Sustainability is Good Business:

Maintaining Basin Health and Developing Hydropower in Myanmar

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20 June 2018

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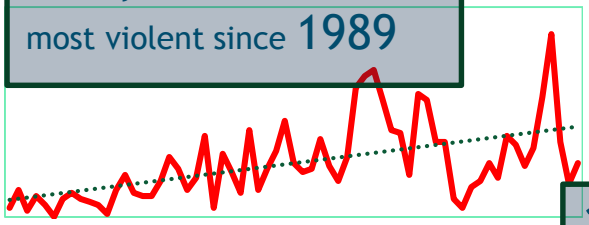
MYANMAR

CONTEXT & CHALLENGES

Last 5 years
most violent since 1989



34 million
need electricity
& Rising national power demand

$2 billion/year to meet electricity targets by

2030

3,000 miles of rivers
49 GW hydro
7800 MW suspended

Weak regulatory framework;
limited government capacity;
project-by-project EIAs

Legacy E&S issues
Civil society unrest

Multiple HPPs cause significant long-term, broad scale E&S impacts

4th in world: inland fisheries capture
1.3 million t/yr = 3.2m jobs

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CREATING MARKETS for

Sustainable Hydropower Investment

Strategic Environmental Assessment of the Hydropower Sector in Myanmar

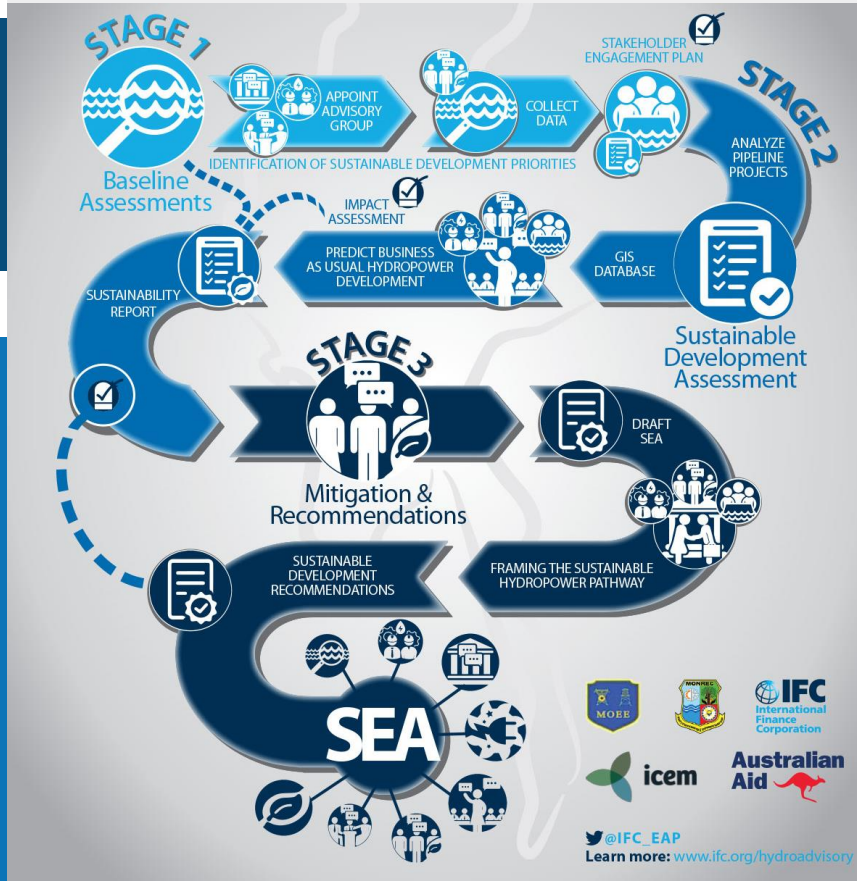
VISION

Sustainable hydropower development *based on integrated water, land and ecosystem planning, balancing a range of natural resource uses and priorities to* ***achieve economic development, environmental sustainability and social equity.***

OBJECTIVES

- **Maintain underlying natural river basin processes** that regulate and maintain river health and other ecosystem services
- **Retain & protect unique sites and important values** (biophysical and socio-economic)
- Generate adequate **low cost and reliable energy for** domestic consumption and in future export

IFC SOLUTION
Strategic Environmental Assessment



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SEA components & methodology

Trilateral agreement with Ministry of Electricity and Energy & Ministry of Natural Resources and Environment

Informed process:

- **better informed and improved dialogue between stakeholders**
- **greater understanding by decision makers/others on range of stakeholder values and priorities for the sustainable hydropower**
- **Understanding natural resources carrying capacity**

Open and broad consultation:

- **55 multi-stakeholder activities + an Advisory Group + 6 Expert Groups**
- **Government technical focal points on SEA team**
- **River basin consultations, workshops, deep dives**

Technical studies:

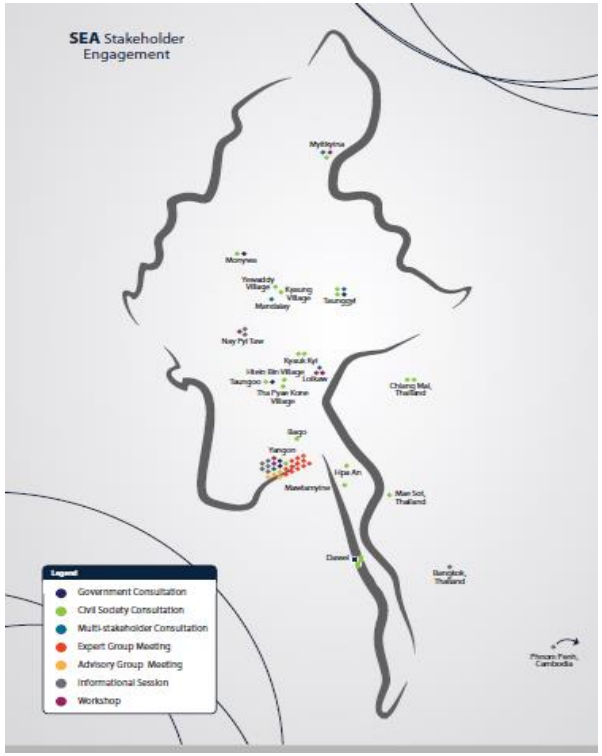
- **Baseline assessments**

hydrology & geomorphology, aquatic ecology/fish, terrestrial ecology, social, conflict, hydropower and energy, economics

- **Hydropower database**
- **Mainstem and sub-basin evaluations**
- **BAU development impact (sustainability) analysis**

