. Since the inflow direction is reversed compared to the case of the pump, the shape of the runner is opposite to that of the pump (possibility of cavitation).	Output: about 1 to 200 kW Drop: about 6 to 80m Flow rate: 0.02 to 1m3/s	No guide vanes, constant flow only. The maximum efficiency is low, less than 80%.	Efficiency decreases when the head change is large.	Cavitation characteristics are severe and require modification of blade shape. The lifespan of bearings and water seals is short. Unrestrained speed countermeasures are required.

Source: "Guide for Cost Estimates of Hydropower Planned Construction" (August 2013 Agency for Natural Resources and Energy)

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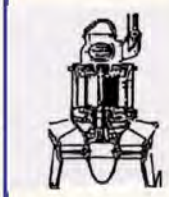
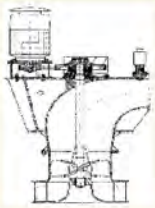
・Reaction water turbine: A water turbine with a structure that applies the water pressure of running water with a pressure head to the runner.

Types		Overview	Structural outline	Scope of application	Part load characteristics	Variable head characteristics	Remarks
Reactive recoil water turbine	Underwater turbine		A type of standard submersible pump type water turbine. A water turbine and a generator are integrated inside the cylindrical unit, and it can be operated underwater with a sealing mechanism. The runner blade angle can be adjusted manually to handle changes in flow rate.	Output: about 10 to 500 kW Drop: about 2.8 to 20m Flow rate: 0.4 to 10m3/s	Slightly lower maximum efficiency. In general, fixed blades are used, and efficiency drops significantly when the load is light.	Efficiency decreases when the head change is large.	A generator is directly connected, making it possible to make it compact. There are no guide vanes to adjust the flow rate, so auxiliary equipment can be omitted. Because it is an underwater type, the service life of bearings and water seals is short. Unrestrained speed countermeasures are required.
	Propeller turbine (syphon type)		It is a type of cylindrical vertical axis propeller water turbine. Some have a runner-shaped structure that allows syphon water intake.	Output: about 1 to 200 kW Drop: about 1.5 to 7m Flow rate: 0.1 to 4.0m3/s	Since the guide vanes and runner vanes are fixed, changes in flow rate can be dealt with by controlling the number of units.	Efficiency decreases when the head change is large.	The structure is simple because there is no drive shaft between the turbine and the generator. Flow adjustment function omitted. The water control valve is used for both operation and stop functions.

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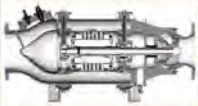
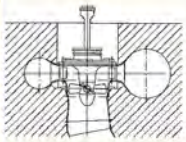
・Impulse water turbine: A water turbine with a structure in which water with a pressure head is jetted from a nozzle, all of which is changed to a velocity head, and the runner is rotated by the impulse of the jet water.

Types		Overview	Structural outline	Scope of application	Part load characteristics	Variable head characteristics	Remarks
Reactive recoil water turbine	Propeller turbine (in-line type)		It is a type of cylindrical propeller water turbine. There is a type in which the generator is directly connected to the water wheel shaft (inside the water channel) and a type in which the generator is mounted on the water wheel and the rotating part of the water wheel and the generator are directly connected with a belt (outside the water channel).	Output: about 1 to 200 kW Drop: 2.0 to 150.0m Flow rate: 0.01~3.0m3/s	Since the runner vanes are basically fixed, the change in flow rate can be dealt with by controlling the number of runners.	Efficiency decreases when the head change is large.	The conventional propeller water turbine has been simplified and can be used in low head and small flow areas.
	Kaplan turbine		It is a type of propeller turbine, and by changing the angle of the runner with respect to the flow rate, it is always adjusted to the optimum blade angle.	Output: about 1,000 to 100,000 kW Drop: about 10 to 60m Flow rate: 10m3/s ~	Even if the flow rate changes, the efficiency drop is small.	Even if the head changes, the efficiency drop is small.	There are few cases where small and medium-sized hydropower is adopted due to economic reasons.

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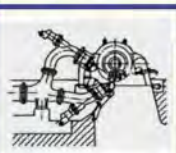
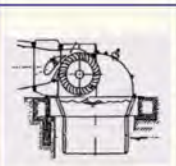
Source: "Guide for Cost Estimates of Hydropower Planned Construction" (August 2013 Agency for Natural Resources and Energy)

・Impulse water turbine: A water turbine with a structure in which water with a pressure head is jetted from a nozzle, all of which is changed to a velocity head, and the runner is rotated by the impulse of the jet water.

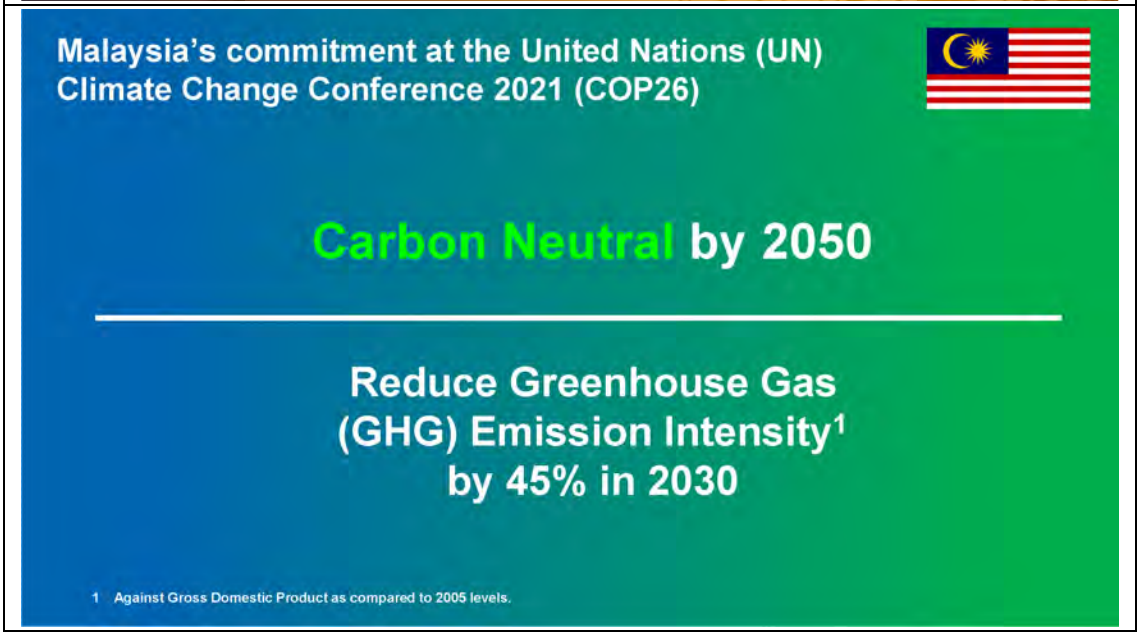
Types		Overview	Structural outline	Scope of application	Part load characteristics	Variable head characteristics	Remarks
Impulse water wheel	Pelton turbine (for small hydropower)		A structure in which the jets flowing out from the nozzle act on the buckets around the runner.	Output: about 0.5 to 4,000 kW Drop: about 17 to 500m Flow rate: 0.01 to 2m3/s	Even if the flow rate changes, the decrease in efficiency is relatively small.	Efficiency decreases when the head change is large.	Because the rotation speed is low, the size of the equipment is large.
	Cross flow turbine		Combining the characteristics of an impulse turbine and a reaction turbine, water flows into a cylindrical runner in the direction perpendicular to its axis and out through the runner.	Output: about 10 to 1,000 kW Drop: about 5 to 200m Flow rate: 0.1 to 8m3/s	The maximum efficiency is slightly inferior, but the light load characteristics are good. In general, operation is possible even with a load of about 15%.	Efficiency decreases when the head change is large.	Simple structure.
	Turgo Impulse Turbine		The difference from the Pelton turbine is that the jet flow is injected from the side of the runner, so the pitch circle becomes smaller and the rotation speed can be increased.	Output: about 100 to 8,000 kW Drop: about 25 to 300m Flow rate: 0.2 to 8m3/s	The maximum efficiency is slightly inferior, but the light load characteristics are good. In general, operation is possible even with a load of about 15%. In the case of the 2-nozzle system, the number of nozzles is switched according to the flow rate.	Efficiency decreases when the head change is large.	Simple structure.

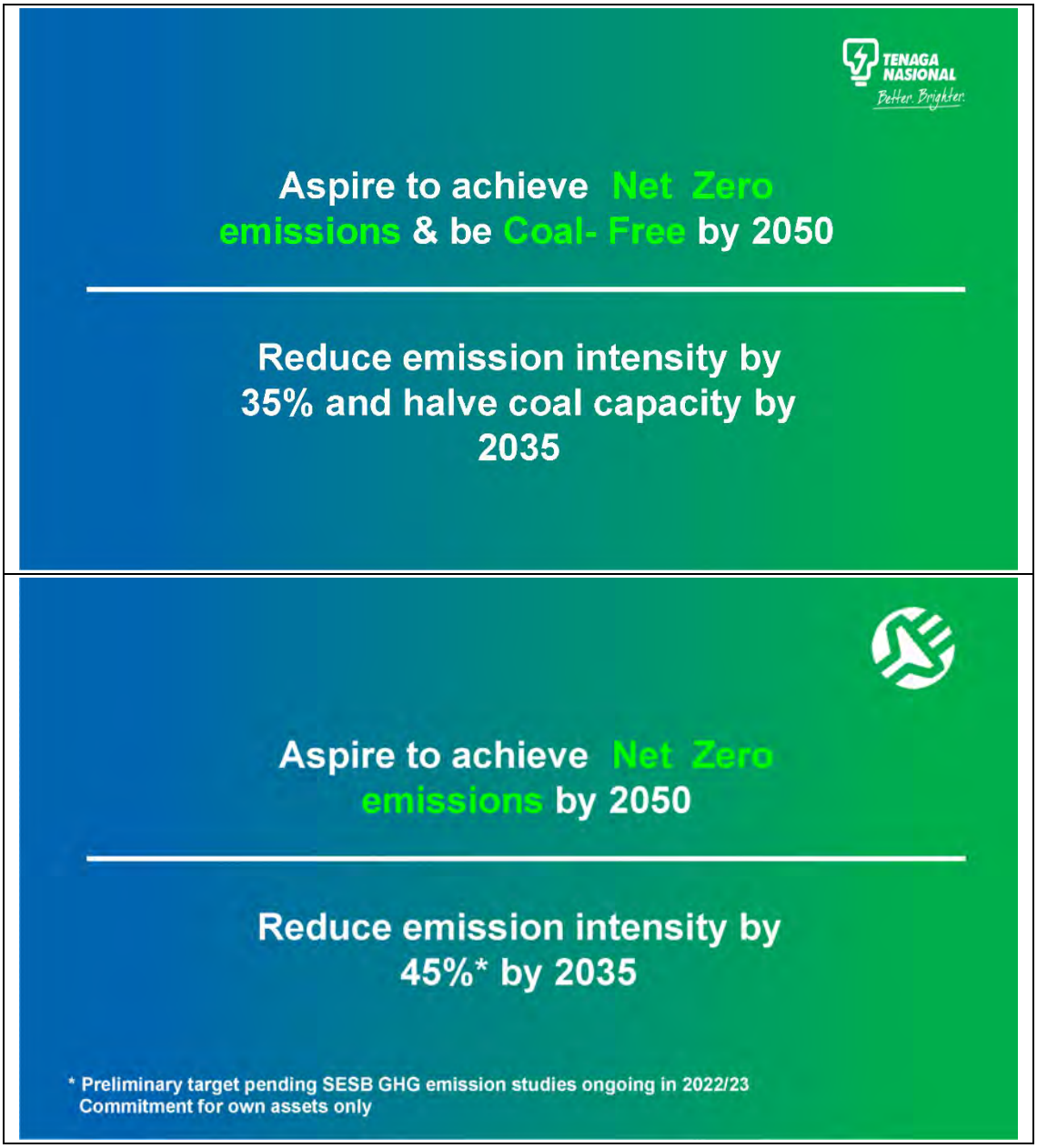
[(2) Type of generator]

Item	Synchronous generator	Induction generator
Isolated operation	Both isolated and parallel operations are possible	Power can be generated only when operating in parallel with a synchronous generator or other power source and cannot be operated independently.
Reactive power regulation	Can be supplied according to the load within the rated power factor	In addition to being unable to supply to the load, it is necessary to take in the excitation current from the system, so supply is not possible.
Synchronization in parallel	Forced parallelization of the synchronization device eliminates the need for a synchronization device	
Inrush current in parallel	Synchronized and paralleled, the transient current is small and there is no problem with the voltage drop in the grid.	A large transient current flows due to forced paralleling, and it is necessary to consider the voltage drop in the system.
Power factor	Power factor can be easily adjusted by field adjustment	It is determined by the output and cannot be adjusted. Reduces the power factor of the system by consuming reactive current
Efficiency	Good	Good, but slightly lower for low-speed machines
Structure	The stator is the same for both, but it's a little more complicated because it has a field winding and an AC exciter.	Since the rotor is cage-shaped, the structure is simple and robust.
Exciter Field adjuster	Requires an exciter and field current regulator	Since the excitation current is taken from the system, no exciter or field adjustment device is required.
Capacity	No problem with large capacity machines	It is difficult to manufacture a large-capacity machine, and several thousand kW or less is suitable.
Maintenance and inspection	Maintenance and inspection of the field winding and exciter are required. Relatively easy for brushless excitation	It is easy because the structure is simple and there is no excitation device.
Price	More expensive than induction generator	Inexpensive compared to synchronous generators

Thank you for your attention.

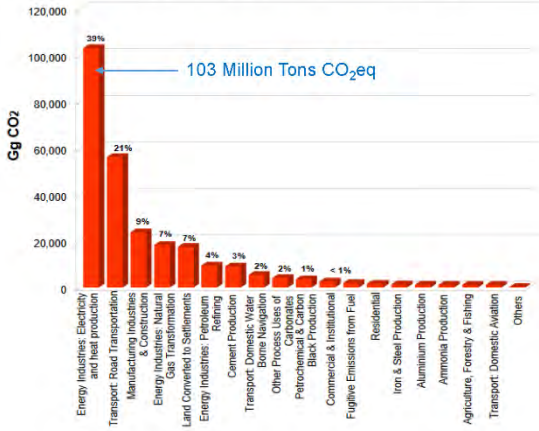
8. 2 Appendix 2：Small Hydro Seminar presentation material (SESB)




TENAGA NASIONAL
Better. Brighter.
Aspire to achieve Net Zero emissions & be Coal- Free by 2050
Reduce emission intensity by 35% and halve coal capacity by 2035
Aspire to achieve Net Zero emissions by 2050
Reduce emission intensity by 45%* by 2035
* Preliminary target pending SESB GHG emission studies ongoing in 2022/23
Commitment for own assets only

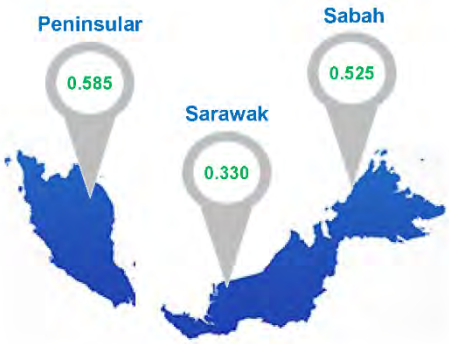
Electricity industry is the highest contributor of CO2 emission by sector

Major sources of carbon dioxide in 2016



(Source: Malaysia third biennial update report to the UNFCCC, Dec 2020)

Electricity Sector Emission Factor in 2017
(tCO2/MWh)



(Source: 2017 CDM Electricity Baseline for Malaysia)

RE Policy Mechanisms for Sabah & F. T. Labuan

2011 - 2020	2016 - 2017	2016 - 2017	2017 - Now
FiT	LSS	NEM	SELCO
Feed-in Tariff RE ≤ 30MW premium tariff to grid (suspended Jul 2020)	**Large Scale Solar** (utility scale) bidding by Energy Commission (2016 & 2017 bids signed 2021, COD 2022/23)	**Net Metering** Small rooftop solar PV billing credit mechanism	**Self Consumption** Small rooftop solar for self consumption