Sustainable Development Framework

- **Sub-basin zoning + Implementation plan**



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Basin Planning required

Business-as-Usual (BAU) development

- Project-centric - driven by engineering & economic feasibility
- No consideration of E&S or cumulative impacts at early stage
- Will not deliver truly sustainable outcomes
  - mainstems would lose connectivity, with basin processes & ecosystem services progressively degraded
  - many tributaries would be developed - est. 45% Myanmar catchment area

Sustainable Development Framework

- Opportunity to balance hydro development with E&S protection
  - only 14% of catchments currently HPP regulated
  - retain intact, free flowing rivers
  - develop others

29 projects operating
– 3,298 MW
(70% of Myanmar energy mix)

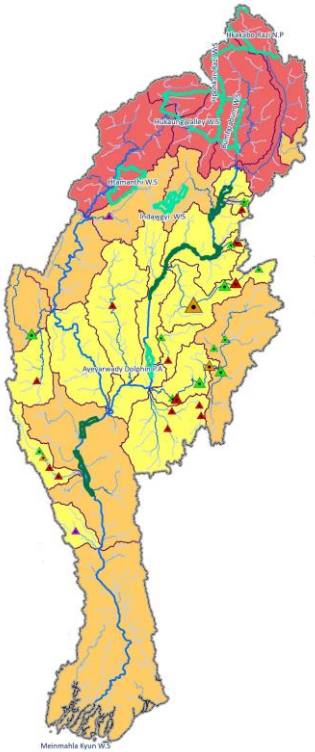
6 projects under construct.
– 1,564 MW (some stalled)

69 projects proposed
– 43,848 MW
– 13 very large (1,000+ MW)
– 6 over 2,000 MW
– 8 on mainstem (14,960MW)

Gov't → Private Sector

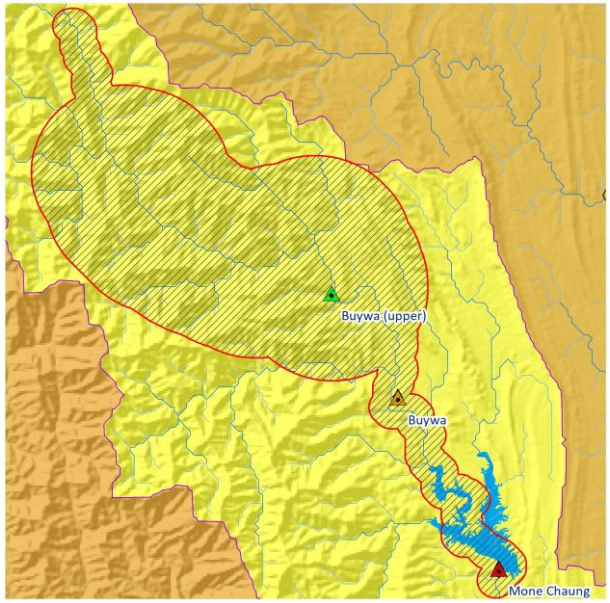
INTEGRATED PLANNING LEVELS

Basin zoning



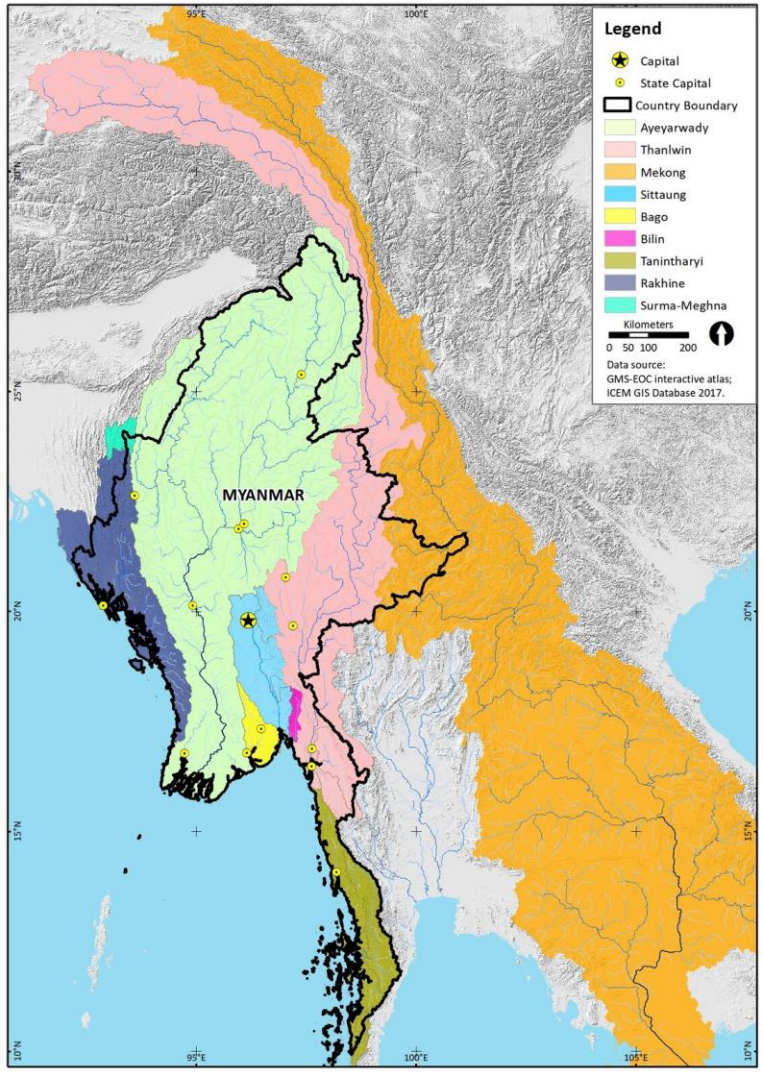
Sub-basin Cumulative Impact Assessment (CIA)