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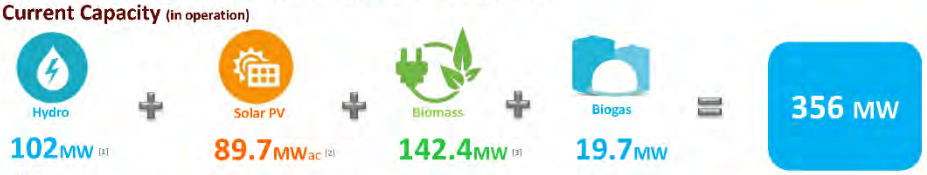
Current Renewable Energy Capacity in Sabah and F.T. Labuan

Renewable Energy capacity has only achieved 15% in 2022

Current Capacity (in operation)



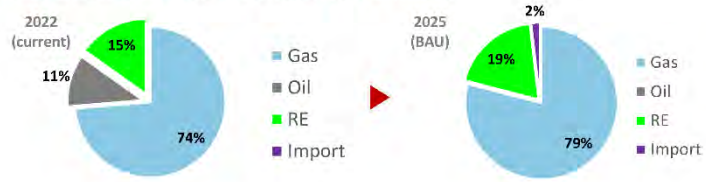
102MW [1] | 89.7MWac [2] | 142.4MW [3] | 19.7MW

Notes:

Capacity (MW)	Hydro	Solar	Biomass	Biogas	Total
On Grid	98	84.2	25.8	0.6	218.1
Off Grid	3.8	7.5	116.6	19.1	138.0
Total	101.8	82.2	142.4	19.7	356.1

1. Hydro capacity includes Tenom Pangi, FiT small hydro and SESB mini hydro and off grid small hydro
2. Solar PV capacity converted to AC (DC:AC = 1.2) and includes FiT Solar PV (Commercial 32MWdc; Individual 6.5MWdc; Community 3MWdc), LSS Tadau 50MWac. Excluding solar hybrids.
3. Biomass capacity excludes FiT plants (Kinabio and Seguntor) whose generation licenses have been revoked by ST.

RE Current and Future Generation Mix (on grid only)

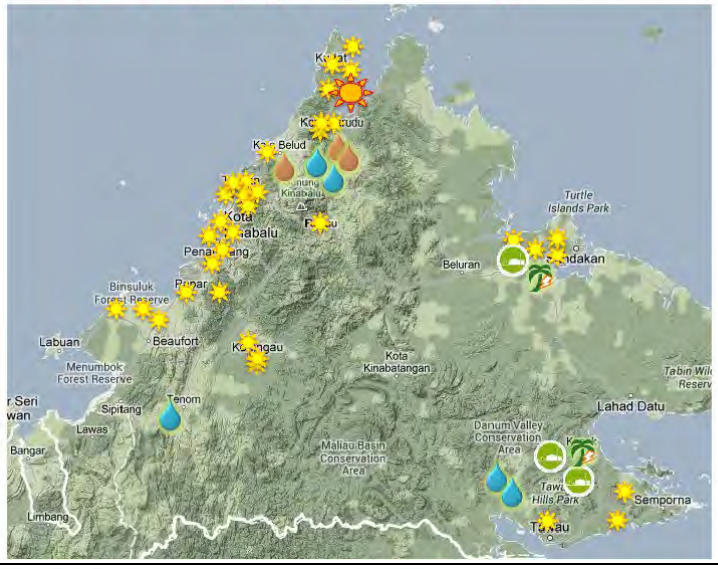


Under BAU, Sabah will not achieve Govt. RE Targets
2025 – 31%
2035 – 40%

RE Capacity 2011 (grid connected only)

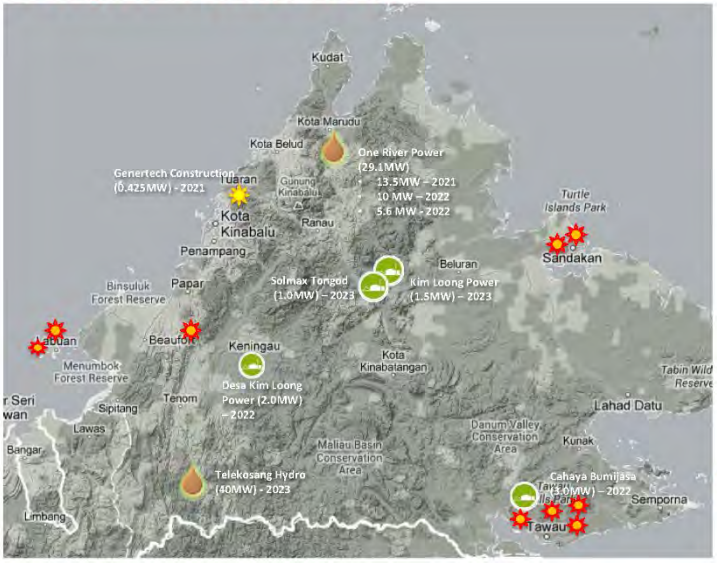
Legend	Capacity
Hydro SESB	70 MW
Hydro IPP (IPP)	6.5 MW
Biomass (IPP)	30 MW
Total	**106.5 MW**

RE Capacity in 2022 (grid connected only)



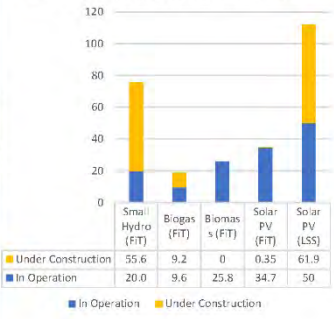
Legend	Capacity
Hydro SESB	78 MW
Hydro IPP (FiT)	20 MW
Biomass (FiT)	25.8 MW
Biogas (FiT)	9.6 MW
Solar PV (FiT)	34.7 MW
Solar PV (LSS)	50.0 MW
Total	**218.1 MW**

RE Projects under Construction

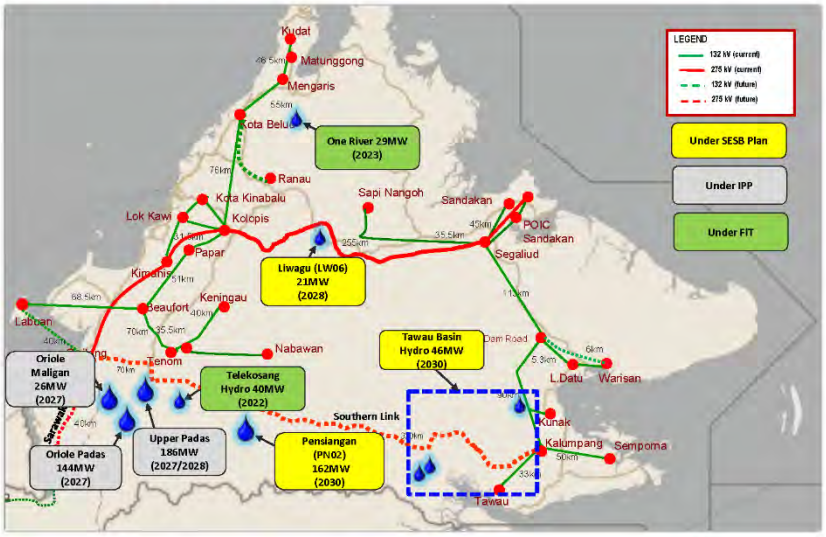


Under Construction	Capacity
Hydro IPP (FiT)	69.1 MW
Biomass (FiT)	0 MW
Biogas (FiT)	9.2 MW
Solar PV (FiT)	0.35 MW
Solar LSS	61.9 MW
Total	**140.55 MW**

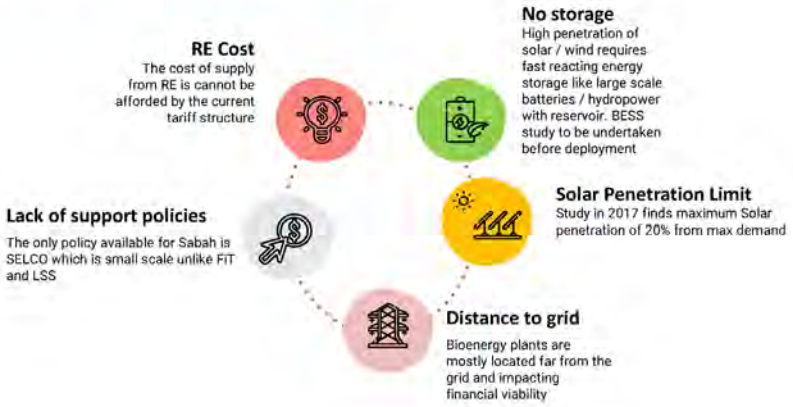
FiT Plants in Operation / Under Construction



Outlook of Sabah Hydropower

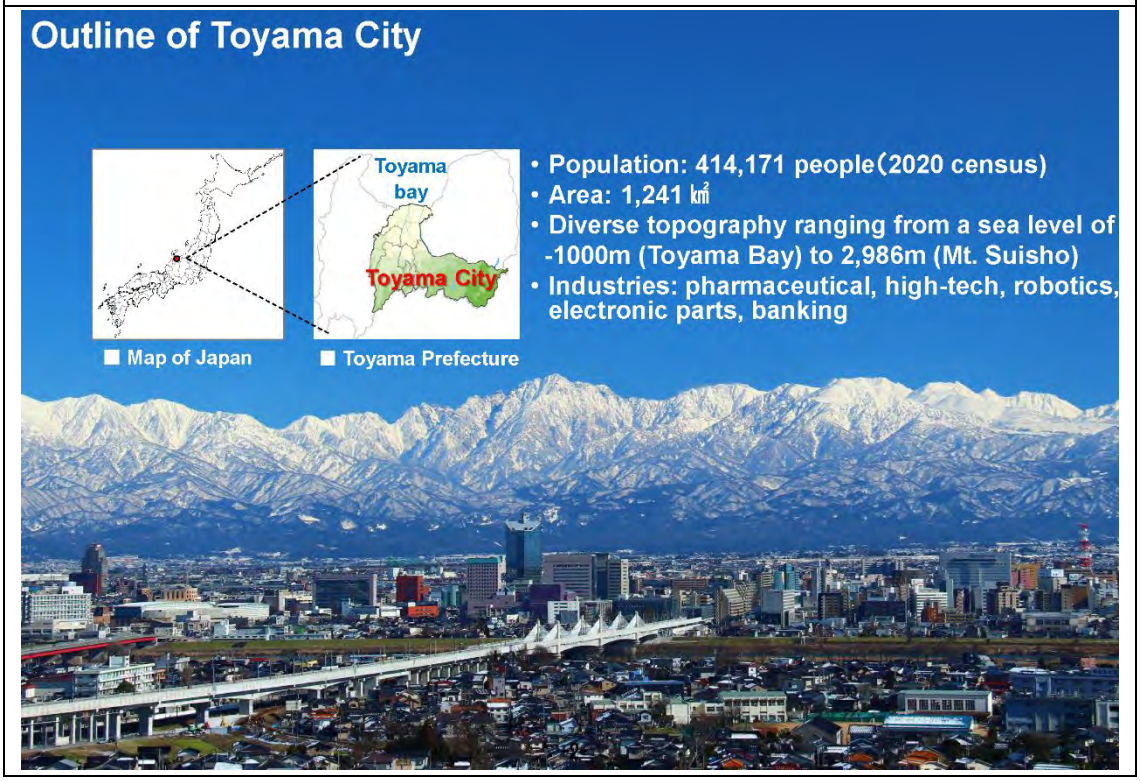


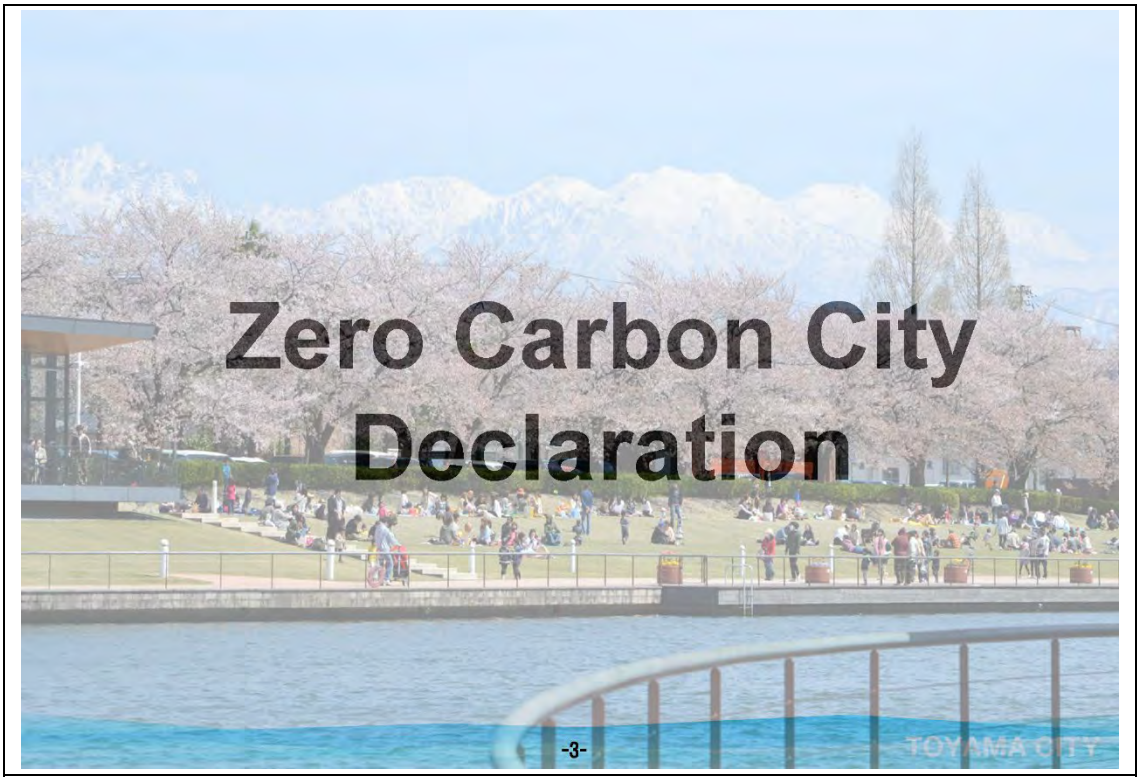
Challenges for RE Growth going forward



Disclaimer

8. 3　Appendix 3：City-to-City Collaboration Seminar presentation material (Toyama City)





Declaration of 2050 Zero Carbon City (Mar. 2021)

富山市
ゼロカーボンシティ宣言

本市はこれまで、将来市民にも責任の持てる、持続可能な都市構造への転換を推進するため、「公共交通を軸とした拠点集中型のコンパクトなまちづくり」に取り組み、その取組みを発展させ、環境モデル都市、環境未来都市、SDGｓ未来都市等の選定を受けてまいりました。

一方、近年は急速な気候変動の進展により、世界的には豪雨・洪水・台風をはじめとする災害の激甚化、本市においても令和３年１月の記録的な大雪等の異常気象が多発しており、市民の安心・安全な日常生活が脅かされ、気候変動対策の強化が求められております。

また、昨今の国の動向としては、地球温暖化対策推進法の改正に際して、2050年の温室効果ガス排出実質ゼロを法定目標とする方針が決定されるとともに、令和２年12月に策定された「グリーン成長戦略」においては、温暖化対策を経済成長の制約やコストとする時代は終わり、積極的な温暖化対策の推進が「経済と環境の好循環」を創出する旨が示されております。

こうした国内外の動向を踏まえ、本市では、包括的なエネルギー政策の推進に向けて、令和３年３月に策定する「富山市エネルギービジョン」において、2050年の温室効果ガス排出実質ゼロに向けた方針・施策等を定めるとともに、「第２次富山市ＳＤＧｓ未来都市計画」においても、目標のひとつとして、コンパクトシティ戦略と包括的なエネルギー政策の融合による「経済成長と環境負荷の低減の同時実現」を通して、地域活性化・地方創生に貢献する旨を掲げております。

本市は、グリーン社会の実現に向けて、「コンパクトシティのネクストステージ」を見据え、環境政策のさらなる強化により、持続可能なまちづくりの深化を図るため、本日ここに「ゼロカーボンシティ」を表明いたします。

令和３年３月１日　富山市長　森　雅志

環境モデル都市富山
ECO-MODEL CITY TOYAMA
SDGs未来都市
TOYAMA
環境未来都市
とやま
FUTURE CITY TOYAMA

Japan's 2050 Carbon Neutral Declaration by Prime Minister Suga.（Oct. 2020）

⇒Amid growing momentum toward the realization of carbon neutrality and with an eye on the **"next stage of the compact city"** development, Toyama City announced its goal of becoming a "zero-carbon city" to deepen sustainable urban development by further strengthening environmental measures.