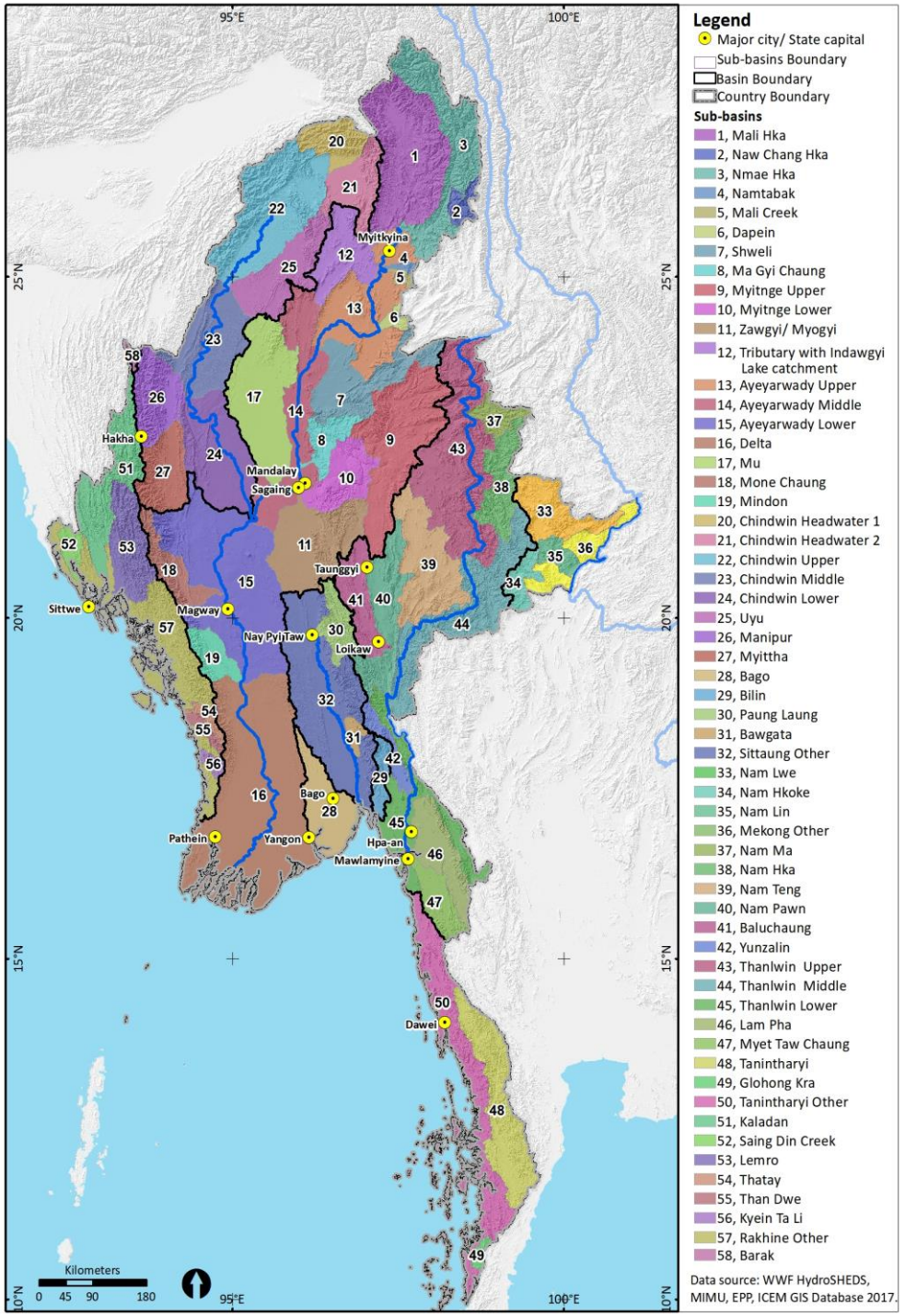
Project Environmental Impact Assessment (EIA)



MYANMAR BASINS

- 6 river basins
  - Ayeyarwady – 55% of Myanmar land area
  - Thanlwin – 19%
  - Mekong, Sittuang, Bago, Belin – 11%
- 2 coastal basins
  - grouping smaller coastal watersheds
  - Tanintharyi & Rakhine – 15%
- 58 sub-basins




95°E
100°E
25°N
20°N
15°N
10°N
Myitkyina
Hakha
Mandalay
Sagaing
Taunggyi
Sittwe
Magway
Nay PyiTaw
Loikaw
Bago
Pathein
Yangon
Hpa-an
Mawlamyine
Dawei
Kilometers
0 45 90 180
Legend
Major city/ State capital
Sub-basins Boundary
Basin Boundary
Country Boundary
Sub-basins
1, Mali Hka
2, Naw Chang Hka
3, Nmae Hka
4, Namtabak
5, Mali Creek
6, Dapein
7, Shweli
8, Ma Gyi Chaung
9, Myitnge Upper
10, Myitnge Lower
11, Zawgyi/ Myogyi
12, Tributary with Indawgyi Lake catchment
13, Ayeyarwady Upper
14, Ayeyarwady Middle
15, Ayeyarwady Lower
16, Delta
17, Mu
18, Mone Chaung
19, Mindon
20, Chindwin Headwater 1
21, Chindwin Headwater 2
22, Chindwin Upper
23, Chindwin Middle
24, Chindwin Lower
25, Uyu
26, Manipur
27, Myittha
28, Bago
29, Bilin
30, Paung Laung
31, Bawgata
32, Sittaung Other
33, Nam Lwe
34, Nam Hkoke
35, Nam Lin
36, Mekong Other
37, Nam Ma
38, Nam Hka
39, Nam Teng
40, Nam Pawn
41, Baluchaung
42, Yunzalin
43, Thanlwin Upper
44, Thanlwin Middle
45, Thanlwin Lower
46, Lam Pha
47, Myet Taw Chaung
48, Tanintharyi
49, Glohong Kra
50, Tanintharyi Other
51, Kaladan
52, Saing Din Creek
53, Lemro
54, Thatay
55, Than Dwe
56, Kyein Ta Li
57, Rakhine Other
58, Barak
Data source: WWF HydroSHEDS, MIMU, EPP, ICEM GIS Database 2017.

SUSTAINABLE BASIN DEVELOPMENT PRINCIPLES & BASIN ZONING PLAN

- Keeping development within the sustainable capacity of the basin
  - maintain essential processes & functions
  - maintain ecosystem services essential to livelihoods
- Avoiding adverse impacts on significant, high value sub-basins & sites
- Retaining intact, free-flowing sub-basins to offset sub-basins regulated & degraded by hydropower
- Like-for-like trade-offs between sub-basins – similar biophysical & ecological conditions wherever possible
- A tool for siting projects to deliver basin sustainability
- The first edition
  - best available information
  - revised and developed as more detailed information is obtained
- The essential starting point of integrated hydropower planning
- Ultimately seeking to retain healthy basin processes and functions, as well as unique values, while delivering hydropower within the basin 'carrying capacity'
- Balancing utilisation
  - identifying potentially suitable areas for development
  - identifying areas for reservation

RECOGNISING DIFFERENT NATURAL RESOURCE UNITS

Mainstem rivers

- **Essential system connectivity**
  - unimpeded pathway for water, sediment, fish and other aquatic organisms to move between sub-basins and the sea
  - maintains ecosystem services
- **Connectivity-related basin functions**
  - water cycling and flow characteristics (seasonality, water levels)
  - river channel maintenance
  - aquatic ecology cues and processes (e.g. for fish migration) and riverine habitat maintenance
  - flushing of land derived nutrients into the sea
  - sediment replenishment in marine areas that maintains coastal landforms
  - natural hazard regulation – floods and coastal protection
  - prevention of saltwater intrusion in delta regions

Sub-basins

- Providing the primary land/water interface where physical, chemical and biological processes influence basin ecological functioning

Basin health critical to freshwater and marine fish production

- National fish production = 5 M metric tons (3% world production)
- 3.2 M people employed in sector - 800,000 full-time, 2.4 M part-time
- 4th largest contributor to GDP
- 4th largest source of foreign exchange earnings
- Important source of animal protein – est. 30 kg/person/annum

MAINSTEM RESERVATION

- Major river with critical basin processes and functions
  - may also have a notable effect on other areas e.g. delta & coastal processes
- Very large average annual flow rate – generally above 1,000 m^3/s
- Strahler Order 4

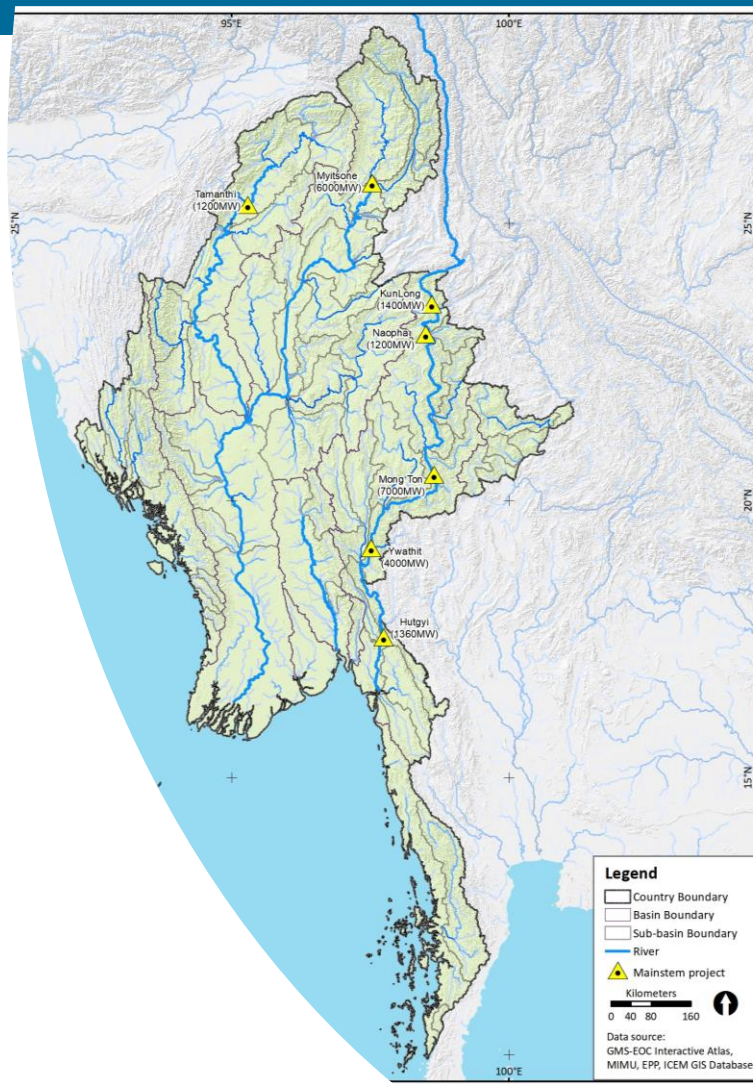
Ayeyarwady - 1,500 km

Chindwin - 900 km

Thanlwin - 1,200 km

Mekong - 200 km

Sittaung - 300 km



SUB-BASIN ZONING

58 sub-basins rated to compare values

- Ratings based on three biophysical factors
  - Geomorphology, Aquatic ecology & fisheries, Terrestrial biodiversity
- Geomorphology
  - river connectivity & delta/coastline stability
  - potential sediment production
  - flow
- Aquatic ecology and fisheries
  - river reach rarity (WWF, 2014)
  - presence of endemic species
  - KBAs, Ramsar sites and important wetland areas
  - confluences
  - karst geology
  - presence of threatened fish and aquatic organisms
- Terrestrial biodiversity
  - % PA/KBA
  - % intact forest (≥80% crown cover)

Social/Livelihoods and Conflict not used in ratings

- poor social data + sub-basin level a poor indicator of impact
- conflict to be used as a yes/no layer

- Social
  - Dependency on natural resources- % of own account worker (farmer, fisher, forestry);
  - Vulnerability- % of female headed households;
  - Poverty proxy- % of households ownership of television.
- Conflict
  - Presence and status of armed groups;
  - Historical population displacement;
  - Conflict incidents 2012-2017.

Sub-Basin Zones

'High' zone

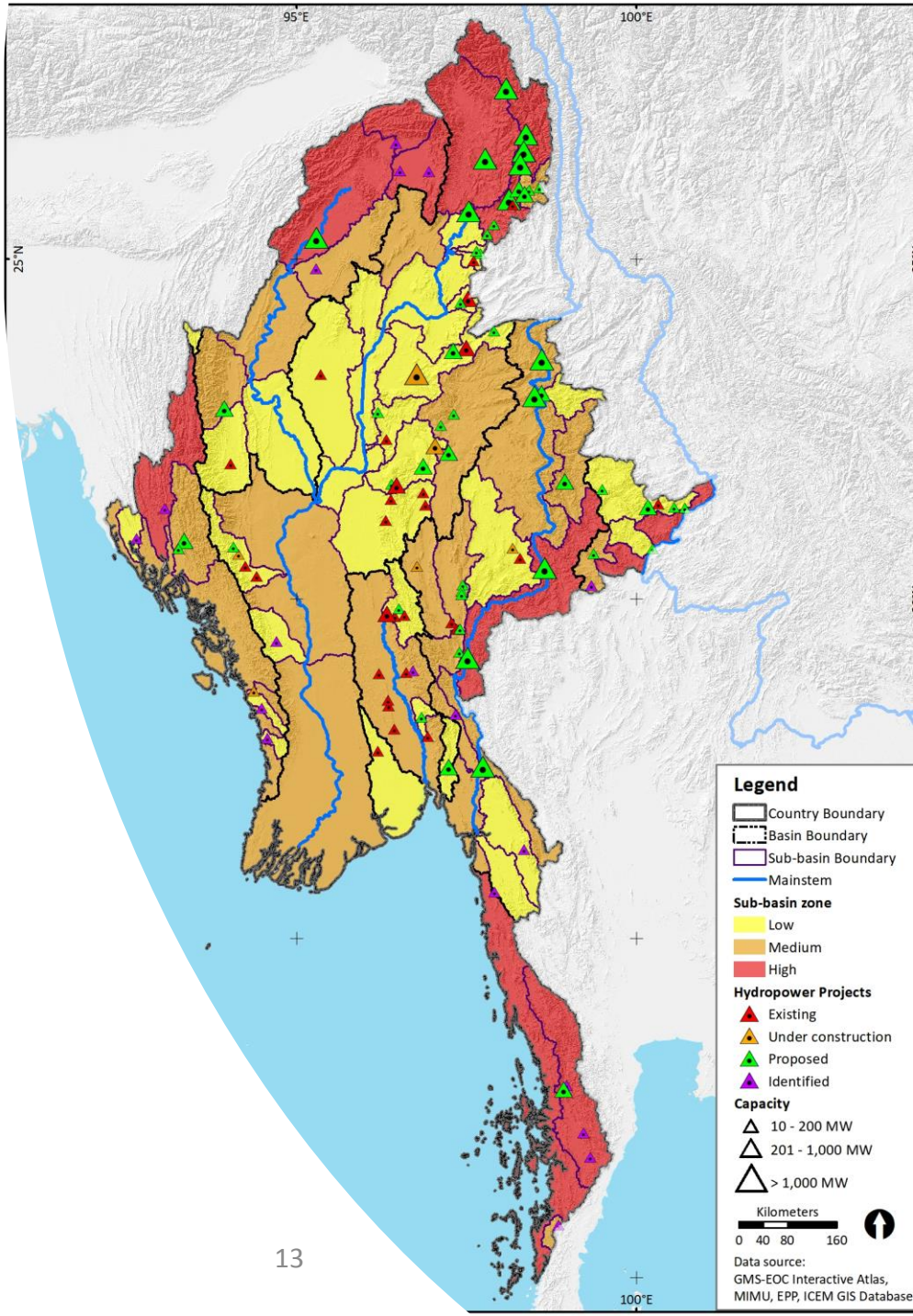
- high conservation value
  - important contribution to basin processes (e.g. high flows, large sediment load) and/or
  - unique natural values (e.g. important aquatic habitat) for at least two biophysical factors