This announcement will help accelerate local efforts to collaborate with various stakeholders for decarbonization.

Compact City Policy and Decarbonization Initiatives

Compact City Planning

By revitalizing public transport such as railway track lines, and by concentrating residential, commercial, business, and cultural buildings along those lines, a compact city is created with public transportation at its center.

【Conceptual diagram】
Toyama's "BBQ-Stick" urban structure

Sticks: Public transportation with a certain level of service
Circles(Food): Walking zones connected by the sticks

【Three pillars for realization】

1. Revitalization of public transportation
2. Promotion of residential living in areas along public transport infrastructure
3. Revitalization of central urban area

Toyama City's SDGs Future City Plan (2018-2020)

【Main Concept –SDGs model Initiative–】
Combine LRT network and autonomous distributed energy management to enhance the effort of building a compact city

【Project purpose】
Toyama city has been working on the city's public transportation with LRT network. Combining that effort with autonomous distributed energy management that allows energy generation and consumption on the local level can enhance the effort to build a compact city. It will also generate technological and social innovations, which in turn will make Toyama city a sustainable value added innovative city.

Establish a sustainable regional public transportation network system starting with LRT network.

Building an autonomous distributed energy infrastructure network.

Evaluate the added value of compact city strategy. Package and publicize the strategy to the world.

Build a healthy and smart city that utilizes IoT.

-7-

TOYAMA CITY

Second Toyama City's SDGs Future City Plan (Suummary,2021-)

【Vision of the future】
Realize a sustainable value added innovative city by applying a compact city strategy

【Approach Policy】

1.City Structure
Compact city planning through the renovation of public transportation

2.Lifestyle
Design a healthy city that connects people so they can have a high-quality and work style

3.Energy
Build a Safe & Environmentally Smart City and Autonomous distributed Energy System

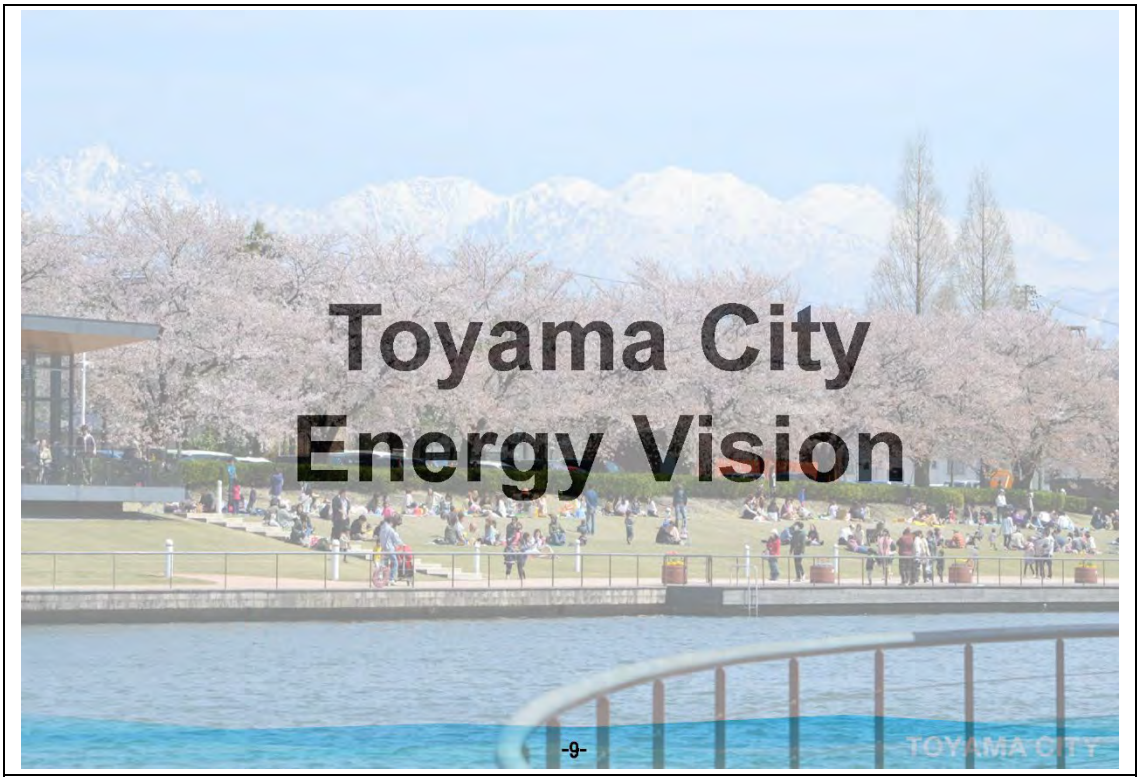
4.Industry
Revitalize industries to generate technological and social innovations

5.City and Community
Strengthen the city's brand power by partnering with diverse stakeholders

Among the above approach policies, in order to embody effort of 3.energy, Toyama city Energy Vision sets forth policies, reduction targets of CO2 emission , and city initiatives for realizing a zero carbon city by 2050

-8-

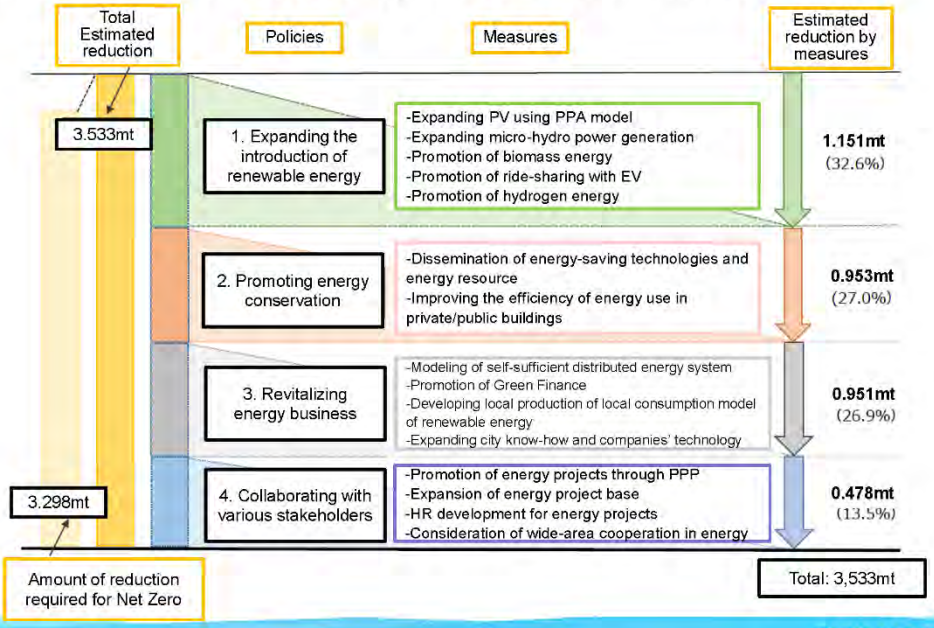
TOYAMA CITY



A Milestone for Zero Carbon

	FY2021-FY2029	2030(Mid-term Target)	2050(Long-term Target)	
GHG reduction rate (compared to 2005)	11% reduction(FY2017)	30% reduction	**100% reduction**	
RE Target (vs power demand)	41%(FY2019)	47%	65%	
Phases	• Support for independent activities of private sector • Implementation of model projects	• Full-scale activities led by private sector • Transition to new social system and elemental technology	• Formation of a vast market • Realization of zero-carbon society	
【Policy 1】 Expanding the introduction of renewable energy	1. Expanding PV using PPA model	Expansion of zero-carbon market	Five-fold introduction of renewable energy	Zero emissions from the city
	2. Expanding micro-hydro power generation 3. Promoting biomass energy	Double the introduction of renewable energy		
	4. Promoting ride-sharing with EV 5. Promoting hydrogen energy	Penetration of EV & FCV		Zero emissions from transportation
【Policy 2】 Promoting energy conservation	6. Dissemination of energy-saving tech & energy resource	Development of energy management	Achieve zero-emissions including existing building	Zero emissions from buildings
	7. Improving the efficiency of energy use in private buildings	Conversion of new housing to ZEH		
	8. Improving the efficiency of energy use in public buildings	Conversion of new buildings to ZEB		
【Policy 3】 Revitalizing the energy business	9. Modeling of self-sufficient distributed energy system	Improving local resilience	Formation of self-sufficient distributed energy infrastructure network	Zero emissions from life and the city
	10. Promoting Green Finance	Increasing ESG investment		
	11. Developing local production of local consumption model of RE.	Expand use of renewable energy		
	12. Expanding city know-how & companies' technology			
【Policy 4】 Collaborating with stakeholders	13. Promoting energy projects through PPP	Collaborative platform	Promotion by industry-academia-government-finance inst.	
	14. Expanding energy project base	Formation of human infrastructure		
	15. HR development for energy projects			
	16. Considering wide-area cooperation in energy	Accelerating the realization of zero-carbon society		

Toward Zero Carbon City - CO2 emission reduction image -



Proactive initiatives for decarbonization

【Measure 1,4】
- Holding and operating a public-private partnership platform (～Mar.2022)
  attendee: energy company (electric power, gas), financial institution, educational institution, relational division in the city, another administrative agency (prefecture)

【Measure 8】
- Promotion of ZEB (Net Zero Energy Building) in public facility
  classification: school, environmental educational facility

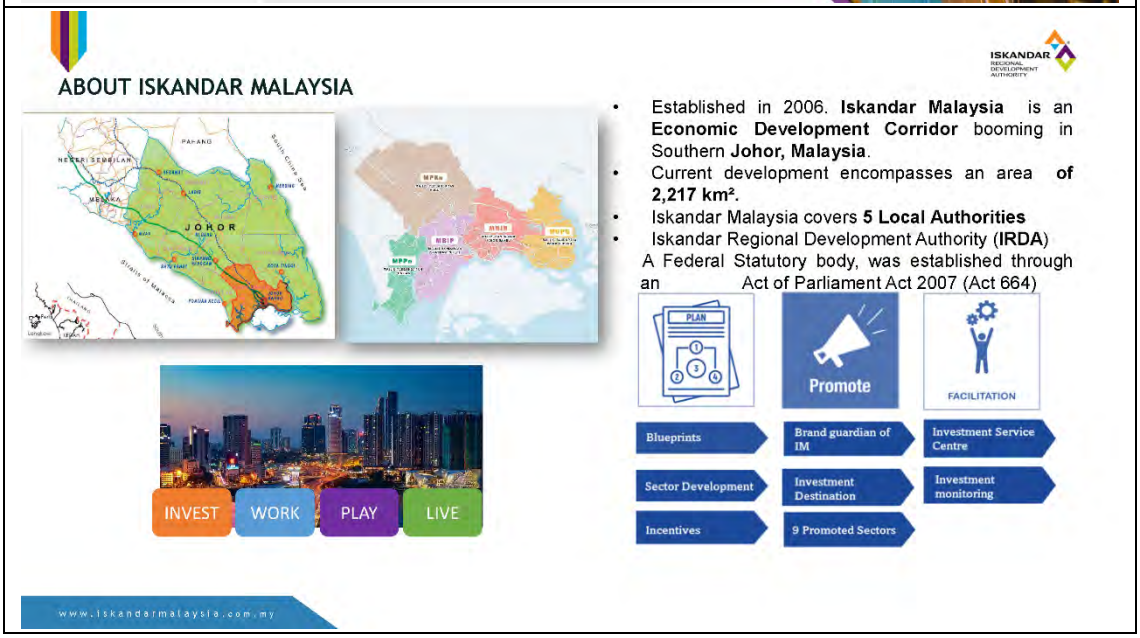
【measure 9】
- Model construction of autonomous distributed energy system using public facility
  location: gymnasium (adjacent community hall, public hall in suburbs)

Financial support for individual and company

【promoting measure 5,6,7】
- Energy-Saving resource (target: stationary storage battery, fuel cell, pellet stove)
- ZEH (Net Zero Energy House)
- FCV (Fuel Cell Vehicle)
- EV (Electric Vehicle) charger

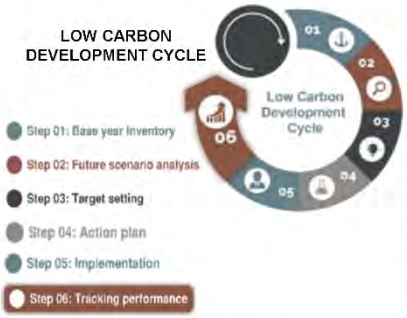

Thank you!
-13-
TOYAMA CITY

8. 4 Appendix 4 : City-to-City Collaboration Seminar presentation material (IRDA)



CHARTING ISKANDAR MALAYSIA'S LOW CARBON AND SUSTAINABLE ENVIRONMENT

- Iskandar Malaysia is the **pioneer city** in Malaysia to drive low carbon initiatives **since 2009**
- Low Carbon Society Blueprint for Iskandar Malaysia 2025 (LCSBPIM 2025) is one of the continuous efforts of research outputs of our SATREPS (Science and Technology Research Partnership for Sustainable Development)
- Iskandar Malaysia managed to **complete the LCS Development Cycle** from Science to Policy, Action and Monitoring.



Low Carbon Society Blueprint for IM 2025 | *LCS Action Plan 2025 for 5 Local Authorities* | *LCS Report Card* | *LCS Blueprint Stocktaking Exercise* | *IM GHG Inventory 2015-2019*

SCIENCE TO POLICY → ACTION / IMPLEMENTATION → MONITORING

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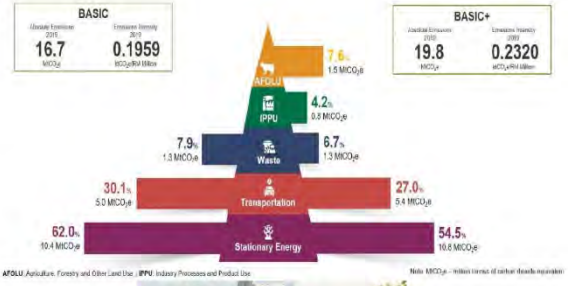
LOW CARBON PROGRAMME IMPLEMENTATION

- **More than 60 programmes completed and 214 are ongoing.**
- **The FIRST region in Malaysia** to use and comply with an internationally recognised standard – the Global Protocol for Community-scale Greenhouse Gas Emission Inventory **(GPC)**
- Iskandar Malaysia **GHG Inventory 2019** the emissions intensity of GDP shows **a significant decrease of 19.7% using 2010 as the base year.**



CASBEE ISKANDAR
Comprehensive Assessment System for Built Environment Efficiency (CASBEE) Iskandar.