'Medium' zone

- medium conservation value
  - no high conservation value features over a notable area for two biophysical factors, but
  - may contain notable values for a single factor or pockets of such values

'Low' zone

- low conservation value
  - no high conservation value features over a notable area for any biophysical factor, although
  - may contain pockets of high value



MEDIUM AND LOW ZONE UTILISATION

- Medium & Low zone sub-basins cover over 75% of Myanmar
- GoM to decide on utilization balance in these zones
  - between (i) hydropower development and (ii) reservation to maintain system health and ecosystem services
- Early stages of zoning implementation
  - all Medium and Low zone sub-basins considered for potential development
- Utilisation refinement over time
  - as new information is obtained on natural and social resources, basin modelling is refined and projects are approved and developed, utilisation trade-offs will be made between sub-basins
    - some sub-basins and watersheds set aside for protection
    - others becoming a focus for development

RECOMMENDED SUB-BASIN DEVELOPMENT

High zone

- Large scale HPPs are recommended for restricted development
- Smaller scale, lower impact HPPs or other alternatives should be considered within strict selection criteria
  e.g. % sub-basin regulated, land acquisition, type of project, size of project

Medium and Low zones

- Potentially suitable for development – GoM to decide on development / reservation mix
- Project MoU
- Project approval subject to appropriate site, design, operating regime, EIA/IEE

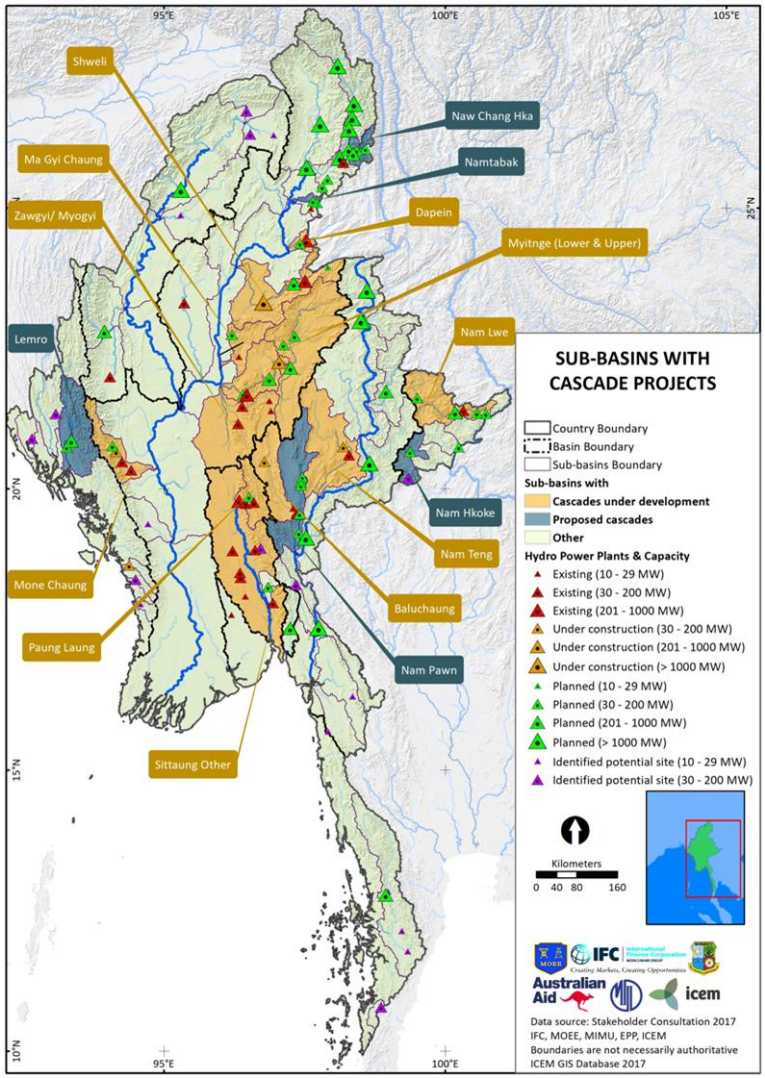
Priority Sub-basins for Development

Cascade hydropower in selected sub-basins

- usually preferable to similar capacity in many sub-basins
- lower overall magnitude of impact per unit of energy
- increased power generation per unit of water regulated – multiple powerhouses generating from stored water