BEMRS
Building Energy Monitoring & Reporting System (BEMRS)

Green Accord Award Initiatives
ISKANDAR MALAYSIA ECOLIFE CHALLENGE
Iskandar Malaysia Ecolife Challenge

PESISIR ISKANDAR MALAYSIA
Partnership for Interdisciplinary Studies for Shoreline Ecosystem

Segget River Revitalization Project

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INTERNATIONAL COLLABORATIONS

GLOBAL COVENANT of MAYORS for CLIMATE & ENERGY

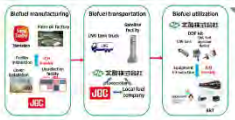
Member for GCOM -Global Covenant of Mayors for Climate & Energy Since 2017

GTALCC GREEN TECHNOLOGY APPLICATION FOR THE DEVELOPMENT OF LOW CARBON CITIES

One of the 5 selected cities and delivered low carbon project under the UNDP-GEF-funded **Green Technology Application for Low Carbon Cities (GTALCC) programme.**

Partnership in the Alliance to End Plastic Waste **and ICLEI – Developing Plastic Waste-Free Cities in Iskandar Malaysia**

City to City Collaboration with **City of Kitakyushu- Realizing Industrial Symbiosis with CO2 Free Energy and Industrial Symbiosis.**



Collaboration with the **City of Toyama-** Urban Development Projects through **Decarbonized Transportation using Bio-fuel and BaaS initiative.**

UK Foreign Commonwealth Office Prosperity Fund - Smart integrated mobility management system for Iskandar Malaysia Capacity building on data analytics.

West Midlands Combined Authority

City to City Collaboration: With **West Midland Combined Authority,** Birmingham on Transport and Mobility.

USTDA U.S. TRADE AND DEVELOPMENT AGENCY

U.S. Trade and Development Agency - implementation plans for the Iskandar Malaysia Urban Observatory (IMUO)

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AWARDS AND RECOGNITION

- Iskandar Malaysia has received **SCORE A: LEADERSHIP**; the highest band score in 2019, 2020 and 2022 for CDP Cities Reporting.
- Iskandar Malaysia one of 123 cities across the globe that is taking **bold leadership on environmental action** and transparency, despite the pressures of a challenging global economic situation.
- Iskandar Malaysia has received **high confidence scoring** in the WWF **One Planet City Challenge**

ONE PLANET CITY CHALLENGE

Iskandar Malaysia's Overall Confidence Scoring

79%

Overall Confidence Rating

75% (High Confidence Level)

CDP DISCLOSURE INSIGHT ACTION

CITIES A LIST 2022

Iskandar Malaysia

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LOW CARBON AGENDA AT STATE AND LOCAL AUTHORITIES

Johor Sustainable Development Plan (PPMJ) 2030

Johor Structure Plan (RSN) 2030

Comprehensive Development Plan III (2022-2030)

District Local Plan (RTD) Johor Bahru and Kulai 2025 (Replacement)

Johor Green Growth Roadmap

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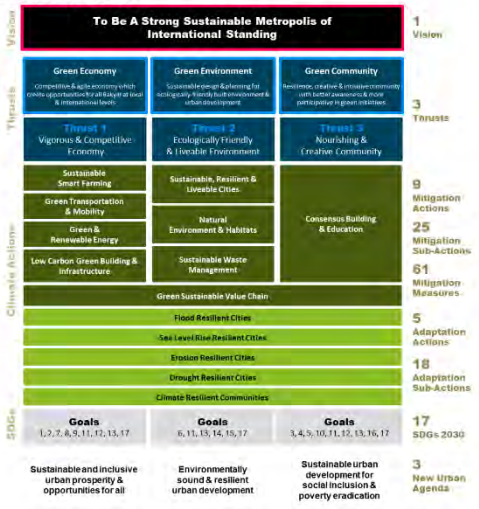
LOW CARBON SOCIETY BLUEPRINT FOR ISKANDAR MALAYSIA 2030 - CLIMATE ACTION PLAN

- **Climate Action Plan and roadmap** for Iskandar Malaysia inclusive of both **climate mitigation and adaptation**
- Utilise a **scientific approach** to the carbon emission baseline and future scenarios study
- **Promote awareness** of climate change and its mitigation and adaptation. These must essentially be targeted among the State government, regional authority, local authorities, industries, businesses, and the community.
- Lead to the materialisation of Iskandar Malaysia Climate Action Plan by 2030 and beyond **aligned to Malaysia's Carbon Reduction Target**



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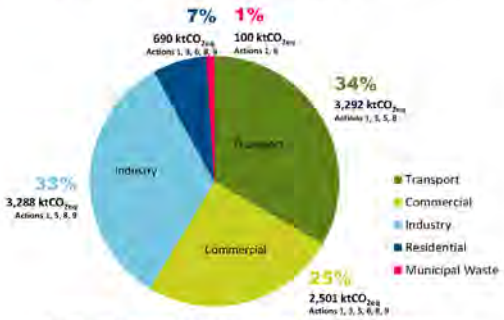
LOW CARBON SOCIETY BLUEPRINT FOR ISKANDAR MALAYSIA 2030 - CLIMATE MITIGATION TARGET

Reducing the intensity of GHG emission by up to 70 % by 2030 compared to the 2010 level



Iskandar Malaysia 2030 Sectoral GHG Emission Reduction Potential ($ktCO_{2eq}$) and Contributing LCS Actions

Priority Project

- GTM 5.1a: Facilitate The Development of a Comprehensive Rail Network
- GVC 8.4b: Promote sustainable industrial production process for lower energy intensity
- GVC 8.4a: Encourage efficient usage of resources & industrial inputs
- RE 8.1a: Enhancing RE and EE Installation Projects

LOW CARBON SOCIETY BLUEPRINT FOR ISKANDAR MALAYSIA 2030 - CLIMATE ADAPATION GOAL

To develop cities and society that are resilient towards climate change

FLOOD
To improve resilience of townships and communities towards flood risks, and reduce property damage and fatalities by 50% by 2030

SEA LEVEL RISE
To improve resilience of Iskandar Malaysia against sea level rise by 50 % by 2030, specifically safeguarding natural coastal resources and communities

COASTAL EROSION
To improve resilience of Iskandar Malaysia against coastal erosion impacts by 50 % by 2030, specifically safeguarding natural coastal resources and communities

COMMUNITY
To strengthen resilience and adaptive capacities of Iskandar Malaysia's communities by 2030 through community-based programmes

Priority Project

- FR 1.4 Expand the Crisis Preparedness System for community at Each Local Authority (CPSC)
- FRC 1.2 Establishment and Implementation Of Flood Control Structure Measures
- SRC 2.1 Implement Structural Sea Level Rise Control Measures for High-Risk Areas
- FRC 1.3 Establishment and Implementation of Reliable Early Warning System And Weather Forecast
- CRC 3.1 Implement Structural Coastal Erosion Measures for High-Risk Areas

OUR COMMITMENT

i. Continue our commitment and effort to reduce our emission intensity. Focus on 5 areas of GHG reduction:
   i. Energy: Renewable Energy
   ii. Transportation: Biofuel and other alternatives
   iii. Waste: Circular economy, solid waste
   iv. Water: Water management; and
   v. Sustainable management and conservation of forest land or biomass stocks

ii. Continue our effort in climate adaptation to develop cities and society that are resilient towards climate change i.e. Floods, Sea Level Rise, Coastal Erosion, Community Preparedness

iii. Serves as a Low Carbon Hub and offers a platform for green programmes, implementation, and collaboration.

iv. Continue to build climate awareness and provide resources for all stakeholders, i.e. government agencies, businesses, and community, to walk in concert with policies and measures to mitigate climate change.

v. Continue to contribute to international efforts to strengthen collaboration and action on climate change.