Myanmar already following this model

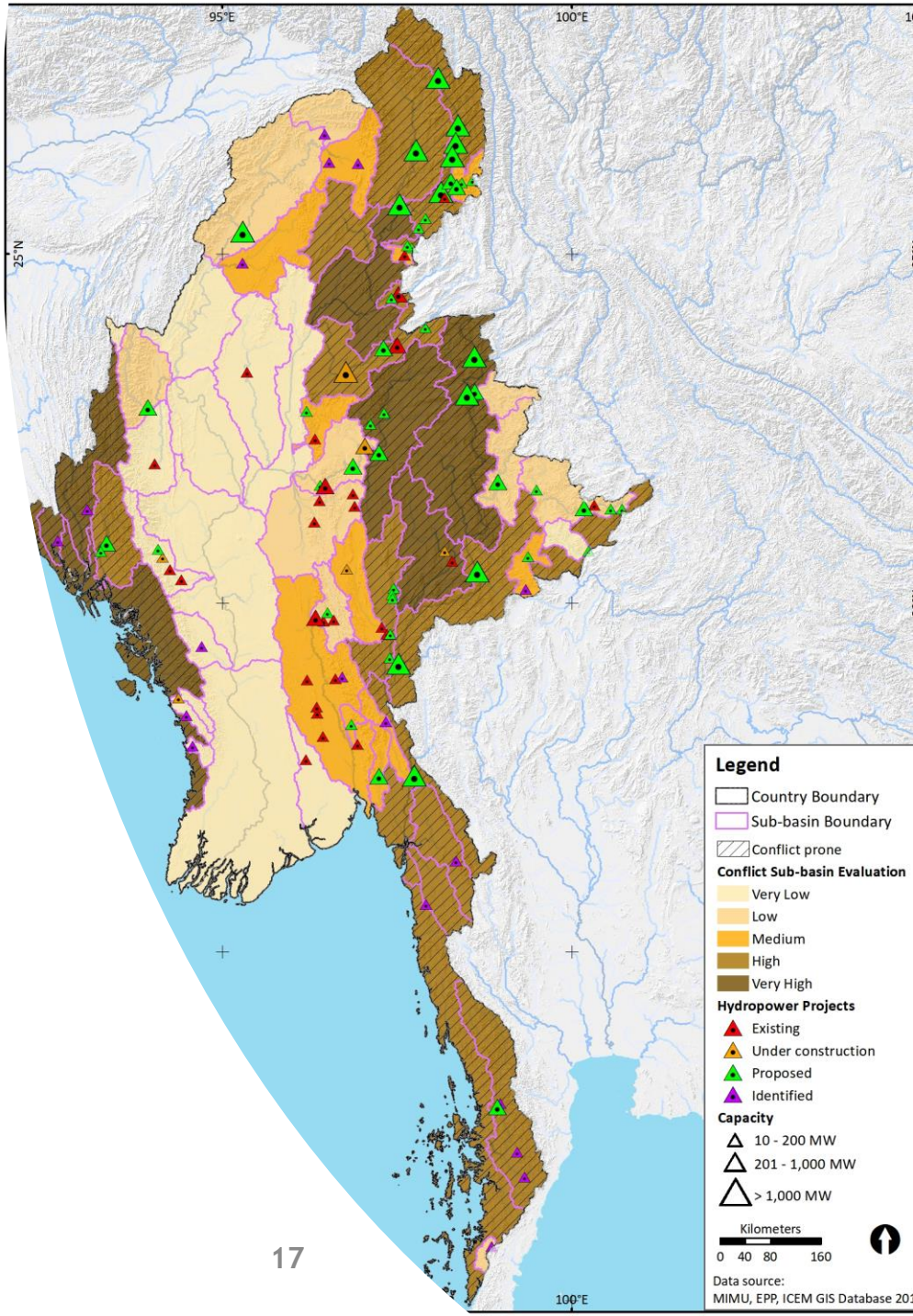
- 80% (3,912 MW) of existing / under construction projects in cascades
- ¾ of proposed projects in cascades
- 11 sub-basins with proposed HPPs have one or more operational projects
- 5 sub-basins with potential for cascade development



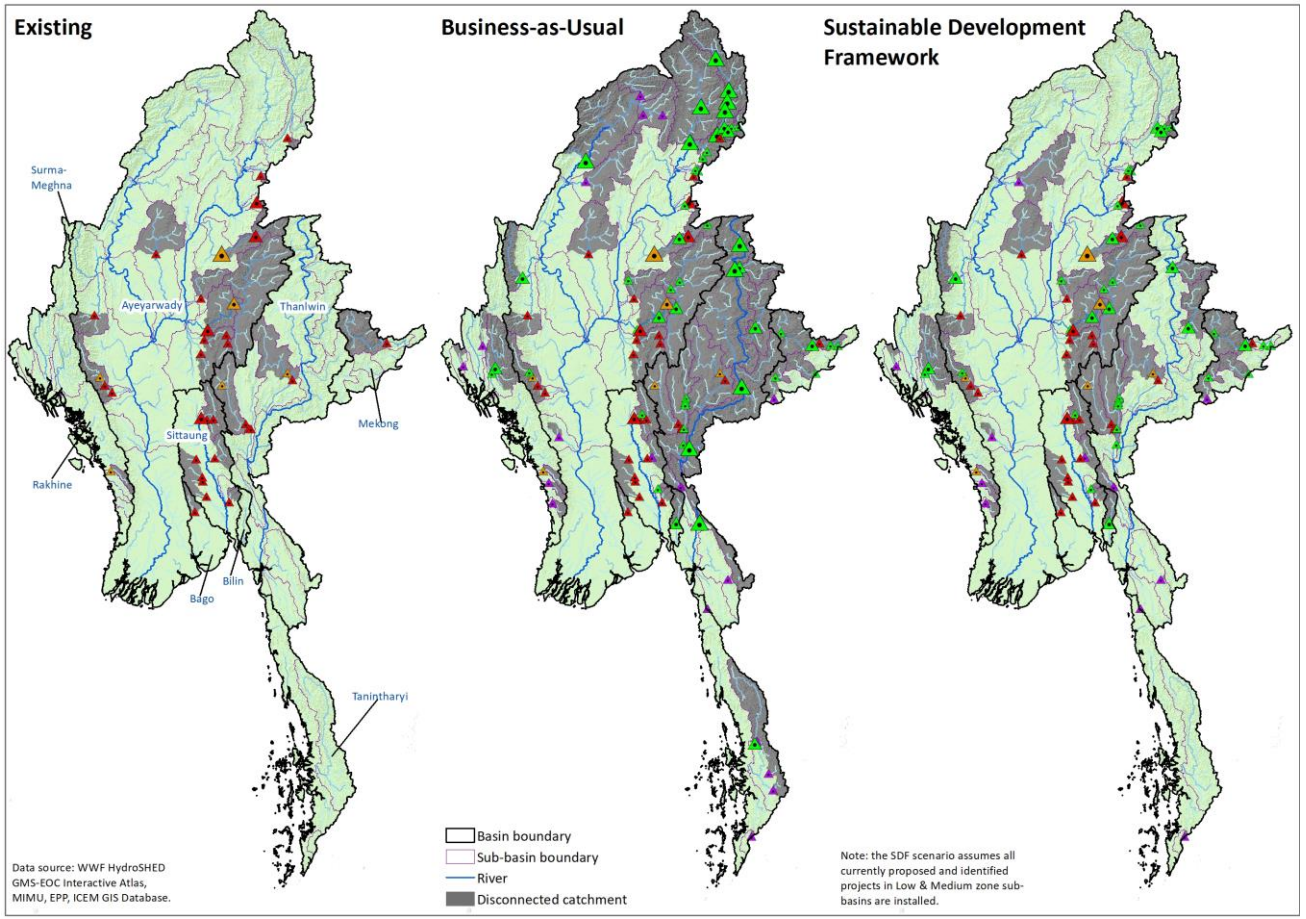
Conflict sensitivity analysis

- Conflict is overlaid on the baseline evaluations
- Planned projects in conflict prone areas should explicitly assess conflict risks
- Conflict sensitivity analysis is needed in recognition of the complex and dynamic nature of conflict

- Broaden stakeholder engagement (in addition to directly-affected) to include:
  - Historically displaced populations
  - Ethnic armed organisations (EAOs) and ethnic political parties

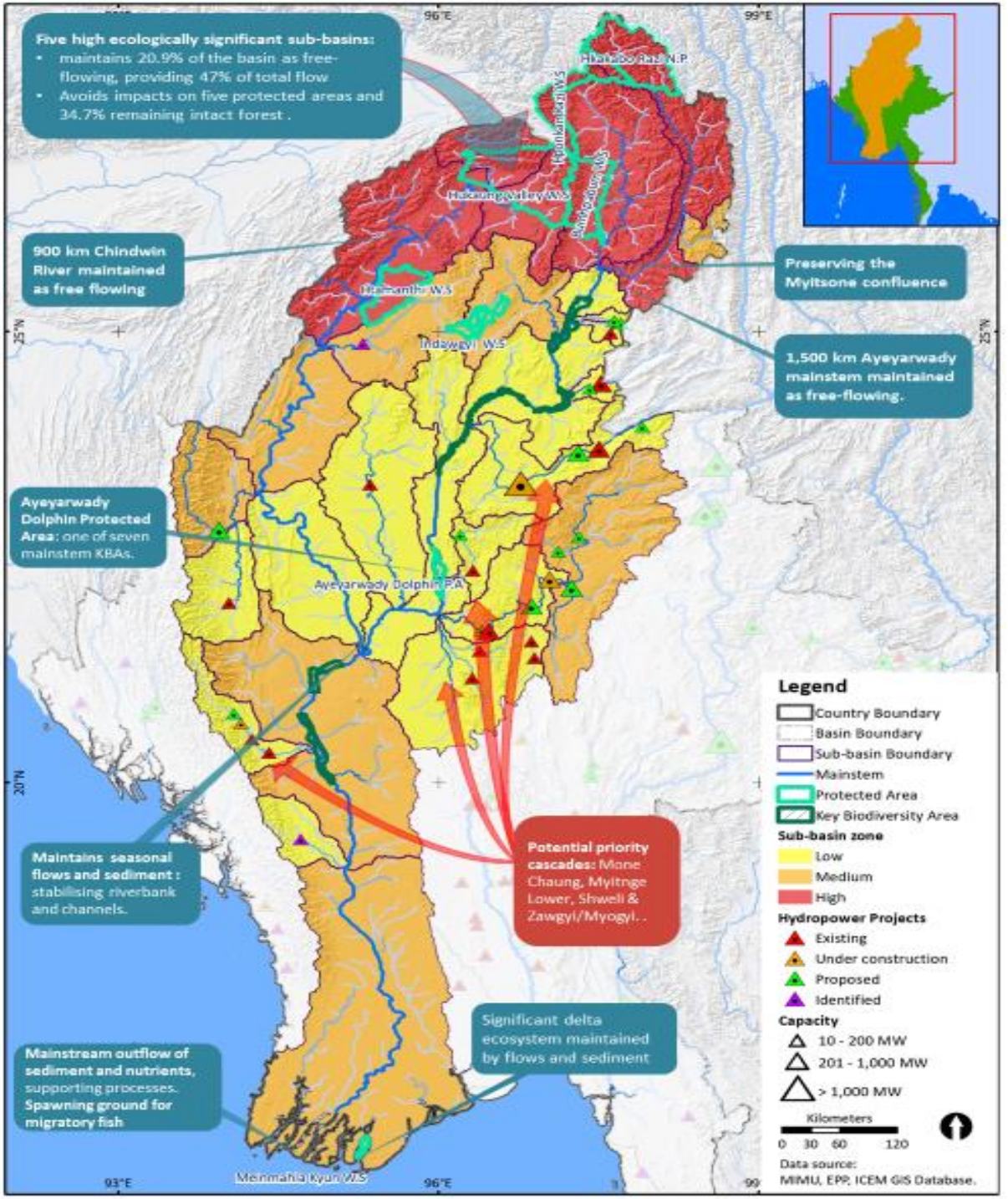


REGULATED / DISCONNECTED CATCHMENT



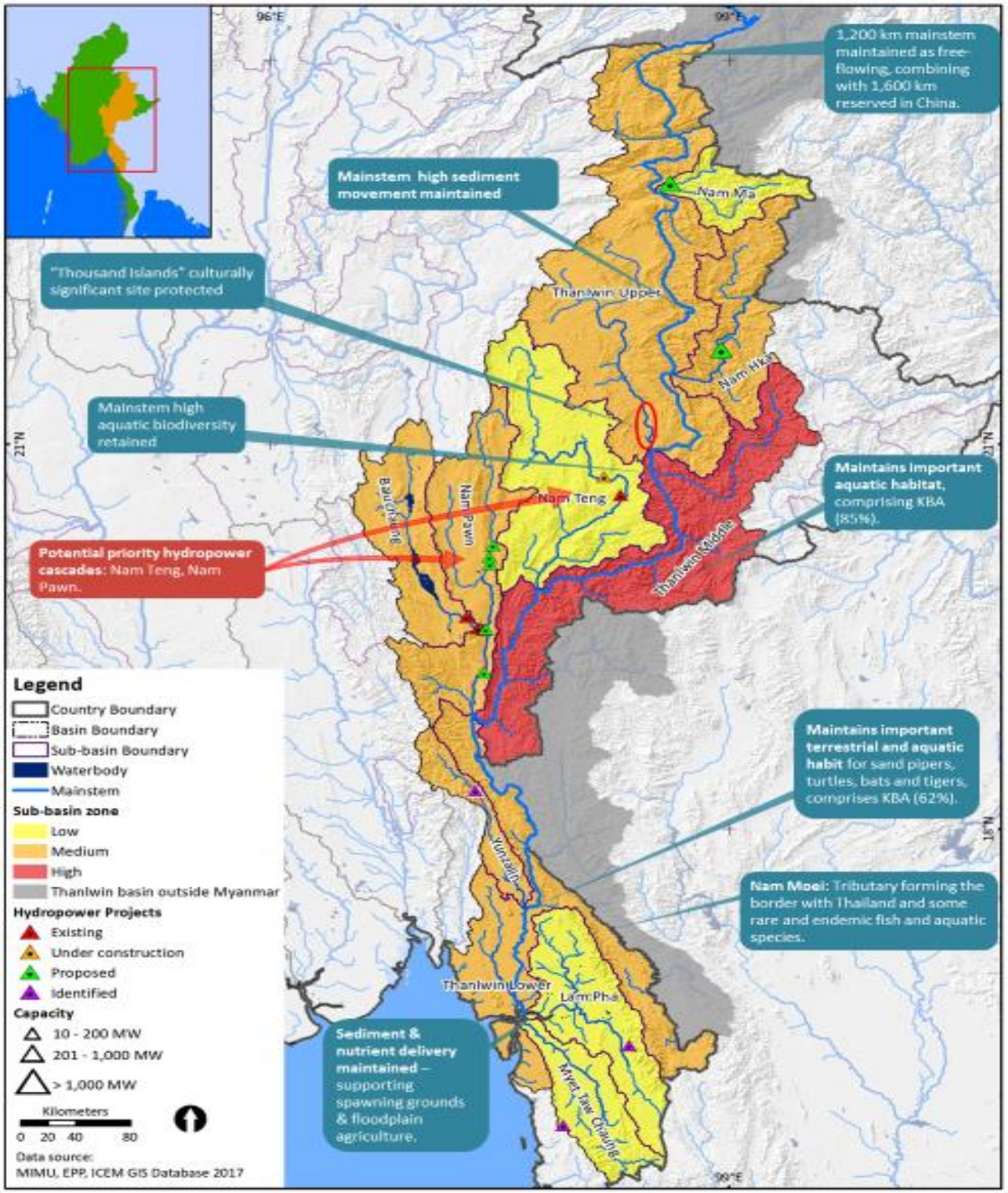
What does sustainable hydropower look like?

Ayeyarwady Basin



What does sustainable hydropower look like?

Thanlwin Basin



Future Hydropower Sector

Difficult to predict - determined by many factors

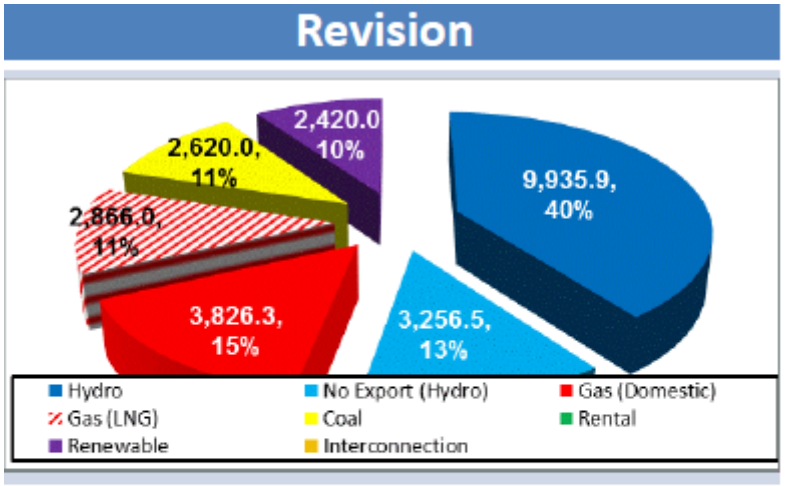
- future power demand
- cost of hydropower over alternative power sources
- power export opportunities
- Power important opportunities
- Etc.

- GOM suspended: 7,800MW
- Thanlwin mainstem: 15,000MW
- Nmae Hka High Zone: 11,400MW

Implementation of Basin Zoning Plans

- existing projects = **3,300 MW**
- new hydropower generation = **9,000 MW +**
  - under construction = 1,600 MW (several stalled)
  - proposed in Medium & Low zones = 7,400 MW (indicative est.)
  - other (HPPs <10 MW, etc) + high zone small-scale = not possible to estimate
  - Refurbishment of existing assets ?

Total sector = **12,300 MW +**



24,040.7MW

Hydro, Domestic Gas (Existing), LNG, Domestic Gas (New) Imported Coal and Renewable Energy

MOEE & JICA: study of generation mix Feb 2018

THIS IS MORE THAN A REPORT……..

Tools and information

- Hydropower GIS
- Sub-Basin evaluations
- SDF Basin Zoning Plans
- SDF Implementation Plan

- Hydropower Developers' Working Group (HDWG)

Implementation Plan

- Joint MOEE-MONREC Hydropower Planning Committee
- Sustainable Hydropower Policy
- Project screening procedure
- Sustainable hydropower design guidelines
- Improvement of impact assessment and management planning
- Research and data gathering
  - SOBA Thanlwin
  - Various Env / Social research
- Coordination with regions and states & private sector

How has this created impact & sustainable markets?