ISKANDAR REGIONAL DEVELOPMENT AUTHORITY

GTALCC

Saturday, 12 November 2022
2.00pm – 3.30pm
Blue Zone, Area C, Malaysia Pavilion, P130

COP27 SHARM EL-SHEIKH EGYPT 2022

MALAYSIA PAVILION

ISKANDAR MALAYSIA: EMPOWERING SUSTAINABILITY WITH PARTNERS

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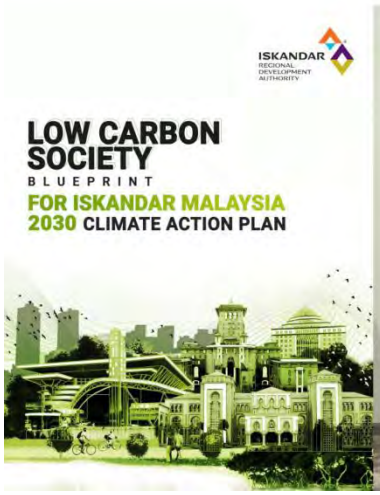
THE LAUNCHING OF
LOW CARBON SOCIETY BLUEPRINT FOR ISKANDAR MALAYSIA 2030 CLIMATE ACTION PLAN



ANNOUNCEMENT OF NEW COLLABORATION

Iskandar Malaysia Coastal Resilience And Climate Adaptation Centre - A Knowledge Alliance To Mitigate The Impacts Of Climate Change And Enhance The Resilience Of Coastal Ecosystems

www.iskandarmalaysia.com.my

THANK YOU

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REGIONAL
DEVELOPMENT
AUTHORITY

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IskandarMalaysia

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8.5 Appendix 5 : City-to-City Collaboration Seminar presentation material (Kota Kinabalu City)

KK-GCAP

(Kota Kinabalu Green City Action Plan)

City Planning Department
Kota Kinabalu City Hall

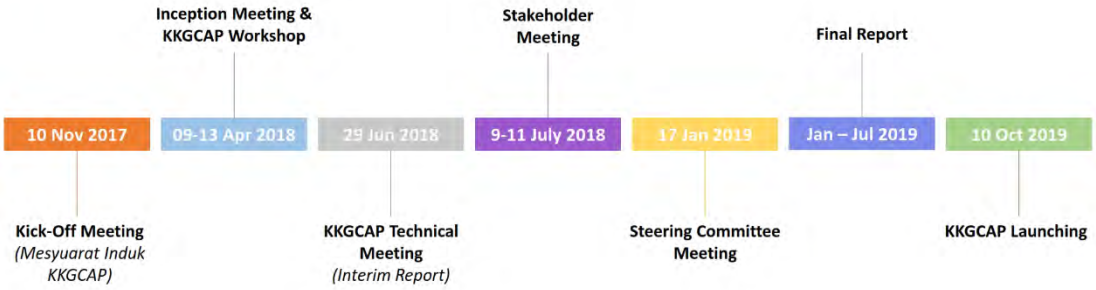
KK-GCAP
(Kota Kinabalu Green City Action Plan)

Introduction

- Asian Development bank (ADB) is spearheading the development of Green City Action Plans (GCAP) in the Brunei Darussalam-Indonesia-Malaysia-Philippines East ASEAN Growth Area (BIMP-EAGA) region.
- Kota Kinabalu City was selected as one of the first participating cities to develop this initiative under the Green City Action Plan (GCAP) program BEV2025 - the strategic blueprint for sustainable development and growth.
- The KK GCAP report provides a comprehensive assessment of urban issues, climate change vulnerability and impacts of climate change
- Objectives
  - Reduce carbon footprints
  - Improve the quality of environment
  - Strengthen economic competitiveness
  - Raise awareness towards achieving climate resilient

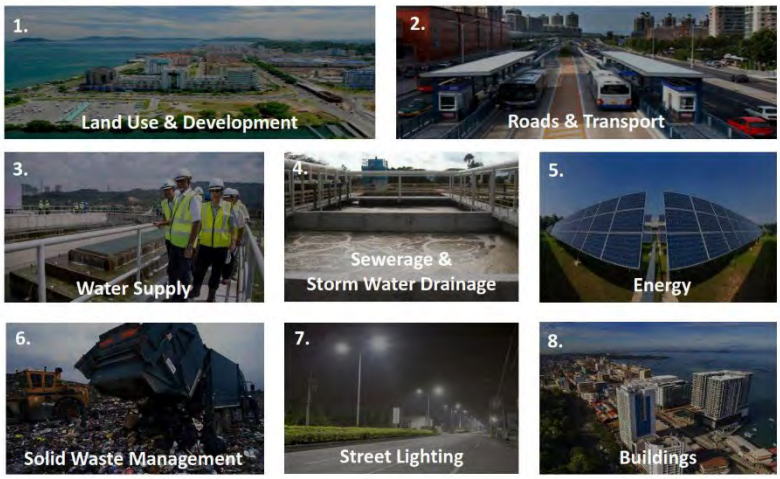
KK-GCAP
(Kota Kinabalu Green City Action Plan)

Chronology



KK-GCAP
(Kota Kinabalu Green City Action Plan)

Sectors



KK-GCAP
(Kota Kinabalu Green City Action Plan)

Priority Projects

1. Implementation of 100 MW solar PV systems (roof-top and solar farm)
2. Energy Efficient Street Lighting
3. Integrated Public Transport System
4. Integrated Solid Waste Management Facility
5. Energy Efficient Buildings Project
6. Education for Sustainable Development (A. Eco-schools; B. Eco Campus (University Malaysia Sabah and others); C. Training and sensitization)
7. Reduction of Non-Revenue Water (NRW)
8. Sustainability initiatives in Pulau Gaya Island
9. Jesselton Waterfront City

KK-GCAP
(Kota Kinabalu Green City Action Plan)

Potential Funds

1. Self-financing
2. Public-private partnerships
3. Grants from state / central government programmes
4. Grants from bilateral / multilateral development / financing agencies
5. Floating green bonds and accessing finance through other market based mechanisms
6. Adopting a blended finance approach by seeking funds from philanthropies and international donors
7. Accessing soft loans from either the state / centre or international financing entities
8. Global funds such as the Green Climate Fund or the Global Environment Facility, for medium to large scale projects (with support from the Government of Malaysia)
9. Other market mechanisms and / or investments from private entities

KK-GCAP
(Kota Kinabalu Green City Action Plan)

Priority Projects

1. Implementation of 100 MW solar PV systems (roof-top and solar farm) – Bus Station

Progress	Agency / Department
• Fund : RMK12 • Current Progress: Appointment of consultant • Target completion : 4 years starting 2022	Jabatan Pengangkutan & Trafik DBKK

KK-GCAP
(Kota Kinabalu Green City Action Plan)

Priority Projects

2. Energy Efficient Street Lighting

Progress	Agency / Department
• Fund : RMK12 • Current progress : 25% completion • Target completion : 2023	Jabatan Kejuruteraan DBKK

KK-GCAP
(Kota Kinabalu Green City Action Plan)

Priority Projects

3. Integrated Public Transport System

Progress	Agency / Department
• JV project • Central terminal (completed) • North & south terminal (Pelantikkan usahasama bersama pemaju) • Target completion : -	Jabatan Pengangkutan & Trafik DBKK

KK-GCAP
(Kota Kinabalu Green City Action Plan)

Priority Projects

4. Integrated Solid Waste Management Facility

Progress	Agency / Department
i. Develop community waste management system • Fund : RMK12 • Infrastruktur telah dibina • Target completion : 2023	Jabatan Pengurusan Sisa Pepejal DBKK
ii. Construct Rubbish boom trap at Likas River • Fund : RMK12 • Preliminary study telah dijalankan • Target completion : 2023	

KK-GCAP
(Kota Kinabalu Green City Action Plan)

Priority Projects

6. Education for Sustainable Development

Progress	Agency / Department
• SERASI (Sekolah Rakan Alam Sekitar) Programme • Started since 2003 (secondary school); 2004 onwards (primary and secondary schools) • Objectives: • To enhance awareness of the importance of environmental protection and conservation in schools • To instil a positive and caring attitude for the environment • To promote environmental education programmes	Jabatan Alam Sekitar & Jabatan Perlindungan Alam Sekitar

KK-GCAP
(Kota Kinabalu Green City Action Plan)

Priority Projects

9. Jesselton Waterfront City

Progress	Agency / Department
i. Sabah International Convention Centre • Fund : Private • To complete balance of Performing Art Hall 80% works • Target completion : 2023	Yayasan Sabah
ii. Kota Kinabalu Convention City • Fund : Private • Phase 1 piling works for the 5 Star hotel block completed • Target completion : 2025	
iii. Jesselton Quay (Parcel A & B) • Fund : Private • Building works completed	Suria Capital Holdings Berhad
iv. One Jesselton Waterfront • Fund : Private • Development Plan Preparation	
v. International Cruise and Ferry Terminal • Fund : Private • No progress	

KK-GCAP
(Kota Kinabalu Green City Action Plan)

Way Forward

- Relevant agencies to update progress every year
- Project Information Note (PIN) documents could be used as the basis for sourcing finance for the implementation.