- Placing E&S at the forefront of early decision-making
  - One of the biggest challenges for Myanmar
- Government engagement throughout & capacity
- Industry association – private sector involvement
- Market enabling:
  - For government – the right information to balance hydro development and natural resource protection
  - Developers/investors – rational site selection that lowers project risks
  - Greater clarity on project selection and status + initial E&S values and impacts
  - De-risking potential future hurdles

How to implement the SDF and enable uptake

- Close engagement with GOM (Power & Environment Ministries)
  - presentations/coordination
  - liaising with State Counselor's office
- Coordinating with organizations to uptake top recommendations
- Periodic update of SDF based on new data
- IFC:
  - protocol development for GOM to use SEA
  - capacity building across Myanmar
  - conduct CIA
  - handover of GIS, all data and training

Summary

Large scale hydropower will impact basin health for a century or more

- but it is possible to balance hydropower development with long-term basin health by choosing the right configuration of projects in cascade formation, close to load centres to meet the countries domestic and later export need.

Balancing resource protection and hydropower development is difficult but essential

- maintaining natural basin processes, functions and values for system health
- maintaining livelihoods dependent on ecosystem services
- Addressing stakeholder concerns and avoiding delays and lengthy negotiations due to existing conflict areas
- contributing to reliable and affordable renewable energy supply to 55 million people

Implementation of the Basin Zoning Plans to screen projects

- an important first step
- individual projects considered in a whole-of-basin sustainability context (a move from ad hoc project selection)
- intact, free-flowing sub-basins retained to offset sub-basins regulated and degraded by hydropower